S. 20

PROCEEDINGS

OF THE

BRISTOL

NATURALISTS' SOCIETY.

EDITED BY

WM. LANT CARPENTER, B.A., B.Sc.,
Honorary Reporting Secretary.

FOR THE FOUR MONTHS ENDING APRIL, 1866.

Bristol:
PRINTED AND PUBLISHED FOR THE SOCIETY, BY G. MORRIS,
2, ST. STEPHEN'S AVENUE.

☞ *For Notices of Meetings, &c., see page 2 of the Wrapper.*

BRISTOL NATURALISTS' SOCIETY.

NOTICES OF MEETINGS, &c.

The Annual Meeting of the Society will be held at the Philosophical Institution, Park Street, on Thursday, May 3rd, 1866, at half-past seven o'clock.

Business of the Evening:

To receive the Report of the Council and the Treasurer's audited Accounts.

Proposal of a gratuity to the Philosophical Institution.

Election of Officers.

Summer Excursion Meetings.

ADOLPH LEIPNER, *Hon. Secretary.*

Bristol, April 26th, 1866.

SECTIONAL MEETINGS.

Entomological.—Excursion, Monday, May 7th. To meet at the Suspension Bridge, 3.30 p.m.

Chemical and Photographic.—Wednesday, May 9th, 8 p.m.

Zoological.—Thursday, May 10th, 8, p.m.

Botanical.—Excursion, } Days not yet fixed.
Geological.—Excursion, }

PROCEEDINGS

OF THE

BRISTOL

NATURALISTS' SOCIETY,

WITH THE

ANNUAL REPORT, TREASURER'S ACCOUNT,
AND LIST OF MEMBERS.

EDITED BY

WM. LANT CARPENTER, B.A., B.Sc.,
Honorary Reporting Secretary.

MAY, 1866.

Bristol:
PRINTED AND PUBLISHED FOR THE SOCIETY, BY G. MORRIS,
2, ST. STEPHEN'S AVENUE.

For Notices of Meetings and Excursion see page 2 of the Wrapper.

BRISTOL NATURALISTS' SOCIETY.

NOTICES OF MEETINGS, &c.

FIRST EXCURSION.

The first Excursion of the Season will take place on Tuesday, June 12th, to Charfield.

The train will leave Bristol at 11.10 a.m., reaching Charfield at 11.50.

The principal objects of note will be *Old* Tortworth Court and Church; the celebrated Tortworth Chestnut Tree; Tortworth Park; Quarry of Igneous Rock, containing the rare mineral Prehnite; and ancient encampment near Damory Bridge; Upper Llandovery beds with fossils, possibly also Ludlow and Wenlock beds; but special attention will be directed to the Entomology and Botany of the district.

It is also hoped, that permission may be obtained to walk through the grounds of Tortworth Court.

The party will dine at Charfield at 4.30 p.m., and leave there at 6.28., reaching Bristol at 7.15.

Tickets at 5s. 6d. each, including Dinner and Railway, *must* be obtained before *Friday Evening next*, June 8th, at Mrs. Mardon's, Royal Promenade, or at the Institution, Park Street. Ladies are invited.

ADOLPH LEIPNER, *Hon. Secretary*.

June 4th, 1866.

SECTIONAL MEETINGS.

Entomological.—June 4th. Excursion to Brockley. Train at 1.45 p.m.

Botanical.—June 6th. Walk to the Upper part of St. Anne's Wood. To meet at Bath Bridge, 3.30 p.m.

Chemical and Photographic.—June 13th, at the Institution, 8.0 p.m. Mr. J. Beattie, on Pouncey's carbon-printing process, with illustrations.

PROCEEDINGS

OF THE

BRISTOL

NATURALISTS' SOCIETY,

EDITED BY

WM. LANT CARPENTER, B.A., B.Sc.,

Honorary Reporting Secretary.

JUNE, 1866.

Bristol:

PRINTED AND PUBLISHED FOR THE SOCIETY, BY G. MORRIS,

2, ST. STEPHEN'S AVENUE.

For Notice of Excursion see page 2 of the Wrapper.

BRISTOL NATURALISTS' SOCIETY.

NOTICES OF MEETINGS, &c.

SECOND EXCURSION.

The next Excursion of the Society, will take place on Tuesday, July 10th, to Wotton-under-Edge.

The party will leave Bristol by train at 11.10 a.m. for Charfield, whence conveyances will be provided to Wotton-under-Edge. They will ascend the hill, by which a section of the Upper Lias, especially the Upper Lias sands, and of the Inferior Oolite, will be seen. The woods along the brow of the hill towards Nibley afford a great variety of plants and insects.

As conveyances will be in waiting at Nibley to convey the party back to dinner at Charfield, in time, it is hoped, for the 6.30 p.m. train to Bristol, all the interval can be profitably employed in searching the neighbourhood, the actual walk not exceeding three miles.

Tickets, to include everything, may be had at Mardon and Co., Royal Promenade, or at the Institution, Park Street, at 7s. 6d., if taken before mid-day of Saturday, 7th inst., after that date 8s. 6d.

LADIES ARE INVITED.

A. LEIPNER, *Hon. Secretary.*

Bristol, July 3rd, 1866.

PROCEEDINGS

OF THE

BRISTOL

NATURALISTS' SOCIETY,

EDITED BY

WM. LANT CARPENTER, B.A., B.Sc.,

Honorary Reporting Secretary.

JULY, AUGUST, & SEPTEMBER, 1866.

Bristol:

PRINTED AND PUBLISHED FOR THE SOCIETY, BY G. MORRIS,

2, ST. STEPHEN'S AVENUE.

For Notices of Meetings, &c., see page 2 of the Wrapper.

BRISTOL NATURALISTS' SOCIETY.

SESSION, 1866—7.

NOTICES OF MEETINGS, &c.

GENERAL MEETING.

The FIRST GENERAL MONTHLY MEETING for this Session, will be held at the Philosophical Institution, on Thursday Evening, October 4th.

Business of the Evening:

Papers by:—

Mr. EDMUND T. HIGGINS, on "Otoliths," with Illustrations.

MAJOR T. AUSTIN, F.R.S., on "Rock Basins, Logan Rocks, and Tolmen."

Communications are invited.

ADOLPH LEIPNER, *Hon. Secretary.*

Bristol, Sept. 28th, 1866.

SECTIONAL MEETINGS.

In the small room of the Institution Library.

Entomological.—Tuesday, October 9th, 8 p.m.

Chemical and Photographic.—Wednesday, October 10th, 8 p.m.

Zoological.—Thursday, October 11th, 8 p.m.

Botanical.—Thursday, October 18th, 7.30 p.m.

Geological.—Thursday, October 25th, 7.30 p.m.

PROCEEDINGS

OF THE

BRISTOL

NATURALISTS' SOCIETY,

EDITED BY

WM. LANT CARPENTER, B.A., B.Sc.,

Honorary Reporting Secretary.

OCTOBER, 1866.

Bristol:

PRINTED AND PUBLISHED FOR THE SOCIETY, BY G. MORRIS,

2, ST. STEPHEN'S AVENUE.

For Notices of Meetings, &c., see page 2 of the Wrapper.

BRISTOL NATURALISTS' SOCIETY.

Session 1866—67.

NOTICES OF MEETINGS, &c.

GENERAL MEETING.

The next General Meeting of the Society will be held at the Philosophical Institution, on Thursday Evening, November 1st, at Half-past Seven o'clock.

Business of the Evening:

To confirm the resolution of the last Meeting—" That an additional 2s. 6d. be subscribed for the present year, the financial year to commence in future with the sessional year."

To confirm the alteration of Rule IX : " That all Ordinary Members subscribe *seven shillings and sixpence* per annum towards defraying the expenses of the Society ; the subscription to commence at their entrance, and to be renewed on the *Annual Meeting in May*."

Paper by Professor James Buckman, F.L.S., etc., " On the Structure and Economy of the British Grasses."

Ladies are invited.

ADOLPH LEIPNER, *Hon. Secretary.*

Bristol, October 24th, 1866.

SECTIONAL MEETINGS.

In the small room of the Institution Library.

Zoological.—Thursday, November 8th, 8 p.m.

Mr. S. H. Swayne " On Baleen."

Entomological.—Tuesday, November 13th, 8 p.m.

Chemical and Photographic.—Wednesday, Nov. 14th, 8 p.m.

Botanical.—Thursday, November 15th, 7.30 p.m.

Geological.—Thursday, Nov. 22nd, 7.30 p.m.

PROCEEDINGS

OF THE

BRISTOL

NATURALISTS' SOCIETY,

EDITED BY

WM. LANT CARPENTER, B.A., B.Sc.,

Honorary Reporting Secretary.

NOVEMBER, 1866.

Bristol:

PRINTED AND PUBLISHED FOR THE SOCIETY, BY G. MORRIS,

2, ST. STEPHEN'S AVENUE.

For Notices of Meetings, &c., see page 2 of the Wrapper.

BRISTOL NATURALISTS' SOCIETY.

SESSION 1866—67.

NOTICES OF MEETINGS, &c.

GENERAL MEETING.

The next GENERAL MEETING of the Society will be held at the Philosophical Institution, on Thursday Evening, December 6th, at Half-past Seven o'clock.

Business of the Evening:

Papers by—

Mr. C. O. GROOME-NAPIER, F.G.S., "On the Economic value of British Insects."

Mr. W. W. STODDART, F.G.S., "On the Caterpillar-Fungus or Winter-worm-Summer-plant."

LADIES ARE INVITED.

ADOLPH LEIPNER, *Hon. Secretary.*

Bristol, November 8th, 1866.

SECTIONAL MEETINGS.

In the small room of the Institution Library.

Entomological.—Tuesday, December 11th, 8 p.m.

Chemical and Photographic.—Wednesday, Dec. 12th, 8 p.m.

Zoological.—Thursday, December 13th, 8 p.m.

Botanical.—Thursday, December 20th, 7.30 p.m.

Geological.—Thursday, December 27th, 7.30 p.m.

PROCEEDINGS

OF THE

BRISTOL NATURALISTS' SOCIETY,

EDITED BY

WM. LANT CARPENTER, B.A., B.Sc.,

Honorary Reporting Secretary.

JANUARY, 1866.

Bristol:

PRINTED AND PUBLISHED FOR THE SOCIETY, BY G. MORRIS,

2, ST. STEPHEN'S AVENUE.

For Notices of Meetings, &c., see page 2 of the Wrapper.

BRISTOL NATURALISTS' SOCIETY.

SESSION 1866—67.

NOTICES OF MEETINGS, &c.

GENERAL MEETING.

The next GENERAL MEETING of the Society will be held at the Philosophical Institution, on Thursday Evening, January 3rd, 1867, at Half-past Seven o'clock.

Business of the Evening:

Paper by—

Dr. HENRY E. FRIPP, "On recent Discoveries in Insect Embryogeny."

LADIES ARE INVITED.

ADOLPH LEIPNER, *Hon. Secretary.*

Bristol, December 24th, 1866.

SECTIONAL MEETINGS.

In the small room of the Institution Library.

Entomological.—Tuesday, January 8th, 8 p.m.
Chemical and Photographic.—Wednesday, Jan. 9th, 8 p.m.
Zoological.—Thursday, January 10th, 8 p.m.
Botanical.—Thursday, January 17th, 7.30 p.m.
Geological.—Thursday, January 24th, 7.30 p.m.

NOTICE.—A Title page, Index, and Table of Contents to the Proceedings for 1866, will be issued with, it is hoped, the January number.

A list of errata will be issued at the same time. The Editor has to apologise for many misprints having been overlooked, the proofs having been revised in many instances too hastily, owing to the pressure of other engagements. He will be very much obliged for any corrections that may be sent to his address, 12, Brighton Park, Clifton, before the third week in January.

WM. LANT CARPENTER.
Hon. Reporting Secretary.

PROCEEDINGS

OF THE

BRISTOL

NATURALISTS' SOCIETY.

Vol. II 1867

Bristol:

PRINTED FOR THE SOCIETY, BY THE BRISTOL PRINTING COMPANY (LIMITED), 15, NELSON STREET.

PROCEEDINGS

OF THE

BRISTOL

NATURALISTS' SOCIETY.

Vol. III 1868

Bristol:

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PROCEEDINGS

OF THE

BRISTOL

NATURALISTS' SOCIETY.

Vol. 4 18~~6~~70 1869

Bristol:

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PROCEEDINGS

OF THE

BRISTOL

NATURALISTS' SOCIETY.

Vol. V 1870

Bristol:

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PROCEEDINGS

OF THE

BRISTOL

NATURALISTS' SOCIETY.

Vol. VI. 1871

Bristol:

PRINTED FOR THE SOCIETY, BY THE BRISTOL PRINTING COMPANY (LIMITED), 15, NELSON STREET.

Vol. VII. Part 1.

PROCEEDINGS

OF THE

BRISTOL NATURALISTS' SOCIETY,

1872.

JANUARY TO MAY.

EDITED BY

EDWARD W. CLAYPOLE, B.A., B.Sc.,

Hon. Rep. Sec.

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Bristol:

PRINTED FOR THE SOCIETY BY I. HEMMONS, ST. STEPHEN'S AVENUE.

Vol. VII. Part 2.

PROCEEDINGS

OF THE

BRISTOL NATURALISTS' SOCIETY

1872.

MAY TO DECEMBER.

EDITED BY

E. B. TAWNEY, F.G.S.

Hon. Rep. Sec.

Bristol:

PRINTED FOR THE SOCIETY BY W. C. HEMMONS, ST. STEPHEN'S AVENUE.

S. 20.

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PROCEEDINGS

OF THE

BRISTOL NATURALISTS' SOCIETY,

for 1st Series see end of Vol.

(Established 1862,)

FOR THE YEAR 1866.

EDITED BY

WM. LANT CARPENTER, B.A., B. Sc.,

Honorary Reporting Secretary.

NEW SERIES.

VOL. I.

Bristol:

Printed and Published by G. Morris, 2, St. Stephen's Avenue.

1866.

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List of Errata, &c.

PAGE	LINE FROM TOP.	
2	22	*for* iris; *read* iris—
27	31	*for* ligitimate *read* legitimate.
34	12	*for* F.R.S. *read* F.G.S.
35	15	*add* Sherbourne, Dorset.
75	14	*for* November *read* October.
76	6	*for* oviviparous *read* ovoviviparous.
79	16	*for* referens *read* repens.
82	1, 11, 12, 14, 18, and 7 & 13 from bottom	*for* Tribolites *read* Trilobites.
87	20	*omit* 'since.'
88	6	*for* Frittaries *read* fritillaries.
88	28	*for* 1900 *read* above 1900.
88	33	*for* atropa *read* Atropos.
91	24	*for* then *read* them.
91	38	*for* 'larvae than the perfect moth' *read* 'perfect moth than the larvae.'
91	41	*after* Stoddart *read* F.G.S.
92	33, 42	*for* Sphoeria *read* Sphœriae.
92	19, 29, 34, 46,	*for* Sphoerium *read* Sphœria.
93	2,	*for* Sphoerium *read* Sphœria.
95	24	*for* thin *read* three.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

JANUARY, 1866.

GENERAL MEETING.

THURSDAY, JANUARY 4.—Mr. W. SANDERS, F.R.S., President, in the chair.

The Hon. Secretary announced the following donations to the Library —Lovell Reeve's "British Land and Fresh Water Mollusca," presented by Mr. W. James; "Memoir and Papers of Hugh E. Strickland," presented by Mr. W. H. L. Walcott; "The Food, Use, and Beauty of British Birds," by C. O. Groome Napier, presented by the author.

The PRESIDENT said that it was his painful duty to announce the death of Mr. George E. Roberts, of London, a gentleman who was widely known and respected for his geological researches in the field; and who was one of the Corresponding Members of the Society.

Dr. HENRY FRIPP read an elaborate Essay "On the Function of Sight in Fishes, and on certain Structural Peculiarities of the Fishes' Eye," the subject matter of which was divided into two parts.

The author, briefly alluding to the popular misapprehension respecting the status of the fish in the animal scale, pointed out that under the peculiar physical conditions of fish existence, the different sensory endowments might be expected to vary greatly in functional activity and organic development. Thus the senses of touch and taste, particularly the latter, were relatively undeveloped; those of smell and hearing, being of higher importance, and especially adapted to the medium through which odors and sounds were conveyed, indicated an increased speciality of function; whilst the sense of sight was provided for by an organisation developed on the type common to all classes of the vertebrate kingdom, and exhibited a perfection of construction which corresponded with the extreme importance of the seeing faculty to the active life of the fish. The singular arrangement of a body without limbs, yet adapted to rapid locomotion and dependent on a remarkable development of the muscles of the trunk, was shewn to meet exactly the problem of the progression of an animal immersed in water. The control and direction of this muscular power were shewn to be dependent on the quickness and accuracy of vision. The quantity and quality of subaqueous light were next commented on, and the variation of light in strata of different depths as affected by the different states of the surface waters, *e.g.*, their state of rest and motion, their freedom from turbidity, as also by the state of sunlit or clouded atmosphere; in illustration of which the habits of fish and their power of vision at different depths were considered. The position of the eyes on the head, the direction of the line of vision, and the extent of the sphere of vision in different species of fish, came next under review. The question of the immobility of the pupil, as involving certain views relating to the perfection of the eye as an optical instrument, and to the received theories concerning the accommodation of vision to near and distant objects, was fully discussed, and a comparison instituted between the immoveable iris of the fish and the moveable iris of man and mammalians. The investigations of Brown-Sequard, concerning the contractility of the fishes' iris under the direct stimulus of light, were also noticed; a statement of Gosse respecting the iris of the butterfly blenny was also commented on.

The second part of this essay was devoted to anatomical details of the coats of the eye:—1. the sclerotic and cornea; 2. the choroid, with its ciliary processes, and 3. the choroid "gland" receiving especial notice. The several peculiarities of iris; structure were illustrated by drawings and preparations, the latter being more fully exhibited in the Zoological Section, on February 8th. Some remarks upon the limits of error in, as compared with the certain advantages obtained by, microscopical examination, were made in introducing this portion of the subject. After describing the several structures of the iris and ciliary processes, it was shewn that, both on anatomical and physiological grounds, the immobility of the iris, which had been accepted as a fact derived from general observation, was proved by the absence of muscle tissue in the iris, and the presence of a considerable band of inelastic and non-contractile fibrous tissue, which formed the borders of the pupillary opening. The absence of a ciliary muscle and the undeveloped condition of the ciliary processes were pointed out, as indicating that no function of "accommodation" could be argued on the commonly received theory of a change of position by forward traction of the lens, whilst the equally significant fact of the fishes' lens being too hard and too inelastic to admit any explanation of accommodation by change of the curved surface of the lens, was brought forward in proof of the absence of any such accommodation being produced in the eye of the fish as is observed in the other vertebrata. With respect to the choroid gland, Dr. Fripp, after briefly stating the views of anatomists concerning its structure, demonstrated the purely vascular nature of the gland, and expressed his disbelief in the explanations hitherto given of the function assigned to it, shewing that there existed no relation whatever between the action of the capillaries and vessels of which the gland was composed, and any function of "accommodation." This hypothetical relation was negatived by considering the facts already brought forward in disproof of the assumption that any change of place or curve of the lens took place, and also by consideration of the static condition of the circulation in the gland, which was intimately connected with the dynamic action of the heart and arteries, and with the varying pressure exercised on the surface of the fishes' body at different depths under the surface of the water. The meaning of this peculiar arrangement of vessels on the choroid gland was thus interpreted, in connection with the risk of injury to which the minute structures within the sclerotic capsule might be exposed, by great variation of pressure or tension of blood in the circulatory system itself, and by the influence of external pressure of water on the cornea of the fishes' eye, which formed a part of the tegumentary covering of the fish.

The following general conclusions were arrived at in a brief summary of the anatomical and physiological points discussed :—

1. That the fishes' vision is perfect for near objects, and that the great refractive power of the lens (a prolate spheroid having great density of substance) is adequate to the production of a defined picture at short focal distance, even when rays of light pass through so dense a medium as water; objects in the air near the water being seen also just as if they touched its surface at the point where the ray is bent.

2. That no "accommodation" such as is known to exist in the human eye for the perfect definition of objects at a distance occurs in fishes—or at least is not provided for in the same manner; the passive state of the fishes' eye being that in which it is enabled to see near objects, no active or physiological change appears necessary for ordinary vision, whilst physical dispersion of light on the water renders distant objects less liable to excite attention.

3. That the iris has no power of reflex action on stimulus of light, and its immobility is in harmony with the optical deficiency of 'accommodation' and the physically deficient illumination of the waters.

4. That the choroid gland is not an organ intended to assist or produce "accommodation" of focal distance of the lens, but that its vascular character, and the absence of any muscular or gland element in its composition, lead necessarily to an interpretation of functions directly relating to the static condition of the circulation fluid, and the changes of dynamic force exerted by the heart under varying pressure from without on the fishes' body. That, in fine, by such an arrangement (analogous examples of peculiarities in the venous circulation of Mammals and other animals dwelling in the water being well known), protection to the delicate tissues of the eye is afforded in the compensating balance of pressure within and without the circulating system.

5. That there results from the globular shape of the eyeball, a secondary reflection of rays of light from the bottom of the eye against the inner pigmented surface of the choroid, which may perhaps intensify the retinal

action, and probably stimulate the cells of the pigment membrane to secrete their molecular pigment from the venous flexuses of the choroid.

The paper was illustrated by a large number of beautiful drawings, by specimens from the Institution Museum, and by numerous microscopic anatomical preparations.

In thanking Dr. Fripp for his exhaustive paper, the President remarked upon the profound thought and the condensation of a large amount of observation displayed in it, and spoke of the honour thus reflected upon the society, as well as of the highest credit being due to the author.

Mr. W. L. CARPENTER, the Hon. Reporting Secretary, then read two short communications, the first having reference to Pharoah's Serpents' Eggs, the chemical toy now so common, and gave the results of experiments that he had made to ascertain the composition of the serpent. As was well known, the white powder forming the egg was sulphocyanide of mercury, and the author described several modes of preparing it. Theoretically represented by the formula $H_g\ C_y\ S_2$ it would contain 63.3 per cent. of mercury, and the specimen he analysed yielded 64.9 per cent. The loss of weight on burning was 19.27 per cent., and as the product contained 70.5 per cent. of mercury, it followed that about one-seventh of the mercury in the egg was volatilised. On this account he insisted strongly on the danger of burning them in small rooms with little ventilation, and alluded to the ill effects which had been observed by himself and others to arise from so doing. He mentioned the insidious and distressing symptoms of poisoning by mercury vapour, and described what he believed to be the reason of the fantastic forms and extraordinary increase of bulk sustained by the sulphocyanide of mercury when decomposed by heat. He showed an experiment to prove that the serpent form was not, as was generally supposed, caused by the cone of tinfoil, and described others which led him to believe that the blackness of the inside of the serpent was due to the mechanical mixture of sulphide of mercury with mellon, or melam, products of the decomposition of the sulphocyanides which had been studied by Liebig. The brown exterior contained no sulphide of mercury, and, when treated with nitro-hydrochloric acid, yielded a solution in which sulphuretted hydrogen caused a yellow floculent precipitate, the nature of which he had not ascertained. The specific gravity of the serpent was 0.069, water being 1.000, and such was the continuity of the skin that no air escaped through it when the serpent was sunk in water.

The author's second communication was entitled "Note upon the Artificial Formation of Flint." After briefly alluding to the various natural deposits of silica, and the nature of some of the compounds of silicic acid, Mr. Carpenter said that in decomposing on a large scale a solution of silicate of soda by a mineral acid, on one occasion, the silica which was at first gelatinous, became quickly agglomerated under water into a very hard semi-transparent mass, resembling flint in its fracture and other respects. The points of interest in connection with it were the conditions under which the transformation took place. He exhibited specimens of flinty silica, which had been formed in a solution at 214° Fah. under a pressure of only three feet of water, in the short space of three hours. He alluded to the possible bearing of this matter upon the explanation of some geological phenomena, usually considered to require extended periods of time for their accomplishment.

Mr. A. Noble mentioned having formed a substance resembling flint by first gelatinising, and then drying in air, an aqueous solution of silicic acid obtained by dialysis. The lateness of the hour, however, prevented further discussion on any of the papers.

MEETINGS OF SECTIONS.

ENTOMOLOGICAL SECTION.

Tuesday, January 9.—Mr. John Bolt in the chair.

After the minutes of the last meeting had been read and confirmed, the members present, in accordance with rule 3 of the section, proceeded to elect a President and Hon. Secretary for the ensuing year. Mr. Stephen Barton was re-elected President, and Mr. George Harding, jun., Secretary.

The Secretary then read the accounts of the section for the previous year, showing a small balance due to him.

CHEMICAL AND PHOTOGRAPHIC SECTION.

Wednesday, January 10.—Dr. W. B. Herapath, F.R.S., in the chair.

After passing the accounts for 1865, the meeting proceeded to ballot for the officers of the section for the ensuing year. Mr. Alfred Noble was elected Hon. Secretary, and Mr. P. J. Worsley, F.C.S., President.

Mr. W. L. Carpenter proposed a vote of thanks to the retiring officers, and Dr. Herapath, in vacating the chair, spoke of the great interest he felt in the section, and his regret at not having been able to devote more time to it, as well as of the good feeling which existed towards himself among all the members.

Mr. Worsley, in assuming office, said that, coming as he did after a man of such genius as Dr. Herapath, he would have to claim the indulgence of the members, though he could yield to no one in an earnest desire to promote the objects for which this section of the Naturalists' Society had been established, and that, although a purely scientific subject was not always attractive, a photographic one ought to be, and it would be his endeavour to render the meetings as generally interesting as possible.

Mr. Worsley then read some notes of observations made by himself and Mr. Gillford on the comparative solubilities of chloride, bromide, and iodide of silver in hyposulphite of soda. 100 parts of this dry salt would dissolve 90 per cent. of chloride of silver, and nearly as much bromide, but only about 5 per cent. of iodide, or, if the solution were heated and allowed to cool, about 6 per cent., the quantity being also influenced by the amount of alkaline iodide present. The solution of chloride or bromide in the hypo contained a double hyposulphite of silver and soda, characterised by a sweet taste, and by being only decomposed with difficulty by boiling; while with the solution of iodide there was no sweet taste, and if an attempt were made to crystallise the solution, pure iodide of silver separated out, showing that it had not been decomposed. Further, there was a great difference in the action of an excess of the halogen salt on the solution. If chloride of potassium were added to a solution of chloride of silver in hyposulphite of soda, no effect was produced; but if iodide of potassium were added to iodide of silver similarly dissolved, a precipitate of iodide of silver was formed, which could only be re-dissolved with very great difficulty by a large excess of hyposulphite of soda. This was very anomalous, and Mr. Worsley could offer no explanation of the fact, nor did any suggestion occur to any member present to account for it.

ZOOLOGICAL SECTION.

Friday, January 12.—Dr. Henry Fripp, President of the section, in the chair.

The audited cash account for the past year was read, showing a small balance in hand. Referring to the six meetings which had been held, the President remarked upon the necessity for more active co-operation on the parts of the members of the section, if it were to be carried on satisfactorily, and hoped that more zeal would be shown in future.

The election of officers of the section then took place, Dr. Fripp being chosen President, and Mr. S. H. Swayne the Hon. Secretary for the ensuing year.

Mr. C. O. Groome Napier exhibited a specimen of Loligo media, found in 1865 at Clevedon, and remarked that these species of Loligo secrete a brown fluid lighter in colour than true sepia. He also showed a male skylark, Alauda arvensis, of abnormal colour, a kind of fawn colour, resembling a cream-coloured lark of South Europe in plumage, but not in the form of the bill.

BOTANICAL SECTION.

Friday, January 19.—Mr. A. Leipner, President of the section, in the chair.

The Hon. Secretary read the accounts for the previous year, showing a balance in hand, which were passed, and a subscription of half-a-guinea was voted to the library fund of the parent society. The officers of the section were then re-elected to their respective departments by acclamation, with thanks for their past services.

Mr. Leipner begged to thank the members for their confidence in him, and said, that although he still felt the greatest interest in the welfare of the section, yet in consequence of his numerous engagements he could not give that attention to its interests which he could have wished, and therefore he should be glad if the members would name some other gentleman to preside over them. It, however, seemed so much the wish of those present that Mr. Leipner should continue to officiate, and attend or otherwise at his convenience, that he kindly consented to do so.

The remainder of the evening was spent in preparing and mounting specimens of dried plants for the herbarium, which is being established by this section. They consisted of plants found within the district of the Bristol Naturalists' Society, which had been either gathered in the course of the field walks of the section during the past summer, or were supplied from the private collections of the members. Each of those present taking a separate department, a large number of specimens, which had been pressed and prepared by the secretary, were mounted and finished.

GEOLOGICAL SECTION.

Thursday, January 25.—Mr. W. Sanders, F.R.S., President of the section, in the chair.

The accounts for 1865 were read and passed, showing a balance in hand, out of which it was resolved to give a donation to the funds of the Society's Library. The ballot was then taken for the officers of the section, Mr. Sanders being re-elected President, and Mr. F. Ashmead the Hon. Secretary.

Mr. W. L. Carpenter made a short communication on behalf of his father, Dr. Carpenter, on the oldest known fossil, Eozoon Canadense, showing the cumulative evidence, from a great variety of separate probabilities, that its structure was one of animal growth, although its organic nature had been lately called in question, and also announcing the discovery of the same fossil in the limestone beds of the great fundamental Gneiss of central Europe, which Sir R. Murchison had shown on other grounds to be the equivalent of the Canadian Laurentian rocks.

Mr. W. W. Stoddart read some notes on Devonian Palæontology. Remarking that the beginning and end of this system were not characterised by the accession or disappearance of any peculiar fossils, he observed that Silurian fossils were found in the lower Old Red beds, and Carboniferous in the upper, and this was especially the case with the corals, which were very abundant, belonging chiefly to the Cyathophyllidæ. One kind of coral, Calceola sandalina, had by some writers been mistaken for a Brachiopod. In the upper part of the series was a band filled with the valves of Cypridina, an Entomostracon. After giving a general view of the number of species in the system, Mr. Stoddart noticed some as being peculiarly Devonian, *e.g.*, Stringocephalus, Megalodon, Anodonta Jukesii, Clymenia, and others. The Devonian fishes were then described, as all belonging to two of Agassiz's orders, Placoid and Ganoid, and as having generally heterocercal tails, the most curious being the winged fishes, Ptericthys and Coccosteus. No reptiles had been discovered in the Devonian rocks, nor any animal organisms lower than zoophytes. Mr. Stoddart illustrated his paper with a number of the fossils he described, and Major Austin exhibited several also, as well as a sketch and map of the junction of the Devonian and Cambrian rocks in the county of Waterford.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

FEBRUARY, 1866.

GENERAL MEETING.

THURSDAY, FEB. 1st.—Mr. W. SANDERS, F.R.S., F.G.S., President, in the chair.

The Hon. Secretary announced that the following gentlemen had been duly elected ordinary members:—G. Gillford, F. R. Bernard, T. Usher, R. S. Standerwick.

Mr. W. W. STODDART read a note on Involutina liassica, a microscopic fossil, new to the Bristol district. At the Bath meeting of the British Association, Mr. Brady, of Newcastle, had read a paper announcing the discovery of this fossil in the Lias beds at Fretherne cliff and Defford, and had then proposed the above name for it. Mr. Stoddart had been fortunate enough to meet with it at Horfield, and after stating that it belonged to the lowest division of animal life, Foramenifera, he gave a general outline of the characteristics of this group, with the classification proposed by Dr. Carpenter in his monograph, and illustrated his remarks with some photographs projected on a screen by the oxy-hydrogen microscope. In the classification now generally adopted, the whole group was divided into three subordinate groups, named, according to the character of the shell, Porcellanous, Hyaline or vitreous, and Arenaceous: the fossil described by the author belonged to the last division, in structure lying between Rotalina and Trochammina, and considered by Mr. Brady as possibly a pseudomorph of Pulvinulina. In character it was discoidal, biconvex, from 1-15th to 1-70th of an inch in diameter, and 1-48th inch thick—granulated, the outer edge raised—spiral walls, with straight septa.

Mr. Thomas Pease, F.G.S., one of the vice-presidents, then read a paper by the Rev. Gilbert N. Smith, of Gumfreston, on "Recent Researches in a Bone-Cave near Tenby." This cave, called "The Hoils," or Haul's Mouth, was in an undercliff of the mountain limestone, conspicuously facing the sunrise, whence probably its name was derived. Having been long an object of curiosity, it had been much disturbed, and its contents were first reported on at the Oxford meeting of the British Association by the author. The floor was composed of stalagmitic breccia, three or four inches thick, which had long been broken up, except in patches in one or two corners, one of which was broken up for the first time in July last, when two femurs of a bear, still in position, and unquestionably of the oldest bones, were extracted. Among the disturbed earth and stones, half a lower human jaw was found, a good many chert and flint flakes, and, as if to set all speculation of relative age at rest, five unworn Irish harp halfpence of the reign of George III. In October last search was made for the rest of the human skeleton, the plan adopted being to shovel into the light at the entrance all the soil from the beginning of the passage, and in a recess the greater part of the vertebra, the blade bones, radius and ulna, and other remains of the same, or another, human skeleton were found. These, however, had not attained to that increase of weight and peculiar dense fossil character so well known in cave bones. In the disturbed soil in another part of the cave were found two molars of a bear, other carnivorous teeth, and a tusk, also the prong of a deer's antler. In all, 200 flint flakes, including some "scrapers," and two or three "coves" from which they appeared to have been removed, were found, and larger flaky amorphous pieces of the same greenish, spotted, cherty trap, of which the largest flakes were composed. The cave itself had been thrown off and aside, apparently by the elevation of a ridge of the Old Red Sandstone, extending about ten miles between Tenby and Pembroke. A valley, with a rivulet at the bottom, extended at the base of the limestone cliff, and this valley was at the present day liable to be flooded at spring tides. The paper concluded with a few surmises, conclusions, and suggestions offered by Mr. Smith. The limestone having been formed soft and horizontal on the sea bed, and then elevated, all the animals whose bones had been collected in the cave must have lived and multiplied before the sea washed into it again. Also, these remains in general were carried into the cave by the larger Carnivora, though possibly by man, the flint-flake-maker. With respect to the relative date of the deposits, no conclusion could be drawn, except that they continued from the time the cave bear, hippopotamus, &c., were indigenous until the present. As the tumuli on the ridge above the cave contained flint arrowheads, probably the race of men who used the flints were not far to seek, and *apropos* of flint knives a reference was made to a passage in the book of Joshua, recording the burying of flint (sacrificial) knives in his tumulus. With regard to the thickness of stalagmite, the author referred to the pendulous incrustations under railway bridges as a proof of quick formation, and he also inferred that floods or large volumes of water must have at times entered the cave to produce the results discovered.

After reading the MS., Mr. Pease, on behalf of the author, submitted to the inspection of the meeting several of the bones, teeth, flint-flakes, coins, &c., found in the cave, which Mr. Smith had forwarded in order to illustrate his paper.

The PRESIDENT, in commenting upon this paper, spoke of the great interest excited by this subject, not only among professed geologists, but among educated persons generally, and observed that, treating the antiquity of man as a purely scientific question, it was difficult to estimate aright the value of such evidence as this. He exhibited some flints from the valley of the Somme, and also some early British spear points, arrowheads, &c., found in 1835, by Mr. Francis and Mr. Gwyn Jeffries, at Paviland, under a thick coat of stalagmite, and presented by them to the Institution Museum. The evidence regarding the length of time required for the formation of stalagmite was very conflicting. Men of moderate views, accustomed to observe carefully, and who were looked-up-to, had come to the conclusion that these flints, &c., were contemporaneous with extinct animals, as well as with animals believed to be far more recent. Though the evidence from the gravel beds might be conclusive, as shown by Mr. Prestwich's researches, that from caves was not so.

Mr. H. K. JORDAN, F.G.S., enquired whether the Mollusca found in the cave were Fresh-water or Marine. He described the evidences of a depression of about 40 feet in the land round Tenby, and suggested that many of these bones might have been washed into the cavern by the sea. The speaker also mentioned instances known to him of the varying rate of formation of stalagmite.

Mr. S. H. SWAYNE, in reply to Mr. Jordan, read an extract from a paper in *The Geologist*, for October, 1865, in which the shells alluded to were described as Marine, and their species named.

Major GIBERNE (a visitor) spoke of the rapidity with which stalagmites were formed under railway arches, and also of the quickness with which porous limestone used for filtering water became choked. He described a singularly regular oscillation in the level of a portion of land in India during periods of 70 years.

Mr. LEIPNER explained that the stalagmites under arches arose from the hydrate of lime, which was used in the mortar, and which was many times more soluble in water than the carbonate, being dissolved by the water which trickled through, and that this solution absorbed carbonic acid from the air, forming a stalagmite very different in structure from that which was produced naturally from carbonate of lime.

Mr. ATCHLEY thought, from observations made among the chalk hills of Wiltshire, that the rate of formation of stalagmite was much influenced by currents of air.

Mr. W. W. Stoddart, F.G.S., referred to Mr. Pengelly's paper on such caves in Cornwall, and mentioned the discovery of a copper pin under nine inches of stalagmite. He also spoke of the great influence of the tide in sorting and arranging cave deposits.

After the conclusion of the discussion, Mr. C. O. Groome Napier, F.G.S., exhibited a specimen of the Spur-winged Plover, a bird common in Egypt, which was known to enter the crocodile's mouth, for the purpose, probably, of removing leeches. It had a remarkably sharp horny spur on the wing, the use of which was not known. It was very cunning, unlike the Dottrell, to which it was allied, and eggs of which were exhibited. This bird, as was well-known, was very foolish, and rarely bred in Britain.

Mr. Pease and Mr. Swayne questioned the existence of leeches, but believed the plover acted as a kind of living toothpick to the crocodile.

Mr. Napier also exhibited a cocoon of the Tarantula spider, from Tobago, which had contained 100 eggs, about the size of rape-seed.

MEETINGS OF SECTIONS.

ZOOLOGICAL SECTION.

February 8.—Dr. H. Fripp, President of the section, in the chair.

Mr. H. K. Jordan, F.G.S., exhibited a series of Helix Virgata, a new variety, of a dusky colour, for which he proposed the name H, Virgata, var. tenebrosa. Also, a series of Helix rufescens, var. depressa, a rare shell, found at Paignton, South Devon, and lately on Durdham-down.

The President then showed and explained a large number of very beautiful microscopic preparations, illustrating anatomically the minute structure of the eyes of fishes. The crystalline lens, choroid coat, and pigment cells, the iris and ciliary processes, were thus minutely examined, and especial attention was drawn to the peculiar arrangement of blood vessels in what was commonly called the choroid gland, the function of which Dr. Fripp had endeavoured to explain in his recent paper read at the general meeting of the Society in January. The separation of the arterial trunk, soon after entering the eye, into an immense number of exceedingly minute capillaries running parallel to each other and most closely packed, was well seen, and the subsequent reunion of these into a so-called venous, but, strictly speaking, arterial sinus, whence the blood was distributed to nourish the tissues of the eye, was clearly demonstrated.

ENTOMOLOGICAL SECTION.

FEBRUARY 13.—Mr. STEPHEN BARTON, President of the section, in the chair.

Mr. BARBER exhibited a pair of Hydroporus Neglectus, a new and undescribed Coleopterous insect, taken by Dr. Power (corresponding member); also Ceuthorychus biguttatus, a very rare species, captured by Dr. Power in South Devon.

Mr. J. W. CLARKE exhibited a case containing some fine species from India, and the West Coast of Africa.

It was agreed to continue taking in the *Entomological Magazine*, and to bind the volumes, retaining them for reference as the property of the section.

A proposition was made to institute a weekly evening meeting for collecting, during the summer months, and after some discussion, the settlement of the subject was deferred until the March meeting.

BOTANICAL SECTION.

FEBRUARY 15.—Mr. A. LEIPNER, President of the section, in the chair.

The attendance of members was not very numerous, and the whole of the evening was devoted to the mounting and preparation of specimens for the society's herbarium, no papers or other business being brought forward.

CHEMICAL AND PHOTOGRAPHIC SECTION.

FEBRUARY 15 (postponed from Feb. 14).—Mr. P. J. WORSLEY, B.A., F.C.S., President of the section, in the chair.

Mr. J. R. ROGERS introduced a discussion upon specific heat. After some preliminary remarks upon the varying capacity of bodies for heat, and the meaning of the term specific heat, he raised the question whether there was any relation between the specific heats and atomic volumes of bodies, and pointed out that with many gases, if the numbers representing their specific heats, equal volumes being compared, were divided by the numbers representing their specific heats, equal weights being compared, the quotient was either the atomic weight of the substance, or bore a simple relation to it. Mr. Rogers then suggested as a possible theory of the constitution of matter the hypothesis that the ultimate atoms of bodies were hollow spheres, with heat contained in them, and that the capacity for heat of the substance depended upon the thickness of the films of these hollow spheres.

A short discussion ensued, during which Mr. Beattie, Mr. Noble, Mr. Carpenter, and the President, addressed the meeting.

Mr. W. L. CARPENTER then exhibited and explained an adaptation of the spectroscope to the microscope, first suggested by Mr. Sorby, with which he had made several observations. He described the mode of using the combined instruments, as well as other ways of applying the two together, and promised to show some of the effects produced by it at the next meeting of the section.

GEOLOGICAL SECTION.

FEBRUARY 22.—Mr. W. SANDERS, F.R.S., President of the section, in the chair.

Mr. W. W. STODDART, F.G.S., made a communication upon Ammonites planorbis and its varieties. This was one of the most important, though rare, Lias fossils of the district, and three distinct species of it had been described by Sowerby and D'Orbigny, under the names of Ammonites Johnstonii, Sow., A. torus, and A. tortilis, D'Orb. Dr. Wright, of Cheltenham, who had been much occupied in studying the Ammonites of the Lias, was convinced that these three were simply varieties of one and the same species, A. planorbis. Mr. Stoddart exhibited typical specimens of each, and with the aid of drawings, explained what was meant by the keel, and the suture, stating that the different varieties of the same species were generally the same in the configuration of the sutures. The Lias beds were divided into zones, each characterised by its own Ammonite (which was only found with those limits), as the Planorbis zone, the Bucklandi zone, &c., and A. Planorbis belonging to the group Arietis, which was subdivided into those with no keel, as A. sauzeanus, A. planorbis, &c., and those with a keel, as A. Bucklandi, A. Turneri, &c.

In the conversation which followed, Mr. Jordan, the President, and others, urged the importance of searching for and studying the intermediate links between two strongly marked forms, in order to ascertain what were really species, and what only varieties. British Mollusca generally, Foramenifera, and two fossils, Navicula longicostata and Terebratula ornithocephala, were mentioned as examples of this.

Mr. W. L. CARPENTER exhibited a piece of silica, deposited from a boiling solution of silicate of soda, which was being decomposed by a mineral acid. Under a pressure of 2 feet of water it had acquired, in 3 hours' time, in great part, the hardness, semi-transparency, conchoidal fracture, and other characteristics of flint, with which it was chemically identical, except in respect of the quantity of water combined with it.

The PRESIDENT exhibited some tables illustrating various classifications of fish, which he had prepared with the intention of bringing the subject of the fossil fish of the neighbourhood before the section at some future time. Various characters had been taken as bases for classification, some being adapted best for fossil fishes, others for recent. Mr. Sanders had endeavoured to combine both, imparting into Prof. Owen's classification of fossil fish, some of the divisions usually adopted in works of Natural History for recent fish, in order to obtain one adapted to his purpose.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

MARCH, 1866.

GENERAL MEETING.

Thursday, March 1.—Mr. W. Sanders, F.R.S., President, in the chair.

The Hon. Reporting Secretary said that, in accordance with a desire that had been for some time expressed by various members, the experiment had been made of printing the Proceedings of the Society in a more permanent form than that of the newspaper slips. He laid copies on the table, pointed out the advantages of the plan, furnished estimates of the probable increase of cost, and gave notice that the Council would be prepared with a recommendation upon the subject, at the April meeting. In the mean time, he invited expressions of opinion on the matter, from all members interested.

The Hon. Secretary announced donations to the Society's Library of half a guinea from the Botanical Section, and one guinea, with a volume of the *Geological Magazine*, from the Geological Section.

Mr. W. W. Stoddart exhibited a piece of bamboo cane, which had been buried in the earth, and then incinerated, showing casts of the siliceous cells in the plant, hanging together in a remarkable manner. He also read an extract from a letter of the Rev. G. N. Smith, in reference to that gentleman's account of researches in a bone cave at Tenby, read at the previous meeting, from which it appeared that, though the bones of the bear, &c., were found underneath the undisturbed stalagmite, and were therefore very old, the flint flakes were not, and hence there were no data for determining the age of these.

Mr. Charles F. Ravis then read a paper on "Amber," communicated by Mr. Philip John Butler, of London. The speaker recalled the fact that about two years ago he had exhibited to the society some beautiful specimens of amber, specially with reference to the insects therein contained, and had then made a short communication upon the subject. These specimens had been lent by Mr. Butler, who had since been pursuing his researches, which were embodied in a paper read at the Linnean Society in London, on December 21st, 1865. This paper Mr. Ravis read, adding also a few remarks of his own in the course of it.

That amber was a fossil resin, and that most of what was obtained at the present day was disrupted from the submerged forests under the Baltic Sea, was now generally admitted. Its resinous character was known in the first century of the Christian era, although some of the ancients adopted the wildest theories respecting it, instances of which were given from Sophocles, Ovid, and other writers. That many of the ancients were wrong in their conclusions was certain, and it was equally certain that many in our own day were equally mistaken in supposing specimens to be amber which were only recent resin. Gum animi frequently contained insects, and was hence often confounded with amber, even in museum specimens, and instances had occurred of some authors, in entomological catalogues, actually mingling fossil species of insects in amber with existing species in modern resins. The weight of the largest piece of amber in the British Museum was 41oz., but at Berlin there were larger specimens. The chief use of amber was in connexion with meerschaum clay, animi being used for varnish.

Mr. Ravis here read some notes on two recent resins, confounded with amber, viz., copal and animi. Copal was the Mexican term for gum as well as resin, the resin so called being the produce of Rhus Copallinum; it rarely or never contained insects. Animi was a product of the Eastern hemisphere only; it exuded from Vateria Indica, a gigantic tree of Malabar, and was formerly sold in Indian bazaars under the term Sundross. The Portuguese knew it in 1498, and on settling in South America in 1549 they misapplied the term animi to the resin of New Spain. In continuing Mr. Butler's paper, the following ready mode of distinguishing amber from animi was given. The specimen being polished, was to be placed in cold water, which should be gradually heated to boiling; animi thus treated, frequently even before the water reached 200°, but always on boiling, lost its brilliancy, and was much altered in appearance and shape, while amber was unchanged. Some instances were given of specimens of amber containing fish, which were evidently manufactured, and not of natural occurrence.

The author then described his microscopic investigations into the cloudiness in amber, an appearance which was due to the presence of an immense number of small cavities, of very various shapes, some containing fluid only, others probably gas, or even vacuity, and others again were filled with fluid which had a bubble of gas in it. Mr. H. C. Sorby, F.R.S., well known for his researches on the microscopic structure of crystals, had examined these, and shown that several gave a black cross with polarised light, indicating a want of pressure, as though the material surrounding the bubble had become somewhat solid and contracted, so producing a tension. The cloudiness in amber was due, therefore, to the intimate and irregular mixture of air or some gas, or even vacuities, with it; other examples of the same law of light were seen in pounded rock-salt, or the powder of any transparent solid, clouds, condensed steam, foam, &c. Animi very rarely presented this appearance, nor was it probable that any amount of age would produce it. The greater number of these cavities were spherical, usually less than 1-1000th of an inch diameter, and sometimes occurred in waves, but occasionally some were met with more or less resembling in shape a balloon with car attached. The minute structure of these was described, and a comparison instituted with cavities in the diamond, quartz, mellite, and other mineral substances. Reference was then made to the organic remains, as insects, &c., found in amber, the action of chloroform on it described, and the paper concluded with the inference that amber had remained in a viscous state longer than recent resins, and that some specimens under different circumstances were in that condition much longer than others.

The paper was illustrated with several beautiful specimens of animi and amber, and with drawings by Mr. Ravis of some of the microscopic appearances. Mr. C. O. G. Napier also sent specimens of amber from Fezzan, in North Africa, where they were used as money, as well as some picked up on the beach at Margate, which contained insects.

The President, in thanking Mr. Butler for his paper, and Mr. Ravis for reading it, observed that though the cause and nature of these cavities were obscure, he questioned whether they had any relation to the cavities and vacuities in quartz; similar ones were found in granite, and many of them contained water. He also explained that the submerged forests from which the Baltic amber was derived belonged to the Tertiary period.

Mr. Leipner believed, on various grounds, that the cars attached to the balloon-shaped cavities were probably vacuities—the spherical cavities containing a gas or fluid.

Mr. W. L. Carpenter spoke of the vacuities frequently met with in ice, as described by Prof. Tyndall, as well as of the constant presence of air, which was entangled in it, both of which causes rendered it opaque. He also drew attention to the opacity in many specimens of ordinary resin, caused by the intimate mixture of turpentine, which could be expelled by heat, and the resin made clear. As little as 1 per cent. of turpentine equally diffused through the mass, produced this effect.

Mr. W. W. Stoddart described the production of balloon-shaped cavities in Canada balsam (also a resin) when heated on a glass slide for mounting microscopic objects.

Mr. C. O. Groom-Napier's paper on "The Analogy between the Horse and Man," which was announced for this evening, was postponed till the April meeting, to enable the author to be present, and to read it himself.

MEETINGS OF SECTIONS.

ZOOLOGICAL SECTION.

FRIDAY, MARCH 9.—Dr. H. FRIPP, President of the section, in the chair.

Mr. C. O. GROOM-NAPIER communicated notes (by Mr. Tristram), on the Birds of Palestine. After referring to the reasons which have led to the rarity of observations on the Natural History of this region, the author epitomised a portion of Mr. Tristram's paper read at the Bath Meeting of the British Association, in which it was stated that the ornithological interest of this region culminated in the valley of the Jordan, and in the plains around the Dead Sea, a region remarkable as the most depressed portion of the earth's surface. Mr. Tristram had made notes of upwards of 200 species of birds, a large proportion of which were new, and of the remainder some were also European and others Asiatic, this region seeming, by its fauna, to show intermediate characters. The nidification of many had also been observed. Amongst the more noticeable birds might be mentioned the Ceylon Eagle Owl, only previously known in South India and China, the Galilean Swift (new), Smyrna Kingfisher, Palestine Sunbird, Bulbul, Fantail, eighteen species of Chat (allied to the Wheat Ear), two Vultures, several Falcons, &c., &c. A larger proportion of song birds had been observed in Palestine than in Europe, and Mr. Tristram denied the common statement that brightly plumaged birds were deficient in song, *e.g.*, the Sunbird. Many notes on eggs by Mr. Tristram, hitherto unpublished, were read, and about 50 specimens of eggs, and about a dozen nests, exhibited. Mr. Napier said that he had tried to identify some of these birds with the descriptions in the Bible, and amongst other attempts of this kind, spoke of the Crane of the Bible, which he considered to be a Swallow, and said that the Swan of the Pentateuch was thought to be the Purple Coot.

Mr. T. GRAHAM PONTON exhibited specimens of Sepiola atlantica, a scarce British Cephalopod, found alive at Clevedon last August.

Mr. H. K. JORDAN exhibited a specimen of Scyllarus arctus, a rare crustacean, found at Guernsey by Mr. Gallienne. He observed that it was not mentioned in Bell's "Stalk-eyed Crustacea," and that it was more than double the size of Mediterranean specimens.

ENTOMOLOGICAL SECTION.

TUESDAY, MARCH 13.—Mr. S. BARTON, President of the section, in the chair.

The question respecting the weekly meetings for collecting was first brought forward, and it was eventually determined that they should be held during the coming summer, to commence in April. It was also determined that the April meeting of the Section should be held in the Institution (instead of an excursion as last year), and that the Sectional excursions should commence in May.

Mr. A. E. HUDD exhibited a pair of Acidalia Mancuniata, a new British species of moth (captured by Dr. Knaggs), and read a few notes upon its habits, and the differences between it and A. Subsericeata, a closely allied species occurring in the Bristol District, a pair of which insect was also exhibited. Mr. Hudd also exhibited Scopula Alpinalis, and Pterophorus Spilodactylus, a rare species occurring in the Isle of Wight.

The CHAIRMAN exhibited three species of Coleoptera, belonging to the family of the Paussidæ, a family remarkable for the singular form of the antennæ. The species were C. Piceus, taken by Mr. Barton in Australia (an insect which, Mr. Barton observed, was not only singular from the very peculiar form of the head, but from the fact that it crepitated, when alarmed, like the common Bombardier beetle, Brachinus Crepitans,) Paussus Latrillei, and Paussus Cucullatus, two species which had been sent him by a friend from South Africa.

The SECRETARY then read a paper upon the Pterophorina occurring in the Bristol District. The Pterophorina were a group of moths easily characterised, the most essential and prominent characters being that the fore-wings were more or less deeply cleft in two, the cleft varying in different species from one fourth to one half or more of the entire length of the wing; the hind wings were split, nearly their entire length, into three distinct parts, the divisions of the wings being surrounded by a thick fringe of long hair, giving them a peculiar feathery appearance, and earning for the genus the popular name of Plume moths. There was probably a larger number of this pretty and interesting group occurring in the Bristol District than in any other of equal area in the Kingdom, as out of 29 British species, the author had captured 17 in the immediate neighbourhood of Bristol, and he thought that probably several others would be found here when the district was more thoroughly searched. Among the species not yet discovered near Bristol, the two following were mentioned as not unlikely to be discovered:—Pterophorus Phæodactylus, an insect occurring abundantly near Gloucester, the larva to be found feeding upon Ononis Arvensis in May, and the Imago in July; Pterophorus Loewii, a recently discovered and obscure species, in the perfect state scarcely to be distinguished from Pt. Bipunctidactylus, a species common round Bristol. The larva of Pt. Loewii fed upon the seeds of Erythrœa Centaurea, a common plant in the vicinity of Leigh and Durdham Down. The paper was concluded by the author entering into particulars as to the habits and food-plants of the larva, and the localities of all the species that had been taken by him, and it was illustrated by specimens of all the Bristol species, with the food plants of the larva, and with a number of microscopic preparations of the different species.

CHEMICAL AND PHOTOGRAPHIC SECTION.

Owing to the unavoidable absence from Bristol of both the members who had prepared subjects for the evening, and also of the President, the meeting, which should have been held on Wednesday, March 14, was postponed for a month.

BOTANICAL SECTION.

THURSDAY, MARCH 15.—Mr. J. W. CLARK, in the chair.

Mr. YABBICOM exhibited a razor-strop formed of a portion of the pith of a species of Aloe found in Turkey, the adjacent wood being shaped into the form of a handle; he had been led to suspect, from its possessing this sharpening power, that raphides might be present, but from a close microscopic examination, this proved not to be the case, though they were very abundant in the parenchyma of the leaves of most species of this genus. Mr. Yabbicom also showed a portion of bamboo stem, which had been buried, and afterwards burnt, similar to that shown by Mr. Stoddart at the general meeting of the Society in March, exhibiting a cast of the cells of the plant, which, with a lens, was seen to be very complete. Though this appearance might be due in a measure to the presence of local silica in the plant itself, yet he was of opinion that it was chiefly caused by the absorption into the wood of earthy matters, in a state of solution, by capillary attraction from the soil in which it had been buried. Mr. H. Charbonnier had tried the experiment with bamboo which had not been buried, and had failed to produce the same effect.

The remainder of the evening was spent in mounting specimens for the Society's herbarium.

GEOLOGICAL SECTION.

Owing to the engagements of the President, Mr. Sanders, who had undertaken to read a paper, the meeting, which should have been held on Thursday, March 22, was postponed until the following month.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

APRIL, 1866.

GENERAL MEETING.

THURSDAY, APRIL 5.—Mr. W. SANDERS, F.R.S., President, in the chair.

The HON. SECRETARY announced the election, by the Council, of Mr. George Morris and Mr. Edward J. Kingdom as ordinary members, and of Mr. W. Lonsdale as a corresponding member.

The report of the Council respecting the Printing of the Proceedings in a more permanent form than the newspaper slips, was brought forward by the Hon. Secretaries. It recommended that they should be printed in pamphlet form, demy 8vo. size, uniform with several scientific serials, and issued monthly. Also, that all proceedings from the commencement of 1866, should be re-printed in this form, and that, for the present, no special means be taken to meet the increased expense.

Mr. H. K. JORDAN proposed, and Mr. S. H. SWAYNE seconded, the adoption of this recommendation, which was carried unanimously.

Mr. Turner and Mr. E. J. Gibbons were appointed to audit the Treasurer's accounts, before the next annual meeting.

Dr. BEDDOE exhibited specimens of rude flint and stone arrowheads found in a sand-drift at the mouth of the Kowie river, Cape Colony. No other flint was found in that part of Africa, and these implements were not used by the present inhabitants of the country. He also showed a piece of rude Bushmen's pottery, found in a cave not now used, in an uninhabited part of the country.

The PRESIDENT remarked that the majority of these pieces looked like flakes struck-off in the manufacture of more perfect implements, and adverted to the fact that the same kind of flint was always used for this purpose, even though it must have been frequently brought from long distances, none occurring naturally in the vicinity.

Mr. W. W. STODDART exhibited the new chemical toy, "How to make Green Tea." Red crystallised bichromate of ammonia was heated on a plate of metal over a lamp, and the sesquioxide of chromium which was left, much resembled green tea in appearance.

Mr. T. H. YABBICOM exhibited a fern with fronds of Lastrea spinulosa and L. dilatata growing from the same root, which had originally been brought from Portbury as a specimen of L. spinulosa. These two ferns had been regarded as distinct species, and many considered them even at the present time as separate varieties.

Mr. C. O. GROOM-NAPIER, F.G.S., F.A.S.L., then read a paper entitled "The Horse and his Master: or the Analogy between the Horse and Man." He explained a course of investigation which he had been for a long time pursuing, with reference to "Man the Microcosm,"—how he had been led to examine nature in her lowest and in her highest forms, and how he had found illustrations of man in every department, as a being and as an individual. His paper on the horse was a brief extract from his researches in this direction. He proceeded to draw the analogy between the temperaments of men and horses, and said—

"The sorrel or roan horse, answers to the sanguine temperament in man, which has great working power, but is even more remarkable for the impunity with which it bears long continued fatigue and exposure." He pointed out that horses of mixed colors were the most hardy and enduring, as for instance those with a light colored body and black feet, which answered to light-complexioned persons with grey eyes and black hair. In race-horses the nervous-bilious temperament was illustrated, they united the highest nervous sensibility, the greatest muscular development, and but just sufficient vital force to carry them on at a rapid rate for a short distance. Men he had found whose career resembled that of the race-horse. White horses, he said, were chiefly of the sanguine-lymphatic temperament, which was indicated by fleshiness and softness of muscles, and a liability to certain diseases, in which they shewed a resemblance to a class of very fair men whose hair had a bleached appearance. White horses were altogether less serviceable, but more mild and quiet than the black or chestnut, but shewed the frequent accompaniment of mildness and quietness,—a relative want of spirit. The iron and dappled grey horses, had temperaments analogous to the bilious-lymphatic amongst men. They had great muscular strength, but united with a good deal of stoutness and fleshiness, and at the same time a calmness and steadiness not found in the black and chestnut horses, which were frequently convulsive in their movements. In the black horse he saw a temperament strongly resembling the bilious and its combinations. In the smaller and more delicate breeds the nervous was largely mixed; and in proportion as it was extensively prevalent, so the breed was found to be sensitive and delicate. But when the bilious was nearly pure, or with a tinge of the lymphatic, as in some mouse-colored horses, there was great muscular power with less excitability. Chestnut horses were of a mixed temperament, greatly akin to the bilious-sanguine, which was less developed in those with black feet. The bilious-sanguine temperament in horses as in men was accompanied by an impatient disposition, but by great strength and spirit. Noble and generous qualities were more common amongst light colored breeds, which united intelligence and strength, and which might be compared with men with yellow hair, whose dispositions were more commonly gentler than those possessing hair of a darker color, and who were also often not deficient in vigour. This yellow hair was an indication of a more evenly balanced temperament than that of black or chestnut horses. The temperament, he said, was but an external indication of the various systems of the body, and when evenly balanced was most commonly accompanied by a good constitution. Hence the great endurance shewn by men and horses with yellow hair, which pointed to this evenly-balanced constitution.

The author then considered the breeds of horses in many countries, and found analogies between them and their masters, in Arabia, Khiva, Egypt, Chaldea, Persia, Armenia, Scythia, and Rome. Roman horses, like Roman citizens, came from an immense variety of localities. The Barbary horses were early brought from that country into Spain, and perhaps contributed eventually to the formation of the jennets, a high-spirited and noble breed. They shewed an extraordinary amount of freedom of movement, and were of the same stock probably as the Lusitanian or Portuguese horses, which, according to Justin, were "born of the winds." These were the types of the Moors—emigrants from Africa—who so greatly contributed to the advancement of civilization in the Peninsula; and they were suitable ancestors of the cavalry of Cortes and Pizarro. The most useful horses were the product of the union of greatly differing breeds. Mr. Napier considered the 'cobs' a type of the middle class amongst men, and proceeded to trace the history of the English breeds of horses, shewing how the state of horseflesh was an index of that of civilization in England at least; and concluded that man who could breed horses and other animals suited to his purpose, and produce modifications in them, in accordance with his will, was bound to apply similar principles to the improvement of his own species, which he had equal power to do. "For all history," he said "informs us how vices, diseases, and short lives are hereditary, and how long life, morality, and intelligence are alike transmitted from parents."

The President, in inviting discussion, said that the author had been very successful in pointing out the analogy sought to be drawn, but he could not quite agree with him in thinking that the horse had been created for man's use. He pointed out that, if concurrently with investigations into the early races of men, search were made as to where other animals were first found, the result would show that, before the earliest man, came into existence those tribes which have since been domesticated by man. Mr. Sanders also pointed out the great anatomical differences between the early geological horse, and the present race, which were so numerous as to cause Prof. Owen to assign a different generic name to the fossil horse.

Dr. BEDDOE had no doubt that the analogy was, in the main, a true one, and, as an example, he spoke of the comparison between red-haired men and chestnut horses. Youatt, in his standard work on the horse, considered the dark chestnut horse as equal to any, for a variety of purposes, while the light variety was often weak and delicate, though spirited. The speaker observed that constitution could be predicated from colour more surely in the horse than in man.

Mr. NAPIER, in reply to an observation from Mr. Lobb, said that it was an established fact that the Arab horse would outstrip the English in endurance, though its swiftness for short distances was not so great.

Mr. W. W. STODDART, after some humourous observations upon the analogy drawn by Mr. Napier between the "cob breed" and the middle classes of society, each race uniting in a measure the characteristics of two widely differing tribes, said that he thought that the author's observations, to be strictly scientific, should not be so general and wide, and should be taken with great reserve; they should also, as enunciated, be capable of application to other domestic animals, and this he did not consider they were.

Mr. S. H. SWAYNE confirmed Mr. Sanders' observation upon the early geological horse, which had many characters not exhibited now, rendering it a much less serviceable animal. He was not disposed to explain the resemblance between horses and men so much by analogy, as by the all-mastering and moulding power of the human intellect and will; as examples of this, he instanced the Semitic and Cossack horse and man, and mentioned several other examples of plasticity among the inferior animals. He thought Mr. Stoddart's observations well worthy of attention, especially with reference to dogs, which would probably exceed the horse in plasticity.

Mr. NAPIER, in replying to some of the above remarks, said he did not wish to be understood as believing that the horse was necessarily created contemporaneously with man.

Mr. HENRY K. JORDAN, F.G.S., read a paper entitled "A Few Geological Considerations Suggested by the Peculiar Molluscan Fauna Living in the Littoral Zone of the Channel Isles." He pointed out the tendency of modern geology to explain all the phenomena of the earth's crust by causes now in operation rather than by abnormal forces, sufficient time being allowed for them to produce their effects, and showed that there was need of careful investigation, so as not to draw conclusions from only part of a truth, but rather from the broad basis of well-ascertained and corroborated fact. It was generally considered that the depth at which fossiliferous strata were deposited might be ascertained pretty accurately from the character of the fauna found therein, each bathymetrical zone being inhabited by certain characteristic genera or families. The object of Mr. Jordan's paper was to show that this was not so universally true as was generally supposed, and in support of this view he gave particulars of six well-known British Mollusca, each of which varied greatly in its bathymetrical range.

1. *Venus Casina,* found in the Newer Pliocene deposits, and generally obtained living from the zone of deep water (about 50 fathoms) which girdled the British Isles, had been taken in the Mull of Galloway, in 145 fathoms, and by Mr. Jordan off the Cornish coast in 50 fathoms, in Milford Haven in 6 to 10 fathoms, while on the little island of Hern, opposite Guernsey, it might be found living on the shore among the Zostera Marina.

2. *Buccinum undatum,* was taken in our deepest water, by the Shetland cod-fishermen in 60 to 80 fathoms; it was also readily obtained by the dredge, and found half buried in sand at low spring-tides.

3. *Terebratula caput-serpentis,* like all Brachiopods, inhabited the deep sea, but in the Firth of Clyde might be dredged in a few fathoms, while Rev. M. J. Berkeley had found it between tide marks on the coast of Scotland.

4. *Cyprina Islandica,* essentially a Boreal species, and abundant in the boulder-clay, inhabited the deepest water in the North seas, but further South it was found in shallower water, and in Swansea and Carmarthen bays was taken at low-water mark. Mr. Jordan considered that the probable reason of its living in shallower water as it ranged Southward, was that cold water was its proper habitat, and he inferred that the temperature of the Mediterranean sea, during the glacial epoch, was about the same as the present temperature of the British seas.

5. *Trochus ziziphensis,* occurred at low-water mark at the Channel Islands, was dredged usually in the Laminarian zone, and had been taken in 80 fathoms by Mr. Jeffreys.

6. *Pectunculus glycimeris,* abundant in the Coralline crag, generally considered characteristic of 30 to 50 fathoms depth. Mr. Jordan had dredged it in Milford at from 15 to 4 fathoms, and it abounded so greatly at Jersey at low-water mark, as to be used as an article of food.

Mr. Jordan alluded to several other species, and observed that this interesting phenomenon of deep-water shell-fish living in the Littoral zone, was not confined to Mollusca, and drew the following conclusions from what had been stated—

1. "That bathymetrical range does not influence the distribution of Molluscan and Crustacean fauna so much as the nature and condition of the sea bottom, wherever these are highly favourable, species probably become gregarious."

2. "That geologists cannot even approximately, much less definitely, determine the depth at which fossiliferous strata were deposited, solely on Palæontological evidence."

In the second part of his paper, Mr. Jordan pointed out, from illustrations taken from the Mollusca of the Channel Islands, that great care was necessary in attributing older age to some tertiary strata than others, simply on Palæontological grounds, as Sir Charles Lyell had done in co-ordinating foreign and British tertiaries, wishing to show that the Diestian sands and Bolderburg beds of Belgium were older than the Coralline Crag of Suffolk, because the former contained many genera not to be found in the latter, and indicating warmer climatal conditions. In the Channel Islands were three genera and three species, all belonging to the Lusitanian type, and not found on the British coast, which would be pronounced to be from the Mediterranean, if shown to a continental naturalist.

The President, after remarking upon the philosophical manner in which Mr. Jordan had treated his subject, observed that it was as difficult to draw true conclusions from exceptional, as from so-called general grounds. He described Prof. Forbes' experiments on bathymetrical zones in the Ægean Sea, which established the general rules, exceptions to which Mr. Jordan had that evening been pointing out. It was true, for example, that the Terebratula, usually a deep-sea shell, was sometimes found in the Littoral zone, but, as a general rule, where these shells abounded in any stratum, it was fair to call that a deep-sea deposit. There were many exceptional cases, also, with the larger Carnivora.

The meeting was closed with the usual votes of thanks to the authors of the papers, and the announcement from the chair that this was the last ordinary meeting of the Session, the annual meeting being held in May, to be followed by the Summer Excursion meetings.

MEETINGS OF SECTIONS.

ENTOMOLOGICAL SECTION.

Tuesday, April 10.—Mr. Stephen Barton, President of the section, in the chair.

After the minutes of the previous meeting had been read, the President stated that he found upon inquiry that if the magazines were presented to the Society, the section would be able to have access to them for reference at any of the meetings of the section. It was therefore resolved that the volume of both the magazines, when completed, should be bound by the section and presented to the library of the Society.

It was then resolved that the first monthly excursion should take place on Monday, May 7th, to Leigh Woods, the members to meet at the Clifton side of the Suspension Bridge at half-past 3 o'clock in the afternoon. Weekly meetings for collecting were also arranged for Saturday, April 21st, to Leigh, members to meet at the Suspension Bridge at 6.30 p.m.; for Thursday, April 26th, to the Boiling Wells, Stapleton, to meet at the Mill, near the Ashley-hill Station, at 6.30 p.m.

CHEMICAL AND PHOTOGRAPHIC SECTION.

Wednesday, April 11.—Mr. P. J. Worsley, F.C.S., President of the section, in the chair.

Mr. W. L. Carpenter exhibited his modification of Mr. Sorby's original form of Micro-spectroscope, in which the prism and achromatic condenser were underneath the microscope-stage, and the slit on a detached stand. He explained and illustrated the method of using it, and pointed out that in this form of instrument, by varying the relative focal lengths of the object-glass and the condenser, the spectrum could be made of any required size in the field of the microscope; but that, on account of the great number of separate moveable parts, the satisfactory manipulation of the whole was very difficult. The spectra of cochineal, blood, cudbear, &c., were shown, and also the mode of using the instrument in actual investigations.

Dr. W. B. Herapath related his experience with Mr. Carpenter's instrument, which he had employed in a Toxicological enquiry, and described the Eye-piece Spectroscope for adaptation to the microscope, as now manufactured by Mr. Browning. The use of this involved scarcely any more trouble than the use of an analyzing polariscope prism, but there was no means of varying the size of the spectrum, and, until very lately, it was much more difficult to compare two spectra simultaneously, than it was in the first described instrument. The speaker described minutely the course of investigation pursued by him with reference to the supposed bloodstains on the hatchet used in the Aberdare murder. Dr. Herapath also showed a number of preparations which he had made in the course of an enquiry into a supposed poisoning case at Malmesbury, where it had been thought that the death of the deceased had been caused by bichloride of mercury. He had obtained mercury from the viscera, &c., sent to him for examination, but in no case was it in the soluble form, but almost entirely in the metallic state, or as sulphuret, and as he was not aware of any reducing agent in the body sufficiently powerful to bring mercury to the metallic state from its chloride, he concluded that the mercury found, resulted from the absorption of medicinal preparations of mercury, administered in a perfectly ligitimate manner.

The President showed a number of photographs which, when mounted with starch, became covered with yellow spots, and asked the members present their opinion upon the cause of them, and the possible means of preventing them from occurring.

ZOOLOGICAL SECTION.

Thursday, April 12.—Dr. Henry Fripp, President of the Section in the chair.

Mr. C. O. Groom-Napier exhibited an interesting series of bones of the Dodo, chiefly leg-bones, and read an extract from the *Mauritius Commercial Gazette,* quoted in the *Zoologist* for February, 1866, with reference to them. It appeared that they had been recently found in alluvial deposits in that island under three feet of water and mud, after unsuccessful researches in drier localities, and that bones of the tortoise, deer, and flamingo, were discovered at the same time and place. Nearly every bone of this remarkable bird had been obtained there, except the toes and part of the beak. The skull was very thick; and the cerebral cavity small; the cervical vertebræ were especially worthy of attention, the spinal cord being fully double that of a turkey in size; the sternum resembled that of the pigeon tribe, and the leg bones were remarkable for their size, some of the femurs being 7 inches in length.

Mr. A. Leipner then made a communication upon "Asexual Reproduction." The speaker had been led to consider the subject, by reading some recent researches of Leuckart on the Cecidomyde larvæ, a race of two-winged flies, which, depositing their eggs in the buds of plants, produced galls. Between the 9th and 10th segments of the larva appeared a 'germ-stock,' which, after going through several stages, finally developed into a number of larvæ, precisely resembling the original one, which ate their way out of the parent's body, causing its death. These again produced others, and so on, until June, when the larvæ went through the usual metamorphoses, and the resulting insects, after copulation, laid eggs, which developed in the usual manner. The only parallel condition to this was in the Aphides, or plant-lice, where this successive production of larvæ without sexual organs had been continued for four years, but any great fall in the temperature caused a full development of the larvæ, followed by sexual reproduction, to take place. Leuckart had adopted Steenstrup's term for this phenomenon, 'alternation of generations.' In his treatise on Development, M. Quatrefages described three modes. (1.) True Metamorphosis, which affected only one and the same individual. (2.) Geneagenesis, or the production of several generations through the medium of a single germ, and (3.) Parthenogenesis, or the reproduction of perfect eggs from an unfecundated perfect female; as had been long noticed among bees, and as frequently occurring in the vegetable kingdom. Mr. Leipner considered the reproduction of the Aphides and Cecidomydae as coming under the second head, geneagenesis, as no perfect eggs were produced, nor was the reproducing individual a perfect insect; the process, in fact, was only a modification of the phenomenon of gemmation or budding, examples of which he adduced from among many of the lower tribes, Coelenterata, Radiata, Annulosa, Mollusca, &c. The speaker hoped at a future time to present a classification of animals founded upon their modes of reproduction, according to the divisions laid down by Quatrefages.

BRISTOL

Naturalists' Society.

ESTABLISHED 1862.

REPORT OF THE COUNCIL,

READ AND ADOPTED AT THE

FOURTH ANNUAL MEETING

OF THE SOCIETY,

HELD MAY 3RD, 1866.

WITH

THE LIST OF OFFICERS, AND LIST OF MEMBERS.

BRISTOL:
GEO. MORRIS, PRINTER, 2, ST. STEPHEN'S AVENUE.

1866.

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AS APPOINTED AT THE ANNUAL MEETING, MAY 3RD, 1866.

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2, Great George Street, Bristol.

SECTIONS.

ENTOMOLOGICAL.

President, S. Barton. *Secretary,* Geo. Harding, Junr., Stapleton.

Second Tuesday in the month, at 8.0. p.m.

GEOLOGICAL.

President, W. Sanders, F.R.S., F.G.S. *Secretary,* F. Ashmead, C.E., Alma Vale, Clifton.

Fourth Thursday in the month, 7.30. p.m.

BOTANICAL.

President, A. Leipner. *Secretary,* T. H. Yabbicom, 1, Spring Hill, King Square, Bristol.

Third Thursday in the month, 7.30 p.m.

CHEMICAL AND PHOTOGRAPHIC.

President, P. J. Worsley, B.A., F.C.S. *Secretary,* A. Noble, F.C.S., 6, William Street, Ashley Road, Bristol

Second Wednesday in the month, 8. p.m.

ZOOLOGICAL.

President, H. Fripp, M.D. *Secretary,* S. H. Swayne, M.R.C.S., 8, Berkeley Square, Bristol.

Second Thursday in the month, 8.0. p.m.

In the summer months, many of the evening meetings are replaced by excursions.

All sections are open to any member of the Society, on payment of an annual subscription of 2s. 6d. in each case.

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Young, F. Graham

LIST OF CORRESPONDING MEMBERS.

George S. Brady, Esq., Sunderland.

James Buckman, Esq., F.L.S., F.G.S., F.S.A., &c.

William B. Carpenter, Esq., M.D., F.R.S., &c., University of London.

Philip P. Carpenter, Esq., B.A., Ph. D., Montreal.

Robert Etheridge, F.G.S., F.R.S.E., Mus. of Practical Geology, London.

J. P. Galienne, Esq., Guernsey.

Albert Günther, Esq., M.A., M.D., Ph.D., F.Z.S., British Museum.

T. Rupert Jones, Esq., F.G.S., Professor of Geology and Mineralogy, Royal Military College, Sandhurst.

Edwin Lankester, Esq., M.D., F.R.S., Kensington Museum, London.

Frederick Layard, Esq., late of Ceylon.

William Lonsdale, Esq., F.G.S., Bristol.

Charles Moore, Esq., F.G.S., Bath.

Hugh Owen, Esq., Paddington.

Professor John Phillips, M.A., LL.D., F.R.S., F.G.S., Oxford.

John A. Power, Esq., M.A. and L.M., Cantab.; M.R.C.P., Lond.; F.R.G.S., London.

H. J. Slack, Esq., F.G.S., London.

Rev. Frederick Smithe, M.A., F.G.S., Highley Vicarage.

Frederick Smith, Esq., British Museum.

G. H. K. Thwaites, Esq., F.R.S., Royal Botanic Gardens, Beradenia, Ceylon.

REPORT OF THE COUNCIL.

For the fourth time it devolves upon the Council of the Bristol Naturalists' Society, to present its Annual Report.

Four years of active operation, certainly affords ample proof and test of the powers and performances of a Society,—yet at the close of each year, your Council have had the satisfaction of finding abundant material whereon to base their Report, and of recording the favourable progress of the Society ; nor are fair indications of its future activity wanting.

To set one's house in order at stated periods, is the wise regulation of all prudent householders ; for the actual balance of gain or loss is best gathered from the accumulated transactions of the year, when a time has been set apart for *retrospect,* free from the heat and burden of the day. Such a regulation is even more necessary in the case of a literary or scientific association, than in ordinary affairs, whether private or public, inasmuch as it is not held together by any bond of external or internal exigency. A Society *cannot live on the inheritance of the past ;* its existence depends on the *self-consciousness of present active powers,* rather than on the credit of past achievements. Hence it is that the retrospect which its Annual Report affords, is valuable in direct proportion to the assurance which it may give of *present usefulness,* and of *future promise.* With the fulfilment of these conditions such a retrospect may indeed offer every encouragement to perseverance, and the best guarantee of permanent prosperity.

The substantial benefit of a Report, can, however, only be attained by business-like simplicity of statement, and by moderation in its confidence. The prospects and promises which it holds out, must be broadly based on the community of interest and scientific order of the Members of the Society ; for a Society *changes its complexion more rapidly than an individual, decay begins as soon as present activity fails, and its decay is followed by oblivion, even before it officially dissolves.* Every Society that pursues purely scientific aims, and that is dependent solely on voluntary effort, has of necessity a critical constitution and an uncertain vitality, and therefore is in constant need of extended and sustained support *from* *its whole body as well as from individual members.* Your Council deem it an imperative duty to keep this important consideration always in mind, and to forewarn the Society against that inaction which is so perilous to its stability; whilst therefore they gladly report the improved character of the papers which have been read, and the higher interest of the discussions which have taken place, both in the general and sectional meetings, they yet venture to urge upon all and each of the Members, the importance of *active co-operation.* In the time of prosperity they yet feel it prudent, neither to slacken in their official duties, nor to omit such urgent persuasion as may be permitted to them in dwelling on the prospect of the future; fully recognising the actual progress made and looking hopefully forward, they call upon the Society to press on with *a long pull, a strong pull, and a pull altogether.* Fairly established in numbers, influence, and scientific position, the Bristol Naturalists' Society prospers; and whenever decay sets in, it will not be by default of those who stood its sponsors, or of those who first stood in the front array, but rather by the absence of willing recruits to fill the gap occasioned by lapse of time and exhaustion of the pioneers.

The time has not yet arrived, and ought not to arrive, when our Society may "*rest and be thankful.*" Let worthy labourers in quick succession extend the field of labour, and widen the aim and triumph of the Society. Let each individual effort stimulate to general action. Let united interest and sympathy encourage and stimulate individual exertion. Let us adopt the grand thought and words of our great poet—

> Men my brothers, men the workers,
> Ever working something new,
> What they have done, but the earnest
> Of the things which they shall do.

The present Report may be conveniently arranged under the following general heads—

I. Changes in the 'personel' of the Society.
II. Papers and discussions at the general and sectional meetings.
III. Excursions.
IV. Publication of proceedings.
V. Library.
VI. Finance.

I. Changes in the Personel of the Society.

The number of members remains the same as at the end of the last year—the list of newly-elected members balances our loss by resignation. We have to regret the loss of one corresponding member, and of three ordinary members, by decease. Two corresponding members have been elected during the year. Nearly the whole of the resignations of ordinary members have been occasioned by change of residence to a distance which renders their attendance at meetings impracticable.

II. Papers and Discussions.

The following tabular list shews, in a condensed form, the variety of subject matter which has been brought before the Society during the past year. We commence with the

General Meetings.

Name.	*Subject.*
Mr. Hugh Owen	Description and Habits of Periopthalmus Papilio.
" "	The Instability of Colour in the Feathers of Musophaga violacea.
Mr. Groom-Napier	The Attractive Qualities and Food of Birds.
Mr. Charles Ravis	On two Raised Beaches at Weston-super-Mare.
Mr. Henry K. Jordan (communicated by Mr. Stoddart)	On the Malacology of Venus Casina.
Mr. Henry K. Jordan	On the Rock-boring Mollusca.
Mr. Henry Brightman	On the application of the Photographic Printing Process for producing Copies of Botanical and other Specimens.
Dr. Henry Fripp	On the Vision of Fishes, and on certain Structural Peculiarities of the Fishes' Eye.
Mr. Wm. L. Carpenter......	Note on Pharaoh's Serpents' Eggs.
" "	Note on the Artificial Formation of Flint.
Mr. W. W. Stoddart........	On Involutina Liassica.
Rev. Gilbert N. Smith (communicated by Mr. T. Pease)	Recent Researches in a Bone-Cave near Tenby.
Mr. Philip J. Butler (communicated by Mr. Ravis)	On the Cloudiness of Amber.
Mr. Groom-Napier	The Horse and its Master.
Mr. Henry K. Jordan	Geological Considerations suggested by the Peculiar Molluscan Fauna living in the Littoral Zone of the Channel Isles.

It seems deserving of special mention that the papers of Mr. Owen and Mr. Butler were contributed by gentlemen who, though not ordinary members, have kindly manifested their interest in the Society's proceedings by direct personal communication; Mr. Owen, a corresponding member, having given himself the trouble of a long journey for the purpose, and Mr. Butler, by sending through our member, Mr. Ravis, a curious and valuable collection of specimens of amber for exhibition before the Society.

The several papers were listened to with much interest by a very numerous audience, and the discussions and information elicited were throughout of a very satisfactory nature. The Council note also with gratification the fact of a numerous attendance (including visitors, both ladies and gentlemen). The printed reports of each meeting, and of the discussions which followed the papers, render any further detailed notice in this place unnecessary. General meetings have been held monthly from October to April inclusive.

Sectional Meetings.

The *Geological Section* held eight meetings and undertook two excursions. Independent of minor communications, the following papers were read at the meetings of the Geological Section:—

Name.	*Subject.*
Mr. A. Leipner	On two species of Devonian Corals.
Mr. W. W. Stoddart	On Fossil Otoliths.
Mr. W. Sanders	On the Old Red Sandstone formation of Europe.
Mr. W. L. Carpenter....	On Eozoon Canadense (a communication from Dr. W. B. Carpenter).
" "	On the Production of Artificial Silica.
Mr. W. W. Stoddart	On the Fossils of the Old Red Sandstone.
" "	On varieties of Ammonites Planorbis.
Mr. Groom-Napier......	On a Fossil Skull of Rhinoceros tichorinus.

The excursions of the Geological Section comprised a survey of the cuttings on the Portishead Railway, and of those near Whitchurch, on the North Somerset Railway.

Chemical and Photographic Section.—The following papers were read at the meetings of this section.

Name.	*Subject.*
Mr. W. L. Carpenter....	Notes on the Soap Bubble.
Rev. W. Whiting	On Effects of Polarised Light, illustrated by apparatus and specimens.

Mr. J. Beattie..........	On Photographic Lenses and Developing Processes.
Mr. W. L. Carpenter....	The Composition of Pharaoh's Serpents' Eggs.
Mr. A. Noble	Exhibition of large Paper Negatives by Mr. West.
Messrs. Worsley and Gillford.	On the Solubility of Chloride, Iodide, and Bromide of Silver in Hyposulphite of Soda.
Mr. J. R. Rogers	On Specific Heat.
Dr. Herapath Mr. W. L. Carpenter	On the Micro-spectroscope.

Zoological Section.—The papers read at the meetings of the Zoological Section were as follows :—

Name.	*Subject.*
Mr. E. A. Praeger......	On the Food of the Hedgehog, and its mode of Feeding.
Dr. Henry Fripp	Anatomy of the Eye of Cephalopoda.
" "	Exhibition of Preparations and Diagrams of the Retina and Lens of Loligo.
Mr. W. W. Stoddart	The Auditory Apparatus and Otoliths of various Invertebrata and Vertebrata.
Dr. Henry Fripp	Anatomy of the Choroid Gland of Fish.
Mr. Groom-Napier......	Communication from Mr. Tristram on the Birds of Palestine, with a collection of Nests and Eggs.
" "	Bones of the Dodo.
Mr. A. Leipner	On Asexual Reproduction of Larvæ of Cecidomydæ.
Mr. T. G. Ponton	Various Specimens exhibited before the meeting.

Entomological Section.—Four excursions were made by this Section, to Leigh Woods, Brockley, Nailsea Marshes, and Clevedon. Papers were read at the meetings by

Name.	*Subject.*
Mr. S. Barton..........	On two Species of Ceratorhina, and
" "	On the Coleoptera of St. Helena.
Mr. Geo. Harding jun.	On Eupithecia Lariciata, and
" "	On the Pterophorina of the Bristol District.

Many of the evening meetings were wholly or partially occupied by the exhibition and mutual interchange of specimens.

Botanical Section.—Excursions to various places, St. Anne's Wood, Portbury, Leigh Woods, Portishead, &c., occupied this Section during the summer months. At the winter meetings, subjects principally relating to vegetable physiology were discussed, those exciting most interest being

"Starch" and "Raphides." One feature worthy of particular notice in the transactions of this Section, is the preparation of a considerable number of plants for the Society's herbarium.

Besides the special business meetings of the several Sections, a general meeting for the financial account of each Section, and for the election of officers, has been regularly held, in accordance with the rules.

III. The Excursions of the General Society

Were three in number, namely, to Clevedon, Cheddar, and Dundry and Chew Magna. These excursions were well attended, and proved very successful, as well in respect to their scientific interest as to the cordial unanimity of feeling with which they were carried out.

IV. Publication of Proceedings.

Every member of the Society has received during the year, a printed copy of the Honorary Reporting Secretary's abstract of proceedings at the various excursions and meetings, in the order of their occurrence. And recently an enlarged and corrected Report published in pamphlet form, has been distributed in accordance with the minute of the general meeting of the Society, held on the 5th of April last. This report will be in future continued in the same regular form and type, and the Society may now be congratulated on having attained the great desideratum of regularly published proceedings. A still more important undertaking, the programme of which was given in the last annual report, and which was intended to come out in parts, demands a few words of explanation on account of the delay which has occurred in its issue. Considerable preparation has been made, and as the Council recognise at each step in this preparation the magnitude of the labour before them, it has been considered desirable to avoid any too hasty publication which might leave the work incomplete. The first number to be issued involves a complete reconsideration of certain debated questions of the geology of the neighbourhood, the settlement of which demands time and patience, and fresh investigation. The Council have also to take into consideration the financial prospects, upon which such a publication can be attempted.

V. Library.

In accordance with the expressed wish of several members, the formation of a library has been commenced. The sum of £13 6s. 6d. is now in the hands of the Treasurer. And the following list of books, partly bought and partly received as donations, will show at a glance how the project stands at present.

Sowerby's English Botany, new issue. Vols. 1, 2, 3, 4.
Quarterly Journal of Science, from the commencement.
Intellectual Observer. Vols. 1 to 6.
Geological Magazine. Vol. 1.
British Land and Fresh Water Mollusca. Lovell Reeve.
Foramenifera, from the North Atlantic and Arctic Oceans. Jones and Parker.
On a new genus of Echinoderm, and observations on the genus Palaechinus. Major Austin.
Food, Use, and Beauty of British Birds. C. O. Groom-Napier.
Memoirs and Papers of Hugh E. Strickland.
Report of Dr. Benjamin Franklin, and other Commissioners, on Animal Magnetism. London, 1785.
Hortus Cantabridgiensis. James Down. 1815.
The Microscope made easy. Baker. London, 1769.
Botanical arrangement of all the Vegetables, naturally growing in Britain. Withering. 1776.
Brewster's Edinburgh Journal. Vols. 1, 2, 3.

The fund for the library depending entirely on the voluntary subscriptions of an inconsiderable number of the members of the Society, is at present but small, totally inadequate indeed for the desired purpose. The Council cannot omit this opportunity of recommending earnestly, a more efficient support from the whole body of members; and beg to remind the Society, that the use of the library is not confined to subscribing members only, but is offered to all.

VI. Finance.

From the statement of Receipt and Expenditure, which will be read by your Treasurer, it will be seen that the balance, as compared with that of last year, is not so large as formerly, but still, however, on the *right side* of the balance sheet. The arrears of subscriptions, though less than in past years, shew to the Society's disadvantage, notwithstanding the employment of a paid collector. Amongst the items of expenditure placed in the present account, are 19 guineas paid in part as a donation of money to the Institution, and in part for a collection of fossils presented to the Museum. Also an extra expenditure of nearly £9 for reprinting abstracts of papers and proceedings of the Society, since January of the present year. A further item of expenditure appears for lamps, purchased for the use of the Sections during the winter meetings, which remain as the property of the general Society. These several items serve to explain the diminution of balance. The printing expenses for the future must necessarily correspond with the improved style of publication of report, but the Council hope to lessen this expenditure by admitting advertisements on the wrapper.

Having passed in review the principal points which appear to call for notice, your Council feel justified in characterising the action and position of the Bristol Naturalists' Society, as thoroughly sound and efficient, and as well calculated to reassure and encourage those who may not be equally conversant with its steady developement. Your Council also confidently trust in the strength and vitality of an Association, which numbers amongst its members so many accurate observers and active contributors. In conclusion they beg to congratulate the Society on the position it has attained, and on the prospects before it.

"FLOREAT SEMPER."

DR. **W. W. STODDART, *in Account with* THE BRISTOL NATURALISTS' SOCIETY.** CR.

Date	Dr.	£	s.	d.
1866.				
	To Balance in Treasurer's hands ..	46	11	11
April 30.	To Subscriptions received to this date	54	0	0
		£100	11	11
	To Balance in hand	15	0	2
	To Arrears	15	15	0

Audited and found correct,
THOMAS TURNER,
May 1st, 1866. EDWIN J. GIBBONS.

Date	Cr.	£	s.	d.
1865.				
June 15.	By Cash—Donation to Institution ..	15	0	0
Aug. 12.	" Somerton & Co., ...	4	15	6
Oct. 5.	" Fossils for Institution ..	4	19	0
1866.				
Jan. 18.	" Somerton & Co.	4	0	6
Feb. 8.	" Mardon & Co.	13	6	6
April 24.	" Morris	1	18	0
"	" Baker	0	10	0
"	" Sturge	4	12	9
"	" Mardon & Co.	3	17	0
"	" Collector's per centage .	3	4	6
"	" Gratuities, Notices, &c., per Secretary, and sundry Expenses ..	22	8	0
April 30.	" Morris	7	0	0
"	" Balance in hand	15	0	2
		£100	11	11

LIBRARY FUND.

Date	Dr.	£	s.	d.
1866.				
April 30.	To Balance brought forward ..	11	5	0
	To Subscriptions recd. to this date	10	10	0
		£21	15	0
	To Balance	13	6	6

LIBRARY FUND.

Date	Cr.	£	s.	d.
1866.				
Feb. 8.	By Cash Quarterly Journal of Science ..	1	0	0
March 14.	" Sowerby's British Botany ..	7	8	6
	By Balance	13	6	6
		£21	15	0

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

MAY, 1866.

ANNUAL MEETING.

Thursday, May 3.—Mr. W. Sanders, F.R.S., F.G.S., President, in the chair.

The President, in opening the business of the meeting, remarked that the number present was almost as small as at the annual meetings of the Institution. It was generally the case in an old established society, if there were no circumstances of interest to draw members together, they assumed that everything was going on smoothly, and that the business would go on just as well without them as with them, and they would know the proceedings after the meeting was over. He had always found at the Institution meetings, that unless there were some question of importance to be decided, or some heavy complaint to be made against the committee, very few attended; all seemed satisfied—so far satisfied as to stay away, and leave the business to be done by those who were kind enough to attend.

The Hon. Secretary then read the minutes of the last annual meeting, and also of the general meeting held in April. He announced that the following gentlemen had been duly elected ordinary members:—W. H. Budgett, Gundry Stephens, Charles Wheeler, jun., Edwin Wheeler, Henry House, and J. Hutchins. He then read the report of the Council, for which see page 36.

Mr. W. W. Stoddart, Hon. Treasurer, read the audited accounts, for which see page 44, after which he expressed his regret that their balance was getting less. The arrears of subscriptions amounted to £15 15s. The balance in hand would not carry the Society through till next January, and it would be a great pity if the bills were not paid until the subscriptions came in, because that would entrench on next year's funds. Of course the expenses had been slightly increased, and he thought their subscriptions ought to be slightly increased also. A trifle would do. They already paid 5s., and each member cost that, and how were their expenses to be met if such was the case? He thought it was not unreasonable to submit to-night what had occurred to him in making up his report, viz., that the subscription should be 7s. 6d., instead of 5s., and if it was agreeable to the meeting, he would willingly undertake the little extra trouble of collecting another half-crown. This would place them on a firm basis, and enable them to work with a will. Another suggestion he had to make was that the financial year should in future correspond with the Society's year. This would be especially necessary were he to give up the office of treasurer, because the accounts would be very complicated to a new treasurer, and the change could be very simply effected. If they all gave another half-crown, it would carry them on till next May very nicely, and thenceforward had another subscription of 7s. 6d., they would have means without interfering with the accounts at all, after which the treasurer's financial year could be from May to May, the same as the Society's year. The policy of this course must be palpable to all, and he regretted there were not more present to hear his remarks, as he should wish the change to be made in deference to a general opinion and not to the opinion of a few. If agreeable to the members generally that the half-crown should be collected at once, they would have the satisfaction of knowing that everything would be conducted—economically, of course—without the slightest source of uneasiness.

Mr. C. F. Ravis then moved the following resolution:—"That the report now read, together with the Treasurer's account, be approved, and printed under the direction of the Council, and that a list of the officers and members of the Society be added thereto." Mr. Ravis regretted that so few members had heard the report read, because it came with more freshness and power to the mind when read in an assembly. The Society had all the elements of success in it—several guides and pioneers, men of high attainments in science—others of more moderate capacities, but still able to do good work, and also those, probably many, who thought they knew and could do but little, but who, he was persuaded, knew much more than they thought, and could do much more than they thought. If all worked together, as was suggested in the report, the Society would go on and prosper. The speaker then pointed out how advantageously the Society was situated in respect of materials for work, and remarked that their object was by no means attained by the mere collection and naming of specimens; the great aim was the improvement of their own intellectual capacities and powers.

Mr. R. S. Standerwick seconded the resolution, which was adopted unanimously.

Mr. Henry K. Jordan, F.G.S., proposed "That a contribution of ten guineas from the surplus funds in the Treasurer's hands, be presented to the Institution; that the Honorary Secretary be requested at the same time to convey the best thanks of the Naturalists' Society for the kindness with which they have been met by the Committee of the Institution." He believed that the amount proposed to be given this year was not so large as last year. There had been several causes which had brought about this result. Mr. Stoddart had told them that they had considerably increased their expenses, while their income had not materially increased, consequently they had a smaller balance than last year. They did not, however, at all intend that the ten guineas should mark their full appreciation of the kindness the officers of the Institution had shown them, but rather as a small token of their gratitude.

Mr. Berry seconded the motion, which was unanimously adopted.

Mr. S. H. Swayne then proposed the following resolution:—"That the Hon. Treasurer, the Hon. Secretary, and the Hon. Reporting Secretary be requested to continue in their respective offices during the ensuing year." Mr. Swayne said he had much pleasure in moving this resolution, and not the less so because he felt the Society generally would entirely support it. Each of those gentlemen had done such good work for the Society that there could not be two opinions on this resolution. He was sure they would all agree that the reports of the Society had been exceedingly well edited, and the very excellent report the Council had just given them, showed that the Council had a very able member, and one capable of putting out a report in a manner that reflected great credit on the body of which he formed a part. The Society was also greatly indebted to the Treasurer for the amount of work which had fallen to his lot, as must be apparent from the report. That the general business of the Society, of which the Secretary had the management, was of an extremely onerous character, must be plain to all, and that it had been carried out in a way to give very great satisfaction to the members of the Society, must be equally clear. He thought, therefore, there could be but one opinion as to this resolution being carried by acclamation.

Major Austin seconded the resolution with great cordiality.

Mr. H. K. Jordan wished to make one or two short remarks. After expressing his agreement with what had fallen from the Mr. Swayne, he thanked all the officers for the time they devoted to the Society. No men valued time so much as scientific gentlemen, and when they saw those gentlemen coming forward and devoting a great deal of time to the Society, they must feel that they made considerable sacrifices, and that their best thanks were due to them.

The resolution was put to the meeting, and carried by acclamation.

The President said their next duty was to elect their future President, and perhaps he should have an opportunity presently of saying a few words, before he left the chair and yielded it up to whoever they should be pleased to elect.

The ballot was then taken for the election of President, and it was announced that Mr. W. Sanders had been unanimously re-elected.

The President, in acknowledging the compliment, begged them to believe that he felt very grateful for the honour they had conferred on him. It was an honour to which every one in the Society might fairly aspire, and be glad to attain; it was an honour very gratifying to him, and it involved duties which were very agreeable at the same time, viz., to attend the meetings regularly, to be the organ of returning thanks to the contributors, and to preserve order at the meetings. He would ask the younger members of the Society to observe this circumstance, and to perceive that one with no pretensions to high scientific attainments or great intellectual powers, was nevertheless recognised, because during a long career he had endeavoured to promote every scientific object going on in the city, and had encouraged every scientific Society that had been established. He had met with his reward, and he acknowledged it, and would remind any of the younger members of the Society, that though they had no higher attainments than the present President, yet that if they worked on diligently and constantly with a view to be useful, and to promote science, the time would come when they would certainly receive the same reward as he now received.

The ballot was next taken for two Vice-Presidents, which resulted in the re-election of the Rev. Canon Moseley and Mr. T. Pease; and Dr. Beddoe, Mr. S. H. Swayne, and Mr. C. O. Groom-Napier were elected to fill the vacancies in the Council caused by the retirement of three members, in accordance with Rule III. of the Society.

Mr. C. O. Groom-Napier then submitted the following resolution: "That the thanks of the Society are due to its officers, and the members of the Council, for their management of the Society's affairs." It appeared to him, he said, that his resolution had been partly included in the one moved by Mr. Swayne. But he thought the Society would feel with him that their thanks were doubly due to those who had so well discharged the affairs of the Society, and also to the Council for their attendance, attention, and management. He could only cordially express feelings similar to those of Mr. Jordan and Mr. Swayne, in regard to the great services which the officers and members of the Council had performed for the good of the Society (hear, hear).

Major Tubby seconded the motion, and it was most cordially accepted by the meeting.

The President said the officers of the Society had really done the hard work. Two of them were present, and ought certainly to be expected to acknowledge the vote. But perhaps they might prefer that he, as President of the Society, should return thanks on their behalf, and that would enable him to pass over any part of the compliment that belonged to him, entirely to them. He therefore thanked them on their behalf, and wished to say that thanks were really due to them.

Mr. A. Leipner, Hon. Sec., wished to say a word or two in reference to the vote of thanks that had been so kindly passed to the officers of the Society. He might say that it had been a source of very great encouragement to him, and no doubt to his fellow officers, that their endeavours to promote the interests of the Society had been so well and so kindly received. He could assure them he would not fail, so long as he continued to hold the office of Hon. Secretary, to forward the interests of the Society to the utmost of his power. He had one source of uneasiness, that he was heavily pressed for time, and that he could not devote so much time as he should like, and had done in years past, to the affairs of the Society. The members of the Council, however, and his brother officers, had tried to ease the burden falling on him individually, and on that ground the excursions would be managed, not as hitherto, by the Hon. Secretary, but by a deputation from the Council, for the time they took up was more than he could devote from his own private affairs. The excursions for this year had not been completely fixed, but in the Council the following had been spoken of—to Penarth, near Cardiff; Charfield, near Gloucester; and May Hill; neither had it been determined which would be first, or on what day. These matters must be settled by the gentlemen who would have to undertake the management of the excursions, and who had not yet been appointed. He hoped the excursions would be as pleasant as they were last year, and as numerously attended. His experience had been that the most distant excursions were usually the best attended.

Mr. W. W. Stoddart, Hon. Treasurer, also acknowledged the vote of thanks, and hoped the Society would sustain him in his efforts to make both ends meet, by agreeing to the proposition he had made.

Mr. S. H. Swayne said that although their thanks had been voted to the officers generally, he felt that one duty remained, and that was to thank the President personally. He was quite sure it would not be fair for them to separate without thanking the President, for the very perfect manner, he might say, in which the affairs of the Society had been presided over by him, and he was sure he only expressed the general feeling of the Society, when he said that he hoped it might be a very long time before they should have to choose another President.

Major Austin most cordially seconded the proposition, and it was carried by acclamation.

The President said he felt very grateful to them. The constant courtesy he had received was very gratifying, and had enabled him to conduct the business of the meetings with great pleasure to himself, and so long as that mutual kindly feeling continued, no doubt their meetings would always be agreeable to each other. Therefore he accepted the vote with thankfulness, and was very much obliged to the proposer and seconder, and to the meeting for adopting it so kindly.

MEETINGS OF SECTIONS.

BOTANICAL SECTION.

THURSDAY, APRIL 26.—The first walk of this season was taken to explore the neighbourhood of that portion of the river Froome between the two bridges at Stapleton. In consequence of the lateness of the season, however, but few plants of interest were found, those that were, being such as are commonly met with in similar localities, as the Anemone nemorosa, Hyacinthus non-scriptus, and an abundance of Allium ursinum. Some plants of Ranunculus ficaria, growing at the water's edge, were remarkable for the size and abundance of their showy flowers, and a few fine specimens of Myosotis arvensis were picked. In the spring near the second bridge was found a species of Fontinalis, also a quantity of Diatoms, chiefly species of Navicula and Pleurosigma.

GEOLOGICAL SECTION.

FRIDAY, APRIL 27.—Mr. W. SANDERS, F.R.S., F.G.S., President of the section, in the chair.

Mr. C. O. GROOM-NAPIER exhibited a skull of Rhinoceros tichorinus, found in Eastern Siberia, lat. 71°, 1000 versts east of Ural, in tertiary strata very rich in hæmatite, in 1861. When making some excavations for this ore, some bones of the Bear were first found, and some fathoms below the surface, in a loose friable sandstone, this skull was discovered. It was 2 feet 9 inches long, and 14 inches wide, having seven teeth in situ, and it was believed that this was the only adult specimen with so large a number of teeth. A photograph was shown of the most perfect specimen known, but young, and only 2 feet in length.

Mr. W. W. STODDART exhibited a very remarkable specimen of a fossil (coral?) which had also been noticed by Mr. Leipner, as occurring in the Black Rock Quarry. It most nearly resembled Amplexus, when cursorily examined, but really differed in its internal structure, so as to be totally distinct. Mr. Stoddart also exhibited two specimens which had been very kindly lent by Mr. Lonsdale, and which greatly helped towards a correct study of the anatomical characters. He said that if on further examination it should prove to be a true coral, it must be referred to an entirely new genus of Zoantharian zoophytes.

The discussion on the above communications having occupied nearly the whole of the evening, Mr. Sanders's paper on "Fossil Fishes," was again postponed.

ENTOMOLOGICAL SECTION.

The first excursion of the above Section took place on Monday, May 7, to Leigh Woods, the members meeting at 3.30 p.m., at the Suspension Bridge. The day was all that could be desired, and a number of species were observed and taken, especially of Coleoptera. The following were some of the principal species captured :—Scaphidium Quadrimaculatum, about a dozen specimens of this pretty and uncommon species were taken under fungus on dead birch trees; Byphillus lunatus, in fungus on dead ash; Pollydrosus micans, P. cervinus, and Orchestes ilicis, by sweeping and beating birch; besides a number of species of more common occurrence. Lepidoptera were not so abundant as the Coleoptera, and but few species were captured, the principal being—Geometra papilionaria, larva from birch; Tephrosia punctulata; and several species of Tineina and Tortricina.

It was determined that the weekly meetings for collecting should be as follows :—Saturday, May 12, to the Beech Wood, Stapleton, members to meet at Ashley-hill Station, at 6.30 p.m. Thursday, May 17, Boiling Wells, to meet at the Mill, at 6.30 p.m. Thursday, May 24, Bedminster Marshes, to meet at Bedminster Bridge, at 6.30 p.m.

The next monthly excursion of the section was arranged to take place on June 4th, to Brockley. Members to meet at the Bristol and Exeter Railway station to proceed by the 1.45 p.m. train.

ZOOLOGICAL SECTION.

Friday, May 11.—Mr. W. Sanders, F.R.S., in the chair.

The Secretary of the Section, Mr. S. H. Swayne, exhibited two specimens received by him in a letter from Windsor, Sydney, Australia, of "soldier and sailor" Ants, of large size, and possessing very powerful jaws. Mr. Swayne had not yet succeeded in obtaining their specific names. He also showed some of the flat under-shells of Placuna placenta, a species of oyster, which, after being thinned by splitting, were used in Manilla and China as substitutes for window glass.

Mr. Groom-Napier, F.G.S., F.A.S.L., then read a paper on the "Reptiles mentioned in the Bible." He referred to his former paper on "Birds of Palestine and those mentioned in Scripture," and said he had given much attention for some years to the natural objects mentioned in the sacred writings. The frogs that plagued the Egyptians he believed to be the Rana esculenta, or green frogs, so much eaten in France. He said four distinct Hebrew words were translated by the word Adder in the Old Testament, which he treated separately. Some were identified by the derivation of the Hebrew name, signifying some characteristic by which the reptile was recognised. One of the four was probably the Egyptian Cobra, another the Cockatrice, and a third the Cerastes Haselquisti, which the author considered to be also referred to as a "fiery serpent"—Numbers xxi. 6-8. This snake coiled itself up, hiding its head in the sand, and frequently bit the legs of travellers' horses. Mr. Napier then referred to several other reptiles—the leviathan, probably the crocodile,—the lizard, Lev. xi. 30, probably the Pterodactyle gecko, or "fan-foot," common in Egypt, but widely distributed. The Chameleon of the same passage he thought was the Monitor Niloticus, and the snail the true Chameleon Africanus, found in Syria and Egypt. The snail "which melteth," Psl. lviii. 8, he thought referred to a slug which gradually consumed its substance as it crawled, and left its slime behind. He said that he was glad to have the opportunity of calling attention to the fine collection of reptiles in the museum of the Institution, which so well illustrated his paper; and said he hoped that they would be often made available for similar purposes.

CHEMICAL AND PHOTOGRAPHIC SECTION.

WEDNESDAY, MAY 16 (postponed from May 9th).—The section adjourned to the meeting of the Microscopical Society, in order to hear an address from Mr. H. C. Sorby, F.R.S., on his researches with the Micro-spectroscope. Mr. C. T. Hudson, M.A., LL.D., President of the Microscopical Society, occupied the chair. Mr. Sorby characterised the investigations of the absorption bands produced in the spectrum by various coloured solutions, as a more refined mode of recognising substances by their color, and described at some length the construction of the 'direct-vision' spectroscope now applied to the microscope, the arrangements for comparing two spectra together simultaneously by an ingenious arrangement of reflecting prisms, and his mode of examining the spectra of coloured solutions, crystals, and other substances. He dwelt upon the spectra of blood, fresh, old, and when submitted to the action of various chemical reagents, pointing out that no other red colouring matter with which he was acquainted—and he had examined all he could think of—behaved in this way, so that the test was very reliable, as well as delicate, $\frac{1}{100}$th grain being detected with perfect ease, and even $\frac{1}{1000}$th grain with care. The testing of cloth and various fabrics for blood stains was comparatively easy, but in examining stains on leather, the tannic acid interfered to some extent. Mr. Sorby then mentioned several curious facts that he had made out in the course of his investigations. The same substance frequently gave a different spectrum when in the solid state and in solution, and even then the position of the bands often varied with the solvent. Different salts of the same metal sometimes gave different spectra, as in the case of nitrate and acetate of uranium. Alum in solution had a remarkable effect in intensifying the colouring power and action on the spectrum, of many substances. The act of solution upon a double salt produced an effect from which it was inferred, on optical grounds only, that the salt was decomposed. Mr. Sorby exhibited a small micro-spectroscope, which displayed several spectra very beautifully, and which was very easy of manipulation; and Dr. W. B. Herapath showed Mr. Browning's eye-piece direct-vision spectroscope, adapted to his large instrument.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

JUNE, 1866.

GENERAL EXCURSION.

TUESDAY, JUNE 12TH.—The first excursion for this season took place this day, to the neighbourhood of Charfield. Owing to the early part of the day being very wet, several were prevented from attending who had taken tickets, and the number of the party was smaller than usual, but those who had sufficient faith in the weather to set forth, were rewarded by a tolerably fine day, no rain falling until the excursion was over.

The members and their friends left Bristol by the 11.10 a.m., Midland train, and on their arrival at Charfield station, the principal geological features of the surrounding country, as well as the proposed route, were explained by the President, Mr. W. Sanders, F.R.S., F.G.S., with the aid of his very accurate geological map of the district. A good example of greenstone trap, coming up through the Silurian beds, in a field close to the railway, beyond the station, was first visited, and Mr. Sanders drew the attention of members to the vescicular structure of the igneous trap rock, easily breaking in any direction, and therefore unfit for almost any practical purpose, except road-mending, as contrasted with the regular structure of a rock deposited by water, the "joints" of which were taken advantage of by quarrymen in obtaining stones for building and paving. In crossing the fields, the botanists obtained some very fine specimens of Conia maculatum, and later in the day the Digitalis was observed in flower, very early for the season. Avering Green was next visited, where commences a remarkable ridge of trap-rock, which is about three quarters of a mile long; pursuing this for a short distance, the party followed a footpath and lane to Damory Bridge, where a quarry of very siliceous igneous rock was examined, which on a former occasion had yielded specimens of the rare mineral prehnite. On the hill above this, an ancient encampment was visited, whence a fine view of the surrounding country was enjoyed. The rock at the sides of the lanes in this neighbourhood was carefully searched by the geologists of the party, under the guidance of Mr. W. W. Stoddart, F.G.S., who reported that among other fossils characteristic of the Upper Llandovery beds, the following were found, more or less abundantly: Holopella obsoleta, Atrypa hemispherica, stems of Glyptocrinus, Cornulites serpularius, Tentaculites Anglicus, Rhaphistoma lenticulare, Encrinurus, Phacops Stokesii, with many other Trilobites, and the usual Rhynchonella nucula, associated with the common Upper Llandovery Brachiopods, altogether making a very rich collection of fossils, considering the shortness of the time devoted to obtaining them. During the search for fossils, many of the party walked to Old Tortworth Court, and examined the remarkable chestnut-tree in the orchard attached to it. This tree is mentioned in many Botanical works as an example of the age of trees, a document in the reign of Stephen containing a reference to it as even then (12th century) an old tree. The interior of the trunk is much decayed, and the lower branches rest more or less upon the ground. The geologists having rejoined the party, Mr. Sanders pointed out the conglomerate in the Old Red Sandstone of the neighbouring hill, and the whole party proceeded to the grounds of new Tortworth Court, where, by the kind permission of Earl Ducie, most readily granted in answer to the request of the President, they inspected the hothouses and conservatories belonging to the mansion, under the able and obliging guidance of the head-gardener, Mr. Cramb, to whom the members were much indebted for the information so readily and courteously afforded them. In walking through the grounds, he pointed out a spot near the house, where the lowest beds of the mountain limestone were seen, most of the strata in the immediate neighbourhood being Devonian.

After spending a short time very pleasantly in the grounds of the Court, the members walked back to Charfield by the high road, and having, as usual, dined together, on this occasion very comfortably at the inn close to the station, they returned to Bristol by the 6.30 p.m. train.

MEETINGS OF SECTIONS.

GEOLOGICAL SECTION.

Friday, May 18.—First walk of the Season, to Aust Cliff.

The members left Bristol by train at 2.40 p.m., and after a pleasant walk from the New Passage, commenced the examination of the beds at the S.W. end of the Cliff, and as a large mass of the rocks had lately fallen at that place, a good series of fossils, characteristic of the Rhœtic or Avicula contorta zone, were obtained in an exceedingly perfect state.

Among those collected were Pecten Valoniensis, Avicula Contorta, several species of Axinus and Anatina, Cardium Rhœticum, &c., the Pectens and Cardiums being especially good. It was remarked that the Natica Oppelii, which is so common in the rest of the district, was comparatively rare in the Aust beds.

The Cotham marble, lying just above the Avicula limestone, was the next object of examination, and from it were collected scales and teeth of fishes (Dapedius and Pholidophorus.) With these occurred an abundance of the elegant Entomostracon, Estheria minuta, so long regarded as a bivalved mollusc. As very little of the well known "bone-bed" had fallen, only a few of the fish-remains fell to the lot of the collectors, but one good tooth of the curious Ceratodus gibbus, and a few portions of spines of Hybodus were taken, the source of supply being entirely dependent on falls from the upper part of the Cliff.

Before leaving, Mr. Stoddart directed the attention of the members to the instructive examples of "Faults" which occur in the Cliff. The nearly horizontal beds of limestone are so well marked by difference of colour, that the fracture and subsidence of the beds are plainly apparent. From each of these Faults flows a small quantity of water, which percolating through the strata, finds a vent and trickles down the face of the rocks. Here those interested in microscopy, made a rich harvest of a singular stalked diatom Cocconema Cymbiforme, which here grows in great profusion.

The members walked back to the New Passage Hotel, and after a capital tea, returned to Bristol by an early train, having thoroughly enjoyed a very pleasant and instructive ramble.

ENTOMOLOGICAL SECTION.

Monday, June 4.—The second excursion of the Section took place to Goblin Coombe, near Brockley.

The members proceeded by 1.45 p.m. train to Yatton, walking from thence to the Coombe, and as the attendance was good, and the day every thing that could be desired, a large number of species were observed and captured. Among the species of Lepidoptera taken, were

Vanessa C-Album. The specimen of this insect taken had evidently hybernated from last autumn.

L. Argiolus, common round holly.

Thecla Rubi.

B. Neustra, larva abundant on white thorn.

L. Quercifolia, larva.

E. Lariciata, imago on boles of larch.

E. Indigata, on boles of larch.

M. Liturata, F. Piniaria, and T. Variata, being very abundant among fir trees.

Among the species of Coleoptera taken, may be enumerated

Leptura Melanura.

Cryptocephalus lineola.

Cocinella ocellata.

" oblong-punctata.

Cistela castanea.

Phyllobius calcarotus,

besides a large number of more abundant species. The captures were not altogether confined to Entomology, as Listera Nidus-avis was found growing at the foot of an oak tree, and two specimens of the viper were seen, one of which was disabled by a blow from a stick, and duly boxed to accompany the members back to Bristol.

CHEMICAL AND PHOTOGRAPHIC SECTION.

Wednesday, June 13.—Mr. P. J. Worsley, F.C.S., President, in the chair.

Mr. William James exhibited some negatives which had been intensified by a solution of persulphate of uranium, mixed with ferricyanide of potassium. They were of a crimson colour, and the increased intensity, which was well shown in the prints taken from them, was apparently due to an alteration merely in the condition of the deposit, and not to an addition to it, as was the case when most of the intensifiers in ordinary use were employed. On this account, this new preparation was considered preferable.

Dr. W. B. Herapath gave an account of an examination of various precious stones with the micro-spectroscope, undertaken with the view of finding out whether by this means, imitation gems could be distinguished from real. Sapphires of a deep blue could be distinguished from the cobalt blue glass, but with pale blue stones there was no perceptible difference in the bands. It was very easy to decide between a garnet and red glass, the latter cutting off nearly all the spectrum beyond the orange, while the real gem produced three decided bands, two in the green, one in the yellow. Most yellow and orange stones gave no bands, nor did the emerald, nor the amethyst. The imitation of the spinel ruby was very successful, producing an absorption band in the green, as did also the gem itself, which was of a pale pink color.

The gentleman who was to have read a paper on Pouncey's Carbon-printing process, having failed to keep his engagement, the Section shortly afterwards adjourned until the second Wednesday in September.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

JULY & AUGUST, 1866.

GENERAL EXCURSION.

FRIDAY, AUGUST 24TH.—The excursion arranged for July 10th, not having been carried out, in consequence of an insufficient number of tickets having been taken, the same took place on this day, and was fairly attended by members and their friends, as well as by several ladies. As the weather was exceedingly fine, and the arrangements well carried out, a very enjoyable day was the result.

The party, including the President, Mr. W. SANDERS, F.R.S., F.G.S., and one of the Vice-Presidents, Rev. Canon MOSELEY, F.R.S., left Bristol at 11.10 a.m., by rail to Charfield, whence they were conveyed in vehicles to Wotton-under-Edge. At Charfield the Lower Silurian beds were passed over, then for about half-a-mile, the New Red Sandstone, and afterwards the Lower Lias. On ascending the hill, the marlstone was observed, which continued to Wotton, and part of the way up the hill behind the town; but soon after passing the turnpike the lower beds of the Upper Lias Sands were seen, and a quarry was investigated, which displayed very clearly the junction of the uppermost beds of the Lias with the Inferior Oolite. The President remarked that the steep hill opposite the railway station at Bath was composed of the same series of beds, and pointed out Ammonites serpentinus as the characteristic fossil. Here were obtained also, specimens of Greslya, Ceromya, Trigonia costata (a recent species of which genus, as of some other Oolitic fossils, has lately been found in Australia), Myacites, Panopæa, Terebratula perovalis, Pholadomya fidicula, and several Belemnites. The so-called Iron-shot bed attracted much attention, and was considered to be a mixture of silicate of iron and hydrated oxide of iron. Referring to the Ammonites, and some other spiral shells, Canon MOSELEY explained that their growth in these shapes took place in accordance with known mathematical laws, some of which he had investigated.

The next quarry visited displayed entirely the Inferior Oolite, of which the whole range of hills to Nibley was composed. The PRESIDENT remarked that these strata had been deposited in very deep water, as was inferred from their great regularity, and from the paucity of animal remains, these being found most abundantly in beds deposited near the sea shore. At different spots along the hill, however, several beautiful specimens of Rhynchonella spinosa were obtained, also Lima pectiniformis, several species of Terebratula, including T. maxillata, and some beautifully preserved small pectens (two species). Growing abundantly in the neighbourhood of the Inferior Oolite quarry, the botanists of the party found, amongst other plants, Echium vulgare, Reseda luteola, Gentiana Amarella, Campanula glomerata, and Chlora perfoliata.

The party then strolled quietly through the woods on the brow of the hill, stopping frequently to admire the glorious and everchanging views over the landscape, and arrived at the monument now in course of erection on Nibley-hill, to the memory of Tyndall, so celebrated in connection with the Holy Bible, who formerly lived in the neighbourhood. This was carefully inspected, and several of the party mounted to near the top, in order to enjoy the more distant view gained by the increased elevation. It was seen that the rough inside work was built of the stone from the hill, but that the steps of the tower were of Nailsworth stone, also Inferior Oolite, but harder, while the whole of the outside was faced with Bath freestone. Through the kindness of the clerk of the works, the designs for the completion of the monument were inspected.

In the Wood, the following species of plants were gathered: Ononis campestris, Eupatorium cannabinum, Campanula latifolia, and Hypericum androsaemum. A quarry in the hill just above Nibley, yielded some beautiful small pectens, and on decending the hill, the fossils of the Upper Lias Sands were again seen, including, in addition to the list previously given, Modiola Sowerbyi.

At the foot of the hill, conveyances were in readiness to carry the party back to Charfield, where they did justice to the dinner that awaited them, after which the PRESIDENT rose, and, first observing that it was against the rules of the Society to propose any toast after dinner, expressed the pleasure he felt in seeing so large a proportion of ladies present, and then congratulated the members on the advantage of the presence with them that day of one of their Vice-Presidents, Canon Moseley, suggesting that he would perhaps address a few words to them.

Canon MOSELEY, being thus called upon, rose and thanked the President for the allusions made to him. He expressed his firm belief in the advantages of a scientific education, a belief which was increased by meetings such as the present. Science had for its object the pursuit of Truth, and Truth, he said, was a thing of God, who would take care of it; it was impossible that an increase in scientific knowledge should diminish devotion to the Creator. The speaker then adverted to the division of the Sciences into the exact, the experimental, and the observational, remarking that he considered the sciences of observation most worthy of general cultivation—though he was personally devoted to the exact sciences—because they could be pursued, as had been done that day, in the open air—where all the senses were delighted at once, and God was more visibly present. The Canon concluded by congratulating the Society on the adoption of this department of science, and expressing his earnest hopes for its successful continuance.

Shortly after rising from table, the members adjourned to the Railway station, and took the evening train to Bristol, after one of the most pleasant and least fatiguing excursions ever undertaken by the Society.

MEETINGS OF SECTIONS.

BOTANICAL SECTION

WEDNESDAY, JUNE 27.—The members of this Section met at the Bath Bridge, for the purpose of investigating the east end of St. Ann's Wood, Brislington, one of last year's walks having been taken through the lower portion. Upon entering the valley, the eye was struck with the fertility of the vegetation, and the picturesque beauty of the scene. Scattered among the banks were the faintly smelling flowers of Valeriana officinalis, amid gigantic specimens of Heracleum sphondylium, while here and there were seen the half-opened blossoms of Spiræa Ulmaria. The tall, handsome spikes of Digitalis purpurea, formed bright spots in the landscape, relieved occasionally by the golden flowers of Tragopogon pratensis. Less observable were the plants of Symphytum officinale near the stream, and in other situations Bunium flexuosum and Epilobium montanum, the steep banks being carpeted with the delicate Oxalis acetosella and Fragaria Vesca, the latter in flower and fruit, interspersed with Lysimachia nemorum. Further up the valley were found Vicia sativa and V. sepium, and near the railway Onobrychis sativa, Knautia arvensis and Silene inflata, also a plant of Solanum dulcamara. A heavy thunder-storm coming on in the afternoon, put a stop to the investigations at an early hour.

GEOLOGICAL SECTION.

Friday, June 29.—The members of this Section made their second walk of the Season, and examined the lower lias quarries of Bedminster Down, chiefly for the purpose of correlating their beds and fossils, the position of the Cotham Marble or landscape stone being taken in each case as a starting point.

The Quarries on the Wells road were the first visited, and then successively those in the direction of Bristol as far as the junction of the Lias with the new red marls, which is well seen by the road side.

Among the fossils collected were two species of Cypridæ, probably of the genus Candona, which were found in such numbers as to completely cover the surface of a bed of White lias. With these were associated specimens of Estheria minuta, another genus of bivalve Entomostraca, and which in one of the quarries near the reservoir was found in good preservation, with the valves united, and showing the characteristic markings.

In the bank at the edge of the road leading to Bedminster Down, Mr. Stoddart pointed out a very remarkable argillaceous limestone, containing abundance of a fresh water plant (Naiadites petiolata) in such a good state of preservation that the monocotyledonous venation of the leaves was easily discernable with a lens. In the same bed was also noticed the Estheria before mentioned, and a few elytra of beetles.

A short distance above this, Mr. Pass discovered some very perfect teeth of the Saurichthys Apicalis, a fish characteristic of the lowest Lias beds. With them were scales of Dapedius and Pholidophorus. Their appearance here was worthy of note, because their position was rather higher in the Liassic series, than in the corresponding beds of Aust and Garden Cliff. The similarity of the Bedminster beds to those at Garden Cliff, is still greater from the occurrence of the well known Monotis decussata, and Myacites musculoides.

In a Quarry near the Limekiln, the dark coloured schists were seen to be covered with spines and broken tests of an Echinus (a species of Hemipedina). The members also brought away several examples of Lima, especially L. punctata, Astarte, some casts of a gasteropod resembling Phasianella and many others.

The Section thus spent two or three hours in a highly instructive study of the Bedminster strata, which was rendered most interesting and useful by the explanation of the President, Mr. Wm. Sanders.

BOTANICAL SECTION.

Botanical Walk, Tuesday, Sept. 4th.—No report received up to the time of going to press.

CHEMICAL AND PHOTOGRAPHIC SECTION.

Wednesday, September 12th.—Mr. P. J. Worsley, F.C.S., President, in the chair.

Mr. J. Beattie gave a verbal description of Pouncey's Carbon-Printing process. He stated that Pouncey had worked very laboriously to find a process of printing permanent sun-pictures, with all the qualities of prints taken by silver salts. His first plan was with chromate of potash and gelatine, which by exposure to light was hardened and rendered insoluble in water. The results of this process were very crude. He next tried Swan's process, with gelatine and Bichromate of Ammonia; and finally he devised a plan of printing in lithographic ink. He proceeded as follows:—Take a sheet of bag paper, make transparent with nut oil, and coat with a thin film of gelatine. Then take any oily pigment, as lithographic ink, and grind up with bitumen and benzole, and brush over the paper with it. Dry in the dark. Expose it to the negative from the back. Then dissolve out with turpentine, of which several baths are used. The picture is then dried and coated with a transparent varnish, which is allowed to dry till it becomes 'tacky.' It is then laid on card, or paper, or other material (to which it is desired to transfer it) and pressed. The thin paper is then stripped off, and the perfect picture left. Mr. Beattie exhibited some fine specimens on paper, wood, and canvas, and they quite bore out the high eulogium he pronounced on the process. If suitable colouring materials are used, the pictures can be transferred to porcelain, and burnt into the glaze.

Mr. Worsley exhibited some specimens of Swan's process, which had been furnished by that gentleman.

Mr. Beattie considered that the fine surface obtained by Mr. Swan rendered his process most suitable for portraits, while Pouncey's was by far the best for landscapes.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

OCTOBER, 1866.

GENERAL MEETING.

Thursday, October 4th—First general Meeting of the session. Mr. W. Sanders, F.R.S., F.G.S., President, in the chair.

The Hon. Secretary read the minutes of the two excursion meetings, and stated that, had the weather permitted, it had been intended to arrange a third excursion, during September. He also laid on the table the following publications obtained in exchange for this Society's Proceedings:—

Memoirs of the Literary and Philosophical Society of Manchester, Third series, vol. I., 1862; vol. II., 1865.

Proceedings of ditto ditto, vol. III., Sessions 1862-63, 1863-64; vol IV., Session 1864-65.

The Hon. Treasurer called attention to the fact that the present rate of subscription did not cover the increased cost of printing the Proceedings, and moved "That an additional 2s. 6d. be subscribed for the present year, the financial year to commence in future with the sessional year, in May, instead of December."

The Editor of the Proceedings gave some particulars as to their cost, &c., and stated that the Council had failed in their efforts to procure advertisements, by which they had hoped to cover the increased expenditure.

Mr. Jacques seconded Mr. Stoddart's motion, which was carried unanimously.

The Hon. Secretary gave notice that at the next meeting he should move that Rule IX. be altered to read as follows:—

"That all Ordinary Members subscribe seven shillings and sixpence per annum towards defraying the expenses of the Society, the subscription to commence at their entrance, and to be renewed at the Annual Meeting in May."

The President then rose, and after expressing the pleasure he felt at again meeting the Society, read the following address.

"The object of the members of this Society is to become acquainted, to the greatest extent of which they are capable, with all the phenomena presented by the varieties of inorganic matter, and by the various forms of organized beings. Our society is properly named a Naturalists' Society. We study Nature in all its aspects. Our work is practical not speculative. We seek to promote the progress of *Positive Science* in preference to studying the vague questions of pure Philosophy, or the abstractions of Metaphysical Philosophy. Our methods are mainly Inductive. The speculations of the ancients were Deductive. With the Greeks theories were devised, and deductions attempted, but without results. It is said that the ancient Astronomer Democritus asserted that the Milky Way was a cluster of stars, but it remained for Galileo to demonstrate this fact. So Pythagoras and Plato are said to have enunciated a proposition respecting the attraction of bodies, resembling the grand discovery of Newton. But their idea must be pronounced only a fortunate conjecture, and on this account no deductions were made in explanation of the constitution of the universe. Newton, by studying and ascertaining the laws of the phenomena of attraction, discovered their relation with the squares of the distances. His generalization was gained by the Inductive process, the Baconian method. In this instance, the difference is manifest between the Speculative Philosophy of the ancient schools and the Positive Science of the moderns. The first was barren of results, while the latter, elaborated by inductive methods, has yielded truths of immense importance to the action of deductive processes. Our society will then avoid speculating on the essences, origin, and causes of things, and adhere to the study of the *phenomena* which they present. We must admit that the dreams of Philosophy have led on to the realities of science. Astrologers and alchymists were collecting facts for the future astronomer and chemist. The philosopher, who observed the fact of hydraulics, that on raising the piston-rod of a pump barrel, the water likewise ascended, was satisfied with the idea that "Nature abhors a vacuum." From this axiom no useful conclusions could be deduced. Yet the diligent and persevering study of analogous facts tended towards the discovery of the true cause. And although the labours of the ancient philosophers were not wholly unproductive, yet the purely inductive path of Positive Science should be our course. Hence we should avoid the pursuits of the Metaphysician. We should touch very lightly on speculations about Vital Principle—Origin of Life—Nature of Force—and such like mysteries, and I think that attempts to discover the origin of species will not be popular among the students of pure science. Still less shall we be inclined to deviate from our own domain into that which belongs to the Theologian and the teacher of Religion. We will labour in the pursuit of *science*; and not doubting that truths of every kind are consistent, although we may not be able in some instances to reconcile them, we will carry on that pursuit wherever our search may lead us, free from the unreasonable fear, that a correct train of reasoning will ever terminate in fatal error. Natural science is based on pure reason. Religious knowledge, while consistent with reason, has its foundation on a Religious Instinct. The truths of each may appear incompatible and we may be unable to reconcile them. I believe that, in this life, we never shall comprehend this mystery; and I agree with the justness of the remark 'To *know* more, we must *be* more.'"

Fort-Major Austin, F.G.S., then read the following paper on "Rock-Basins, Logan Rocks, and Tolmên," illustrated with some drawings of the localities referred to.

Some years since, in a ramble through Cornwall, I had an opportunity of examining the different geological features of that interesting county, and accordingly rock-basins, logan rocks (rocking stones), and tolmên, attracted my attention. The so-called rock-basins are merely irregular depressions in the granite blocks, caused beyond doubt by the unequal weathering of the stone. While passing many days amidst the rocky masses which abound in Cornwall, I had ample confirmation of the opinion I had formed as to the origin of rock-basins, which certain fanciful antiquarians had ascribed to the Druids, who, it was averred, had scooped out these cavities in the granite blocks for some purposes connected with their religious rites. It was supposed that the rains and dews of heaven deposited therein that pure and untainted element which was required for the due performance of their superstitious ceremonies. Unfortunately for this learned hypothesis, it can be shewn that these said Druidical fonts are nothing more than natural cavities formed by the gradual decomposition of the felspar in the granite. It will be found that in the granite, crystals of felspar frequently occur in groups and patches, as well as disseminated generally through the mass. The felspar being more readily acted on by the atmosphere than the quartz and mica, which are also component parts of the rock, it follows as a necessary consequence that where these clusters of crystals of felspar occur, disintegration goes on with greater rapidity than where the more enduring materials prevail. Hence it is that in those parts where these felspathic groups occur in the centre of a rocky mass, a cavity or rude basin is formed by their crumbling away. In fact, in some instances I have removed handsful of the loose felspar from rock-basins in course of formation. When the felspar superabounds at the side of a rocky mass, its decomposition merely forms an inequality or indent more or less deep, which never attracts attention. When the felspar is more abundant on the under surface of a projecting mass which is exposed to the weather, a rock-basin is formed by the same process, but no water can lodge in the cavity, and unless the Druids possessed the miraculous power of making basins and pitchers hold water with their mouths downwards, such inverted basins would have been of no use to them in collecting the dew and rain for the ablutions and purifications prescribed by their religion. It has also been conjectured that rock-basins were not only made for preserving lustral water, but for containing the blood of victims used as sacrifices. These are pure speculations, unsupported by a single fact. That the Druids used them for purposes of superstition is highly probable, but even this is mere conjecture.

Then as for the two kinds of rock-basins, one with channels of communication between the several cavities on the same stone, and the other with a single cavity only, the explanation already offered equally applies to them all, and there can be little doubt that the *Arch-Druid Time,* aided by the atmosphere, is the grand excavator of all rock-basins past, present, and to come. The fact that these cavities are frequently found near rocking stones in no way strengthens the supposition that the Druids formed them to contain their libations, because the same natural cause which produced one, gave rise to the other.

The sketch of the celebrated rock-basin at Carnbre, Cornwall, and known as the Carnbre Quoit, as well as the smaller one I saw at Treryn, will convey no idea of either being a work of art. Even men with stone implements could have made better shaped basins than these rudely formed depressions. The Carnbre Quoit has been figured in some antiquarian publications.

Besides the Cornish rock-basins, others occur amongst the Bradley rocks in Derbyshire, at Dartmoor, Devonshire, and some other localities. These rude basins may occur in other rocks than granite, but they were probably produced in a similar manner—by the unequal weathering of the stone, or by the surging waters on the sea shore, or the eddying currents of a river.

The author then minutely described a visit to the Rocking stone of St. Levan, 70 tons in weight, which could be set in motion by one man, and which had once been displaced and set up again by Lieut. Goldsmith many years previously.

Rocking stones in Cornwall are called logan rocks, from "log," a provincial term, "to rock, or vibrate." Logan rocks, like rock-basins, are produced by natural causes incessantly in operation—by the gradual decomposition of the two surfaces of compound masses in juxtaposition with each other, which are composed of ingredients of unequal durability, and which are separated by natural joints into blocks of various dimensions. When the harder part of a mass, that is the quartz, happens to be in the centre, the surrounding surface crumbles away, leaving the incumbent block poised on a point or base sufficiently small to allow of its vibrating on a slight force being applied. When the quartz or harder material predominates at the sides, although the same amount of waste or crumbling of the softer parts may take place, and the decomposed portions be washed away by the rains, yet no rocking stone results therefrom, because the base on which it rests is too broad to allow of any lateral movement.

It can easily be imagined that in a district such as the Land's End, and western Cornwall generally, where the upraised granite has been exposed to the influence of the weather for many centuries, both logan rocks and rock-basins are frequently to be met with.

Rocking stones, like rock-basins, have been considered as the work of the Druids, but this opinion is evidently without foundation. The Druids may have used them to inspire their superstitious followers with an idea of their power and sanctity, in order to make the ignorant multitude believe them to be endowed with the attributes of a God. Whether the Druids used rocking stones for divination, or whether they were idols to be worshipped, or were made the fraudulent means by which the ignorant vulgar could be imposed upon, or whether the Druids ever used them at all, are mere matters of conjecture, for no records exist which can illustrate the subject with any degree of certainty.

Rocking stones occur in other parts of England as well as in Cornwall. Among the Brimham rocks in Yorkshire are several, the most remarkable of which rests upon a rude kind of pedestal. On a mountain between Knaresborough and Skipton, in the same county, another is recorded; as also are others near Warton Crag, in Lancashire, the Bradley Rocks, on Stanton Moor: Derbyshire is another locality which claims to possess one of these remarkable objects; at Drewsteignton, Devonshire, a remarkable one is said to be worthy of examination.

Among the natural productions of Cornwall, the tolmên demand notice; they, like the rocking stones, and rock-basins, though perhaps at an early period objects of veneration, or impious fraud, have been produced by natural causes, not by art. One of the most remarkable tolmên known is that of Constantine. This huge detached rock is seen from the eastern part of Mount's Bay, perched as it were on a distant hill top, midway between Helston and Falmouth. The estimated weight of this mass of granite is 700 tons, and unless the rock and the base on which it stands be purchased, it bids fair to become part of our national buildings at Chatham or Plymouth, as the granite quarries had, when I made a drawing of it, reached within a few feet of the natural pedestal on which it stands. An appeal had been made to the three Royal Societies of Cornwall, namely, Falmouth, Penzance, and Truro, in behalf of this rude memorial of nature, but with what success I cannot say.

Strictly speaking, the tolmên of Constantine is not a "holed stone," for the hole or open space is between its two points of support. The aperture thus formed is visible at the distance of several miles. The name tolmên is derived from *tol*, "hole," and *men*, "stone"—holed stone. It has been considered that the ancients attributed great and miraculous virtues to such stones when ritually consecrated, and imagined that whatever touched, lay down upon, passed through or under such stones, acquired thereby a kind of holiness, and became more acceptable to the gods. All this appears to be conjecture, but it bears some countenance from the fact that in Bombay the Gentoos call these tolmên "rocks of purification," a passage through which is considered as purifying the penitent from all sin. *Pak Patan*, the name of an Indian town, also signifies "the passage of purity."

Mr. Grose considered the tolmên to have been intended and used for introducing proselytes or novices, persons under vows, or about to sacrifice, into the deepest mysteries of the Druidical religion.

As to the origin of tolmên, or holed stones, they are in all probability produced through natural agency, and I can see no good reason for supposing them to be the work of men's hands. Without going into the question of the original formation of granite, whether it be wholly an igneous rock, or whether water, as well as fire, performed an important part in its production, it may, I think, be admitted in either case, that when the materials of which it is composed were in a state of paste, entangled gases would cause cavities to be formed in the mass, and that when this mass was upraised and exposed to the action of the atmosphere, by the wearing away of the external coating, the apertures would become revealed to us and attract our notice, just as other phenomena of nature arrest our attention and invite our examination.

It is quite possible that tolmên may not be wholly confined to granitic districts, as cavities and inequalities are common to all stony masses, and therefore these holed stones may probably be met with far away from a granite country.

The President confirmed the views put forward by Major Austin in this paper, observing that many years ago he had himself personally investigated these remarkable rocks. He spoke of 'jointing' as a feature of many igneous rocks, and thought that the Torrs of Devonshire were the result of atmospheric action, remarking also upon the Druidical names, Stanton Drew, Drewsteignton, &c., meaning 'Stone-town of the Druids.'

Mr. Grundy called attention to the Buckstone stone in Monmouthshire, a large mass of conglomerate, 3 feet square at the base, which could easily be made to vibrate.

Mr. Pease, F.G.S., one of the Vice-Presidents, remarked how much opposed Major Austin's views were to those of the Danish archæologists, who attributed all these rocks to the Scandinavian mythology. He also advised that an excursion to the Brimham rocks near Harrogate should include a visit to the Plumpton Rocks.

Mr. Edmund T. Higgins, who had kindly come from London on purpose, then delivered an address upon Otoliths.

Remarking that his subject was essentially dry, except to a comparative anatomist, he referred to his thirteen years work upon the subject, and stated that his chief object that evening was to explain certain modifications in his views upon it, which had been brought about by a recent visit to the West Indies, because he considered himself indirectly responsible for views which had been previously advanced in that room. He was now enabled to state that these ear-stones had not only a distinctive *specific* character, but, contrary to former opinions, special *generic* characters also, and further, he believed that their microscopic structure would be found to be characteristic of groups. This was very important geologically, enabling species to be identified, and while many of the otoliths found in comparatively recent strata were identical with those of recent fish, a large anumber of those that occurred much lower down in the series, were identical with those of fish now existing in the tropical seas.

Mr. Higgins then sketched the auditory apparatus of Reptiles, Birds, and Mammals, and minutely described that of Fish. In this class, from the difference of the medium inhabited, a very different arrangement was necessary. Except in the first family of Percidæ, and in some of the Sharks and Rays, there was no vestige of any external ear or opening, the organs of hearing being hermetically sealed in the interior of the skull. They consisted essentially of three semi-circular canals, posterior, anterior, and external, and one vestibular sac, (seldom two, as frequently represented) communicating with each other in many and various modes. At several of the points of junction, enlargements (ampullæ) existed, containing the two smaller otoliths, while the large characteristic one was always found in the vestibular sac. The smaller otoliths had the power of motion through the canals, and were only absent in the lowest order; and while the canals themselves in the bony fishes were covered with cartilage, those of the cartilaginous fishes passed through the very substance of the skull itself. Professor Muller had pointed out that three substances were concerned in transmitting sound to the auditory nerve of the fish, viz., water—the solid parts of the body—and the fluid of the labyrinth; but the speaker considered that a fourth, the air-bladder, ought to be added. In the families of Cyprinidæ and Siluridæ especially, the otoliths formed a chain below the vestibular sac, where was a connection with a chain of bones behind the skull, and thence again with the air-bladder. The last named bones were probably the true representatives of the ear-bones of Mammals, as it was satisfactorily proved that these otoliths were neither the analogues nor the homologues of the 'Ossicula auditus' in Mammals, as they did not occupy the same position in the skull, the true ear-bones never being found, as these always were, in the vestibular sac or its connected canals. The speaker regarded these otoliths as an excessive developement of the 'otocone' of mammalian ears.

Mr. Higgins then described the otoliths more minutely. They were composed of carbonate of lime and phosphate of lime with a little animal matter, and it was almost invariable to find three on each side. Out of 3700 fish examined, only about 9 had their organs of hearing deficient. In the case of 3, they only existed on one side, in a fourth they were cartilaginous instead of bony, &c. The otoliths of fish with cartilaginous skeletons were not solid, but aggregations of minute rhombic crystals of carbonate of lime. And in the sturgeon, which occupied a place between the bony and cartilaginous fishes, the otoliths were of an intermediate character also. The largest of the three otoliths was the only one valuable in a scientific point of view, and this varied in shape in every possible way. The groove on the under surface was no longer, the speaker considered, of any value as a specific character.

Mr. Higgins concluded his address by referring to the extensive collection which he had brought down, containing a portion of the result of 17 years work at the subject, including the otoliths of nearly 600 species, and by recommending these little bodies to the attention of the comparative anatomist, as being the only portion of the skeleton which possessed a specific distinctive character.

The President, in inviting discussion, remarked that the results of Mr. Higgins were a striking instance of the method of inductive science to which he had alluded in the earlier part of the evening.

Mr. W. W. Stoddart said that no one would thank Mr. Higgins for his address, and for the exhibition of his specimens, with greater sincerity than he did himself. He considered Mr. Grove's recent text of 'continuity' (at his Nottingham address) as the cause of the difference of opinion between them, and of the views formerly expressed, but now modified. While allowing that fish did not hear as air-breathing animals did, he still considered that the office of these otoliths, was, from their density, to increase the vibration caused by the sound.

Mr. Higgins controverted this, and pointed out that all animals which really and truly heard, gained experience by hearing, but that this was not the case with fish, and he regarded this as the strongest proof that fish did not *hear*, but believed that they *felt* through their whole body the vibrations caused by the sound.

Dr. Henry Fripp considered Mr. Higgins' generalisations very valuable—especially with regard to genera. It was of the greatest importance, physiologically, to obtain characteristics of any genus, species, or class, connected with a sense so highly important as that of hearing; these otoliths might be of the greatest importance, even more so than the 'ossicula auditus' in this respect. Considering that the office of the semi-circular canals was to indicate the direction of sounds, he thought that the otoliths might materially assist this function. On the greater or less perfection of the sense, both for obtaining prey, and for indicating the approach of danger, the life of the fish depended. The noises made by the fish in water were received by them as vibrations, and in a paper read at a previous meeting he had explained how the thickness of the skin deadened the sense of touch. The question of the character of the ear was connected with the intensity of the faculty of hearing, and Dr. Fripp laid great stress on the fact that the otolith was evidently not an accidental production, being always found in one place. The ossicula auditus of air breathing animals only served for the transmission of sounds from one membrane to another.

Mr. S. H. Swayne referred to meetings of the Zoological Section, where this subject had been discussed, and spoke of the molecular constitution of otoliths, as somewhat resembling that of certain little bodies in the scales of fish.

The President expressed pleasure at Dr. Fripp's considering that this generic or specific character was associated with a sense of high physiological importance, and remarked that the molecular differences existing among otoliths might be paralleled in the mineral kingdom.

Mr. A. Smith enquired if Mr. Higgins had investigated the sense of smell in fish.

Mr. Higgins having replied in the negative,

Dr. H. Fripp said that in many fish it was so developed that they hunted by its aid. The sensory apparatus consisted essentially of olfactory sacs, through which currents of water were constantly passing.

The Hon. Secretary announced that at the next general monthly meeting, Professor James Buckman, of the Royal Agricultural College, Cirencester, would deliver a discourse upon the structure and economy of British Grasses.

MEETINGS OF SECTIONS.

ENTOMOLOGICAL SECTION.

Tuesday, October 9th.—Mr. F. V. Jacques in the chair.

Mr. Groom-Napier exhibited and made some remarks upon a fine species of Cicada, captured in Greece. The species exhibited, Cicada

Pleleia, was four inches in expanse of wings, which were beautifully veined with brown, the abdomen of a rich horn color with bars of yellow, the thorax resembled tortoise shell finely sculptured, and the head was green. Mr. Napier supposed this insect to be the Cicada menioned by Virgil and Ovid, as the noise caused by the insect was very much greater than that of any grasshopper. He observed that the species was often very destructive to fruit trees in Southern Europe, as it obtained its food like the rest of the order to which it belonged, the Homoptera, by sucking the juices of plants.

Mr. Barber exhibited a box containing several hundred specimens of Homoptera, captured in the Bristol district by himself. The collection, which included a large number of species, was much admired by the members.

The Secretary exhibited three species of Lepidoptera, taken by himself during the summer, and not hitherto recorded as occurring in the district, viz. :—

Acidalia inornata.
Phycis abietella.
P. Carbonariella.

Also a series of Eupithecia pulchellata, bred from the seed pods of Digitalis purpurea.

Mr. Clarke exhibited a nice series of Lycœna Adonis, captured during the summer on Durdham Down. This beautiful species had appeared in some abundance this summer, and had not been recorded as having occurred in the district before.

Mr. A. E. Hudd exhibited a box containing, among other species—
Lycœna adonis.
Acronycta leporina.
Lobophora polycommata.
Eupithecia campanulata (new species).
Eupithecia constrictata.
Ephestia pinguedinella.
Phycis carbonarielia.

CHEMICAL AND PHOTOGRAPHIC SECTION.

Wednesday, Oct, 10th.—Mr. P. J. Worsley, F.C.S., president of the section, in the chair.

The attendance of members was large. The Secretary announced the resignation of Mr. W. H. James.

The Secretary exhibited, through the kindness of Mr. George Finzel, a beautiful series of large photographs of Athens and the neighbourhood, taken by a native photographer, many of which were remarkable for their exceeding softness, as well as delicacy of finish.

Mr. W. W. Stoddart then made a verbal communication upon a new application of the magneto-electric machine. He wished to show to the members a new experiment which he had seen at the Nottingham meeting of the British Association. The novelty consisted in using the current from a magneto-electric machine, instead of, as usual, from a voltaic battery, as the primary or exciting current in a large induction coil, the secondary current of which was made to pass through Geissler's vacuum tubes in the ordinary manner, showing the length of, and stratification in, the discharge. Mr. Stoddart minutely described the structure of the magneto-electric machine, showing how it owed its action to the property of induction, and pointed out that the quantity of electricity produced by its aid was much less than even by a small voltaic battery, and hence the spark obtained from the induction coil was in this case very small. He also drew attention to the fact that, in this arrangement of apparatus, no contact breaker was needed on the induction coil, as the current from the source of electricity was intermittent.

A discussion then took place between Mr. Beattie, Mr. Stoddart, the President, Mr. Noble, and Mr. Carpenter on the laws and nature of force, the use and abuse and improper meanings attached to scientific terms, &c.

ZOOLOGICAL SECTION.

Thursday, Oct. 11th.—Mr. W. Sanders, F.R.S., President of the Society, in the chair.

The attendance of members was limited. The paper on Baleen, by Mr. S. H. Swayne, announced for that evening, was postponed.

Mr. C. O. Groome-Napier, F.G.S., read an elaborate paper on "Animal and plant prototypes," in which he endeavoured to trace the resemblances and differences between man and the lower animals, or even plants. The illustrations of man took two forms, analogy, and actual resemblance.

Among plants there were many types of man. Red fruits were generally acid, corresponding to red-haired races of men, which were usually fiery. Black fruits were strong in taste, and black-haired races, similarly, were little susceptible of improvement. Light-coloured fruits were generally delicate in flavour, aad corresponded to light-haired races. This was carried out in the eggs of birds, and in some other plants, though occasionally colour might only be an accompaniment, and not necessarily a cause. Passing to the animal kingdom, Mollusca, soft pulpy animals, corresponded to men with flabby constitutions, and so with many tribes similar resemblances were traced—for example, between certain tribes of cows and Englishmen, whence the term John Bull was probably derived, that element being easily recognisable—stress being frequently laid upon physiognomical characteristics. The pig and some other animals had been condemned by the Semitic race. Mr. Napier concluded his paper with some interesting observations upon the influence of daily life and surrounding objects upon men and animals, and the power of man in modifying the characteristics of animals according to his own wishes.

In the discussion which followed, Mr. Geo. Harding, Jun., mentioned several white flowers of very powerful scent, and green fruit of decided taste, which were not in accordance with the author's theories; and the President commented upon the fanciful ingenuity displayed by Mr. Napier.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

NOVEMBER, 1866.

GENERAL MEETING.

THURSDAY, NOVEMBER 1ST.—Mr. W. SANDERS, F.R.S., F.G.S., President, in the chair.

The HON. SECRETARY announced that Mr. Philip John Butler, of London, and Mr. Chas. Phipps Lucas, of Redland, had been elected by the Council as ordinary members; also that the following donations to the Society's library had been received:—"The Popular Science Review for 1866," from Dr. Henry Fripp, and "The Geologist," Nos. 1 to 21, from Mr. W. J. Fedden.

The following resolution, which had been passed at the November meeting (*vide* pp. 63, 64), was then confirmed:—

Moved by Mr. STODDART, seconded by Mr. JACQUES, and resolved:—

> "That an additional 2s. 6d. be subscribed for the present year, the financial year to commence in future with the sessional year."

The alteration of Rule IX., proposed at the last meeting by Mr. Leipner, and duly seconded and supported, was also unanimously confirmed. The rule will now therefore read as follows:—

Rule IX.: "That all Ordinary Members subscribe *seven shillings and sixpence* per annum towards defraying the expenses of the Society; the subscription to commence at their entrance, and to be renewed on the *Annual Meeting in May*."

Mr. LEIPNER then rose, and, after thanking the members for agreeing to his proposition, said that he hoped that as little trouble as possible would be given to the hon. treasurer, when he had to collect the additional subscription.

Mr. RICH, a gentleman formerly resident in Bristol, but now in London, called the attention of the meeting to a remarkable variety of Helix rufescens, with a depressed spiral, brought to his notice as occurring here by Miss Jellie, of Redland. It had not been publicly shown before, and the name Helix rufescens, var. compressa, was proposed for it. He also stated that Clausilia bilicata, and C. Rolphii, generally supposed to be oviviparous, had been observed by him to be viviparous.

The PRESIDENT then invited Professor Buckman, late of the Royal Agricultural College, Cirencester, one of the Corresponding Members of the Society, who had come purposely from Dorsetshire to be present at this meeting, to address the Society upon "The Structure and Economy of British Grasses."

Professor BUCKMAN, in introducing his subject, said that he had chosen it because it was one to which so little attention was generally paid. No country—not even excepting Ireland—was so remarkable for the number and variety of its grasses as England; nowhere were such meadows and lawns to be found. Grasses were very wonderfully made, and were composed of but few and very simple elements, though these were almost infinitely varied. Even among professed botanists there was great ignorance existing as regarded the names of the grasses, the same species being sometimes differently named by two or three botanists. The speaker had seen instances of this, and, from his connection with agriculture, had been led to pay great attention to this beautiful tribe of plants. He proposed to describe their structure in general terms, and to add a few words on their general economy, as derived from a somewhat extended experience.

Professor Buckman illustrated his remarks by drawing several diagrammatic sketches on the blackboard, and by a collection of drawings and dried specimens of almost every known species of British grass.

The structure of the *stem*, or culm, was first described. It was shown to be constructed so as to obtain the greatest amount of strength out of the smallest amount of material, being a hollow tube—or fistular—additional strength being given by solid nodes, which were nearer together at the base than at the upper part. The only grass in which there was no node, or at least only one at the bottom of the stem, Molinia Cœrulea, had a solid stem. The manner in which the leaves folded over the stem was then explained, and the existence of a small organ between the stem and the sheath of the leaves, called the *ligule*, was pointed out. This ligule was composed of a very thin membrane, closely adherent to the stem, and its purpose apparently was to keep the leaves in their position. The variations in the structure, character, and position of this ligule were deserving of attentive study, because upon them many of the most reliable modes of distinguishing species were founded. The *flowers* of the grasses were then spoken-of, and they were shown to be in their general plan merely altered arrangements of the leaf developments, although the details were varied to an immense extent. The flowers differed greatly in appearance according to whether the florets were sessile (*i. e.* without stalks) or on pedicels—whether the pedicels were long or short, weak or stiff, horizontal or inclined, cleft in two or single, close together on the stem, or at longer or shorter intervals, numerous or few ; in fact, it was noticed that a very slight alteration in the arrangement of parts materially affected the general appearance of the whole flower. The structure of the seed-vessel and of its surrounding envelopes was then described, and it was shown that another set of distinctions between different species and varieties was given by the adhesion or non-adhesion of these envelopes. For example, the adhesion, or otherwise, of the corolla to the grain gave the distinction between wheat and barley. The speaker stated that there were about 150 species of British grasses, but that these were so varied that the grasses were usually very easy to discriminate; it was very fortunate that all the forms could be reduced to a simple principle, or type-form, from which a great variety were moulded ; and on this account, if on no other, grasses were well worthy of study.

In entering upon the second portion of his subject, the Professor remarked that, out of all the 150 known species of grass, only ten or twelve formed the bulk of any good meadow, these being, so to speak, masters of the situation. In bad pastures, on the other hand, as many as 50 species might occasionally be found, and of these, five or six would be so prominent as to indicate that nothing was right there, and so also, *mutatis mutandis,* with good pastures. The speaker considered the gradual deterioration of a pasture to take place somewhat in the following way :—Even in the best pieces of land some corner or out-of-the-way spot would probably, from dampness, or some other cause, be not as good as the bulk ; on this the bad species would be found, and if the farming was not good, from neglect of top-dressing, or other reasons, the bad grasses would gradually begin to spread. Grasses grew together very closely, and yet two species could not, of course, occupy the same place at once, and a struggle for existence was commenced ; in poor ground the bad species obtained the mastery, and though a war of extermination was constantly going on, such a balance was maintained that the number and kind of species of grass growing on any given piece of land, would give, to those who understood them, such an intimate acquaintance with the nature and properties of the land as no other set of circumstances connected with grasses could possibly do. In reference to the best mode of turning bad pasture into good, Professor Buckman said that he had found it advantageous by practical experience, to fold sheep upon it. The poor grass was either eaten or trodden down by them, and thus a manure was formed,when, the soil being thus improved, the better grasses would grow. This tribe contained some of the most important plants in the country, even independently of the cereal grasses; a vast amount of man's food—butter, cheese, meat, &c. being indirectly dependent on the pastures.

The speaker then called the attention of the society to the changes produced in grasses by irrigation. He had watched some land, worth about

£1 an acre, which was irrigated, and had remarked the changes in the comparative number and bulk of various species caused by irrigation.

	Commencement.	After 2 years.	After 4 years.
Good ..	7	16	25
Middling ..	10	6	2
Bad ..	17	—	—

The above statement was not to be taken as absolutely correct, for it was a very difficult thing *entirely* to kill and extirpate a grass. With respect to the species indicative of different kinds of soil,

About 40	species	were found in ..	bushes, jungles, &c.
„ 10	„	„ ..	aquatic situations.
„ 14	„	„ ..	by the sea side.
„ 35	„	„ ..	meadow land.
„ 23	„	„ ..	arable land &. as weeds.

All these species, according to their number, and the comparative well or ill-doing of each, would point out the exact condition in which any given field, or other piece of land, might be. The same species would frequently vary so much in size, that specimens of the two extremes were considered as distinct species, e. g., among the Fescues, Festuca loliacea, and F. loliacea var. pratensis.

Professor Buckman concluded his discourse by commending the study of these beautiful plants to the members generally, and especially to the ladies, whom he begged to look at them occasionally, as more beautifully varied forms did not exist; they were well worth the botanist's attention also, as they really were not that difficult tribe of plants that they were usually considered to be—and he considered that any proprietors of land would be very fortunate if they profited by all the lessons which the grasses were capable of teaching them.

The President, in inviting discussion, remarked upon the philosophical manner in which Prof. Buckman had handled his subject.

Mr. James Phillips enquired why, when sheep were folded on a piece of land, the good species as well as the bad were not trodden down, and thus both killed?

Prof. Buckman admitted that, to some extent, they would be, but that by the treading-in, &c., of animals, the ground would be made so much richer that the bad grasses would scarcely grow, while the good ones would flourish.

Mr. A. Leipner thanked the speaker for his address, and for having given the Botanical Section a good subject to work upon, referring to the fact that on a former excursion to Avonmouth, Prof. Buckman had gathered 40 species of grass, showing this neighbourhood to be comparatively rich in them. As a practical Botanist, he wished to ask what other parts besides the ligule were least variable, and most useful for the determination of species?

Prof. BUCKMAN replied that there were a few other characters to be relied upon; *e. g.* in the outer envelope, whether the calyx and uvule were equal or unequal, and so also of the calyx and corolla. The presence or absence of an awn, and its variations in length, also furnished characteristics. Many of these matters were very difficult to explain orally, though they could very readily be learnt in the fields, and, to a practised eye, the general look of a grass was generally enough to determine the species, without going into a minute analysis of the various parts.

A VISITOR said that he represented a large body of working farmers, amongst whom two notions were prevalent—first, that the soil of old pasture contained the seeds, or germs, of *all* grasses, and secondly, that the bad ones might be improved into good, and made the stronger of the two.

Prof. BUCKMAN said that he did not believe in the actual conversion of one grass into another, *e. g.* that Italian rye-grass could ever be 'converted into' couch grass, Triticum referens, but he considered that if the two were left growing in the same place, as they could not co-exist, the couch-grass would become the master in the struggle.

The VISITOR wished still to know whether a poor grass might be so altered by cultivation as to deserve a special name, whether, in fact, if good grasses failed to come up, the bad might be converted into good.

Prof. BUCKMAN referred to the wide importance of the subject thus opened up. He held that—as it was so long before a good pasture could be laid down, it was desirable to use every means, such as judicious manuring, before breaking it up, a proceeding which should only be resorted to in extreme cases. Bad grasses were readily expelled, and good gained the ascendancy, very readily under favourable conditions.

Mr. LEIPNER enquired how many British grasses were serviceable for meadows, and how many were actually pernicious?

Prof. BUCKMAN said that though 12 were useful, the bulk of meadow grass consisted of only six or eight species—and that the meadow was better in proportion as other plants besides grasses were kept out. Very few grasses were absolutely poisonous.

Mr. RAVIS enquired why the grass on Durdham and Clifton Downs was so very fine and short?

Prof. BUCKMAN said tha species was Festuca ovina; the leaves were very small, and could often be cut. Their size was probably owing to their upland situation, as different geographical positions exercised great influence on grasses generally. F. ovina was a form of which some botanists put down three or four species, but the speaker believed he had obtained them all from a single position.

Mr. GRUNDY enquired if there was any good mode of extirpating daisies from a lawn?

Prof. BUCKMAN had had practical experience in the matter, but, being fond of them, did not remove them from his own lawn. They were a blemish, however, and their presence was a sign of the soil being poor, and the best mode of getting rid of them was to apply manure, whether soot, superphosphate, or in some other convenient form.

The PRESIDENT, in closing the discussion, moved a vote of thanks to Professor Buckman for his able and interesting discourse, and for the obliging manner in which he had answered the various queries put to him. The vote was carried by acclamation.

MEETINGS OF SECTIONS.

BOTANICAL SECTION.

THURSDAY, OCTOBER 18TH.—The first evening meeting of the Session, Mr. J. W. CLARKE occupying the chair. The minutes of the previous meetings having been read and confirmed,

Mr. H. CHARBONNIER exhibited an interesting series of Anthers and Pollen grains prepared for microscopic observation. The appearance and shape of the pollen varied considerably in different plants. In those from the Fuschia the grains were pyramidal, and the exhibitor had partially succeeded in inducing the protrusion of the pollen tubes by artificial means. Those from Althœa officinalis were spherical and covered with knobs, and in this particular resembled those from the Anthers of Onopordum acanthium. In Cichorium Intybus the grains were seen to be polyhedral, and in Calluna vulgaris to be generally arranged in fours. The smallest shown were from Tanacetum vulgare and Antirrhinum majus. In those from the garden Geranium were seen the parts from whence the pollen tubes would issue, the membrane being probably thinner at those points; and those from the garden Stock and Leontodon taraxacum were strongly marked on the surface. The difference in shape between grains taken from an endogenous plant, and those from exogenous plants, was shown by some from the flower of Lillium candidum, where they had only one longitudinal fold, whereas in Convolvulus major and Centaurea Scabiosa, they each had three folds.

Mr. GROOME-NAPIER exhibited a piece of Jappa or native cloth of the South Sea Islanders, manufactured from the woody fibre of some plant; also, a piece of Cassava or Manioc bread, made from the root of Jatropha manihot, which in its raw state is highly poisonous, but by pounding and repeated washing is rendered edible; the piece shown was made in Tobago.

THURSDAY, NOVEMBER 15TH.—Mr. LEIPNER, President of the section, in the chair.

With regard to "Pollen," the subject which had been discussed at the last meeting, the President said that it had been remarked that plants having star-shaped flowers, generally had pollen marked on the the outer membrane with protuberances which gave to the grains a star-shaped appearance likewise. From recent experiments it had been demonstrated that the previous theory of the pollen tube, viz., that it was a simple extension of the inner membrane of the grain down which the fovilla passed to fertilize the germ, was erroneous, and that this extension of the pollen grain was the result of actual growth, being composed of cellular tissue, and that there was no other fertilizing agent besides the cell contents.

A new analysis of the gluten of wheat was noticed. Being formerly said to consist of fibrine aud vegetable albumen, it was now separated by a French chemist, into Albumen, Fibrin, Casein, Immulcine, and a new principle called Glutine.

Mr. YABBICOM showed a series of Sea-Weeds, taken at Llanduduo, North Wales, embracing among others :—

Gigartina mamillosa.	Delesseria hypoglossum.
Furcellaria fastigiata.	Rhodymenia ciliata.
Chondrus crispus.	Griffithsia setacea.
Plocamium coccineum.	Porphyra lactiniata.

Mr. B. N. LOBB, exhibited a collection of the same class of plants gathered at Lynmouth, North Devon. Among them were :—

Delesseria sanguineum.	Lawrencia pinnatifida.
Delesseria hypoglossum.	Bryopsis plumosa.
Dictyota dichotoma.	Porphyra vulgaris.

And several species of Ceramium, Polysiphonia, Ectocarpus, and Cladophora.

GEOLOGICAL SECTION.

THURSDAY, OCTOBER 25TH.—First evening meeting of the Session, Mr. W. Sanders, F.R.S., F.G.S., President of the Section, in the chair. There was a good attendance of members, and two new names were received of gentlemen wishing to join the section.

Mr. RAVIS exhibited a fine specimen of fossil wood, in which the rings of growth, knots, &c., were well preserved. He could not with certainty trace the place where it was found, but it was put into his hands as coming from Teneriffe, which was, he believed, an island of purely volcanic origin.

Mr. W. W. Stoddart, F.G.S., read a paper on Tribolites, so called from their being divided into three lobes. They were among the most ancient forms of animal life, and had no living representatives, the nearest approach being the Limulus or King-crab, common in the West Indies. The general structure of this Crustacean was described, and particular attention drawn to the hinder legs, which served the office of gills, each carrying on their outer edge a series of plates like the leaves of a book—whence the name Phyllopod, 'leaf-footed.' Except the dorsal part and the immoveable epistoma, the whole of the under surface of the body was soft and perishable, which would account in great measure for the assertion of some writers that Tribolites had no legs. The number of genera and species of Tribolites was very large, more than 200 species being found in Great Britain alone. The Agnostidæ were the lowest in organization, the Phacopidæ the highest. Tribolites were brought into being at the earliest part of the Cambrian period, attained their fullest development at the Llandeilo and Caradoc ages of the Silurian, and died out in the upper Carboniferous shales. Mr Stoddart then, by the aid of diagrams, minutely described the parts of the Tribolite usually found, giving the palæontological terms for them. The fossil remains were formed from a chitinous substance, probably identical with the valves of a Lingula, or the elytra of beetles, and were divided into the head or carapace, divided by many kinds of furrows; cheeks fixed and moveable; the front margin of the head with the rostral shield and labrum or epistoma; the thoracic rings and side lobes or pleurae (always anchylosed); on the number and variety in which specific distinctions were founded; and the pygidium or tail. The head afforded generally a very reliable means of determining genera. Some Trilobites, as the Calymenidæ and Asaphidæ, had the power of rolling themselves up into balls—and a section of a Calymene was exhibited, in which it was thought that traces of phyllopod feet could be detected. The Olenidæ and Ogygidæ had not this power. A specimen of a very rare Trilobite, Encrinurus valeolaris, was also shown, only one other specimen, and that in the British Museum, being known to the speaker as having been hitherto found. Mr. Stoddart then briefly described the exquisitely beautiful eye of the Tribolite. It was compound, like those of insects—being made up of a number of prisms, and having a crystalline lens and pupil, but all arranged under one cornea, and terminating in the optic nerve. Mr. Barrande stated that he had ascertained more than 30,000 facets in each eye of Brontes palifer. Some species, however, did not show any facets, which were most developed in the Phacopidæ. In the remains of earliest Tribolites, eyes were always absent, probably from the cheeks being moveable; but in some cases, as in the Anopolenus, the cheeks, eyes, and head spines, usually supposed to be absent, were found in an abnormal position.

The President, in commenting upon the paper, made some appropriate remarks upon these medals of creation, and upon their importance as being in many cases peculiar to, and characteristic of, certain definite strata.

ZOOLOGICAL SECTION.

THURSDAY, NOVEMBER 8TH.—Dr. HENRY FRIPP, President of the section, in the chair.

Mr. S. H. SWAYNE read a paper on "Baleen, or Whalebone." He said that this curious animal substance is derived from the Edentalous division of the Cetacea, which comprises the genera Balœna, Balœnoptera and Megaptera. The "right," or whalebone whales have no fin on the back, a very bulky body, and an enormous head, with very long straight baleen plates. The Balœnoptera, or "Fin-Whales," a slighter form and smaller head, a high fin on the back near the tail, a plaited belly and twisted baleen plates. The Megaptera, or "Humpbacks," a blunt-shaped head, a lump or excrescence instead of the back-fin, and baleen like that of Balœnoptera. At least three principal forms of Right-whale are known, represented by the Greenland, the Cape, and the North Atlantic. Of these there are probably several species. The two former furnish most of the baleen of commerce. The head is largest in the Greenland (*Balœna Mysticetus*) being one-third the total length and thick in proportion. This depends chiefly on the size and length of the jaws. The wide space between the narrow highly-arched upper jaw and the straighter lower jaw is occupied externally by the baleen plates, covered by the very large lower lip. The plates form two series of upwards of 300 on each side, and with two corresponding series of short subsidiary plates inside them, combine to make a large vaulted roof to the mouth. The shape of each lamina or plate is a long triangle, of which the base is broadest in the Fin-Whales and Humpbacks, and is attached edgewise to the sloping sides of the narrow upper jaw; the apex pointing downwards and outwards towards the widely-spread branches of the lower jaw, one smooth edge looking outwards and a little backwards, and the other fringed throughout with bristles several inches long, being turned inwards towards the large tongue. The whole roof of the mouth is thus covered with a bristly lining, which serves to entangle the small Pteropods, &c., upon which the whale subsists. When feeding, the whale takes in a mouthful of water, full of these floating Molluscs, and on closing the mouth the water escapes again laterally between the baleen-plates. For the most part the plates are pretty uniform in length, but they rather suddenly diminish at each end of the series, from perhaps 11 or more feet in the middle to three or four inches at the ends. The bases of the plates are embedded in a soft white spongy gum, which also forms a raised bead or edge along the outside of each series, and is called the "wreath-band." Dr. Gray has described several varieties of baleen, which he thinks may belong to as many species of Right-whale. Of these the Greenland is the best, being long, flat, and tapering. The baleen of Balœnoptera and Megaptera is short, from a few inches to about two and a half feet long, and broad in proportion, with coarser bristles, and is commonly curved or twisted. A thin section of baleen exhibits in the centre the ends of a number of horny hair-like fibres in single series, or perhaps twelve or fourteen across the short diameter of the plate (according to the species), in shape circular, oblong, or polygonal. Outside these is a layer of horny matter, of nearly equal thickness, which also dips in between the bristles. This exterior cortical layer, like the bristles themselves, is fibrous in structure, and more or less colored by pigment. Each bristle consists of a number of concentric layers, enclosing a central medulla or pith made up of large cells. A section of baleen from Balœnoptera may be readily distinguished from one from Balœna by the *larger size and fewness of the hairs.* As to the growth of the plates—on examining the base of a plate we find a flat hollow two or three inches deep, in which was lodged the soft pulp-blade from which the plate was formed. From the edge of each pulp-blade a number of soft filaments proceed, which become converted into the bristles, the cortical part being formed from the sides of the pulp-blades. Eschnecht and Reinhardt (Ray Society, 1866) do not agree with Hunter and Owen (Odontography) that the cortex is formed from the soft gum, but rather from the sides of the pulp-blades. The pulp-blades of the Balœna are shorter than those of the Balœnoptera, although the plates formed from them are so much longer. According to Eschnecht and Reinhardt baleen is not formed until the latter half of fœtal life; and the pulp is ten times longer in proportion in the new-born than in the full-grown whale. At its first formation bristles only are seen to project from the gum. It is clear that the central laminae grow much faster than those at either end, for at birth none are more than three or four inches long, and in the adult the middle ones are 11 or more feet long, while the end ones have scarcely increased. This also applies to the subsidiary blades. Owen (Odontography) compared the cortex to the external cement of teeth, but even if this were correct there would still be nothing analogous to the enamel organ of teeth. The discovery of a number of small abortive denticles in the jaws of a fœtal Balœnoptera shows that baleen and teeth are not homologous, but vicarious. Mr. Swayne proceeded to show the similarity in structure of baleen and rhinoceros-horn and some other hair-structures, and viewed them all as "compound hair-structures." Microscopic preparations were exhibited, and baleen plates from three or four species of whale.

ENTOMOLOGICAL SECTION.

Tuesday, November 13th.—Mr. Stephen Barton, President of the Section, in the chair.

The President exhibited some specimens of a minute species of

Microgaster, a genus of the Ichneumonidæ, singular from their being parisitical in the eggs of some of the larger lepidopterous insects.

Mr. NOBLE sent for exhibition a fine specimen of a species of Phasmidæ captured in Assam.

Mr. A. E. HUDD exhibited Sesia Philantheformis, a new species recently captured in the Isle of Man; also a cocoon of the same in a dead flower-head of Armeria Maritima (Sea Pink). Dianthæcia Capsophila, also captured in the Isle of Man. Dasycampa Rubiginea taken at Ivy-bloom, at Leigh, in October, and Xanthia Gilvago, taken in Derbyshire.

Mr. HUTCHINS exhibited the following species captured at Ivy-bloom, at Leigh:--Dasycampa Rubiginea, Xylina Petrificata, X. Semibrunnea, and X. Rhizolitha; also, Hoporina Croceago, a fine species not hitherto recorded as occurring in the district.

The SECRETARY exhibited a box containing, among other species, Sesia Scoliœformis, captured at Llangollen; Sesia Philantheformis, from the Isle of Man; Sesia Chrysidiformis, from Folkestone; D. Sicula, captured at Leigh; D. Templi,at Clifton; L. Putrescens, from Torquay; Lithostege Nivearia, captured at Brandon, in Suffolk; C. Ocularis, bred.

The rest of the evening was occupied in examining a number of microscopic objects, principally scales of British and Foreign species of Lepidoptera and Coleoptera, prepared and exhibited by Mr. J. W. Clarke.

CHEMICAL AND PHOTOGRAPHIC SECTION.

WEDNESDAY, NOVEMBER 14TH.—Rev. W. WHITING in the chair.

Dr. W. BIRD HERAPATH, F.R.S., &c., read a paper upon Dr. Muspratt's new spring at Harrogate. After referring in general terms to the character of the Harrogate waters, the speaker quoted the results of analyses made several years ago by Dr. Hofmann, by whom the various springs were grouped in four classes.—1, the strongly sulphurous; 2, the milder sulphurous; 3, the saline chalybeate; and 4, the pure chalybeate. The total quantity of solid constituents varied from 11 to 1,096 grains per gallon—the chief constituent in excess being common salt, and the quantity of sulphide of sodium ranging from 0.3 to 15 grains per gallon. In 1865 Dr. Muspratt had analysed the water of one of the four saline chalybeates, which same spring had been examined in 1854 at the same time as the others, by Dr. Hofmann, and he found to his surprise, a very remarkable alteration in the character of the water; instead of 285 grains solid constituents there were 465, all the chlorides except that of potassium had increased, and also the carbonate of iron, while chlorides of lithium and barium were present in addition, and were entirely new constituents, as was also protochloride of iron, which amounted to 16 grains per gallon, and was only known to occur in two other springs, both of which were on the Continent. Dr. Muspratt's remarkable results had been confirmed by Dr. Herapath himself, as well as by Prof. Miller, of King's College, London. The speaker illustrated his remarks with a number of preparations, showing the amounts of various substances obtained from given measures of the water, and also by a number of delicate tests which demonstrated the nature of the constituents, in the course of which operations he pointed out that the presence of protochloride of iron in any water materially interfered with the action of the permanganate of potash test for organic matter, the iron salt being rapidly oxidised just as organic matter would be. It had been proposed to give the name of Muspratt to the spring, in honour of the chemist who first made known this remarkable change in its character.

Mr. W. L. Carpenter exhibited several beautiful specimens of carbolic acid, manufactured by F. C. Calvert, and Co., Manchester, and made a few remarks upon its manufacture and uses, pointing out its chemical relations to other known substances.

He also showed a number of pieces of gun cotton, in various shapes, and for different uses, manufactured by T. Prentice & Co., Stowmarket, Suffolk. The speaker gave a short account of its mode of manufacture, and of the recent explosion at Woolwich.

Rev. W. Whiting, *àpropos* of gun cotton, described his process for preparing structureless collodion, in which the base of the pyroxiline was Swedish filtering paper.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

DECEMBER, 1866.

GENERAL MEETING.

THURSDAY, DECEMBER 6TH, 1866.—Mr. W. SANDERS, F.R.S., F.G.S., President, in the Chair.

The minutes of the previous meeting having been read and confirmed, the Hon. SECRETARY called the attention of the Society to a re-issue by the Christian Knowledge Society, of Miss Pratt's work on "Poisonous, Noxious, and Suspected Plants," which contained 40 accurate and beautifully coloured drawings, and was to be obtained at a very small cost.

Mr. H. K. JORDAN, F.G.S., rose to make a few remarks upon the exhibition at the previous meeting of a new variety of Helix rufescens, for which variety Mr. Rich, who showed the shell, had proposed the name "compressa." Mr. Jordan said that he had exhibited a series of the same shell, obtained from Paignton, Devon, at the February meeting of the Zoological Section (*vide* Proceedings, page 12), and that the name "depressa," which he considered more suitable, had then been adopted for it, in which Miss Jellie had since acquiesced. He therefore thought that this variety should be known as Helix rufescens, var. depressa, in which opinion the meeting concurred.

A paper by Mr. C. O. GROOM-NAPIER, F.G.S., on "The Economic Value of British Insects," was then read by the Hon. Secretary, Mr. A. LEIPNER, the author being unavoidably absent in London.

After alluding to the popular belief that insects were vermin, made to be taken and destroyed on every hand, the author spoke of their immense number, both as individuals and as species, and said that he should confine his remarks to the British members of the class Lepidoptera, butterflies and moths. British butterflies numbered about 68 species, of which at least 20 were too scarce to be of any economic importance. In nearly all cases, however, it was necessary to consider the habits and food of the larva rather than of the perfect insect. Some caterpillars fed upon noxious weeds, and, as such, were decidedly beneficial, while others were indirectly of use, from the quantity of manure produced by their excreta and decaying bodies, which doubtless assisted to supply the wants of an exhausted soil. The larvæ of twelve species of common butterflies fed upon weeds, and among them were mentioned the Swallow-tail, Papilio machaon, which fed on Umbelliferous plants, and the Frittaries, Melitæa cinxia and M. artemis, whose food were various varieties of plantains, fox-glove, &c., also the genera Cynthia and Vanessa, which were very destructive to thistles, nettles, and plants of a similar character. Twelve species also fed upon valuable plants, and as such were detrimental to the agriculturist and gardener. Means should be taken to destroy them, when birds, insectivorous quadrupeds, or insects of prey, did not sufficiently lessen their numbers, and the destruction of one female imago would prevent the deposition of a great number of eggs. The three species which, from their abundance, size, and frequent attacks upon the vegetables most cultivated in gardens, had been signalled out as the greatest enemies to horticulture, were Aporia crataegi, which was especially injurious to wall fruit trees, Pieris brassicae, and P. rapae, which committed great havoc amongst garden Cruciferae (as turnips, cabbages, &c.) and P. napi, destructive to the rape, horseradish, sea-kale, and other garden plants. The larvæ which fed upon grasses were, as a rule, night-feeders, and it was therefore less easy to ascertain the comparative mischief done by various species; probably the most important were Lasiomata Aegeria, and L. megara, feeding on wayside grasses, Hipparchia semele, and especially H. tithonus, H. janira, and H. hyperanthus, which fed upon meadow grasses, as well as Coenonympha pamphilus. Thecla quercus and T. rubi lived upon the leaves of the oak and bramble respectively.

Of the British moths, 1900 species were known, and as they were mostly vegetable feeders, their numbers were very destructive. The primary division, the Sphinges, were of little economic importance, 20 out of the 30 known species being rare. S. populi and S. ocellatus lived upon the leaves of the poplar, willow, and aspen. The larva of the Death's head Hawk Moth, Acherontia atropa, was sometimes sufficiently common to injure potatoes and jasmine. The larvæ of the Privet and Elephant Hawk Moths were of little economic importance, and the Anthrocera were rather beneficial than otherwise. The class of Bombyces contained 104 species, many of great importance economically; the genus Hepialus fed generally on the roots of plants, H. humuli doing much damage underground in hop-gardens. The larva of the Goat Moth, Cossus ligniperda, did an immense amount of injury to oak, poplar, and other trees, passing two years in the larval state, during which time it tunnelled through the solid wood of the trunks; it was, however, very difficult to destroy. The caterpillars of the Pygaera bucephala too, fed in colonies on many forest trees, frequently stripping them of their leaves. Dasychira pudibunda was the source of great mischief in the hop-grounds, often seriously affecting the revenue from that source. The larvæ of Stilpnotia salicis, and of Porthesia auriflua were very destructive to gardens; in the summer of 1782 this last species multiplied to such an extent in England that prayers were offered in the churches, and money raised to collect the webs at 1s. a bushel. The caterpillars of Clisiocampa Neustria were formidable to the gardener, feeding in colonies under a web, upon the young shoots of fruit trees, as were also those of Arctia caja, Spilosoma menthastri, and S. lubricepeda, which fed upon garden stuff.

The habits and ravages of the Night-moths were not so well known, working as they did generally in the dark. Nearly 300 species were distinguished, and the depredations of many of these, though great in the aggregate, could not be individually estimated, from their comparative scarcity. Several again were so various in their food, that when too numerous, instead of eating useless weeds, they would be induced to attack valuable plants. Nineteen species were enumerated, feeding upon various weeds, dock, plantain, chickweed, as well as upon some garden stuff, and on lichens and low herbage. Three were mentioned as highly detrimental, Cerapteryx graminis, which had been known to devastate acres of grass lands in the North of England; Mamestra brassicae, so injurious to cabbages, lettuce, &c., and Plusia gamma, which fed upon many vegetables and cultivated plants. Various species of the genus Agrotis attacked the roots of wheat and grass crops, and of other garden plants. Several other species of Noctuina were mentioned, amongst them Noctua Xanthographa, a common larva feeding on grasses, and Scopelosoma satellitia, which frequently attacked the smaller caterpillars of its own or of other species. The class of Geometræ were next considered; it numbered 270 species, but only 40 were of economic importance, and of these, 28 were decidedly injurious, and only eight or ten fed upon noxious plants. Halia wavaria and Abraxus grossulariata were very damaging to currant and gooseberry bushes, and generally abounded. The very small larvæ of Chiematobia brumata attacked the early flower buds on the fruit trees, as did also the larvæ of Eupithecia rectangulata. Amongst the Geometræ beneficial to the agriculturist were Acidalia bisetata, which fed upon dandelions, and Larentia digymata, upon various Umbelliferæ.

The British Pyralides were fewer in number, and many of these were very scarce. Pyralis farinalis destroyed grain, flour, bran, &c. Aglossa pinguinalis fed on saddles and harness. Galleria mellonella and Aphomia colonella fed on the wax in the nests of hive and other bees: Ephestia ficella and E. interpunctella lived on dried fruits, &c. A few common species fed upon noxious weeds, including even the stinging nettle. The larvæ of the Veneer Moths were probably grass-feeding. The class Tortricina included many species, and was, on the whole, very destructive to agricultural produce, fruit and forest trees, and various bushes and useful plants. Among the more common and generally destructive, from the variety of their food, were mentioned Tortrix ribeana, several species of Lozotænia, Ptycholonia, Lecheana, and Hedya. The caterpillar of Semasia Woeberana where abundant, did an immense amount of injury, mining under the bark of fruit trees, and thus opening up a passage for insects of other orders; the genera Carpocapsa and Cnephasia had somewhat the same habits. Several species of Tortricina were then mentioned as beneficial to agriculture, feeding on weeds, and in some cases also, as Halonota and Cirsiana, mining the stems of the larger weeds.

The Tineina were the largest group of British moths, containing about 700 species, but the individuals were the smallest in size. Many species were excessively abundant, and in the larval state, collectively more destructive to property than the other divisions. The larvæ differed in their modes of feeding, some mining in the leaves, bark, and stems of plants, or in textile fabrics, others formed cases to work in, while a third set resembled the Tortricina in enclosing themselves in a rolled-up leaf. The Black cloak Woollen Moth, Tinea tapetzella, was exceedingly destructive to woollen cloth, curtains and beds, and objects of natural history, and, like allied species, was very difficult to get rid of. T. granella, feeding on barley, might destroy the contents of a granary. T. pellionella especially attacked feather and wool pillows, linings of carriages, &c. The genera Incurvaria and Swammerdamia were very injurious to fruit trees and bushes, being often extremely abundant, while Argyresthia and Gracilaria caused great damage among hawthorn, sloe, apple, birch, willow and other trees. Amongst those which rolled and twisted-up leaves were mentioned several species of the genus Gelechia. The genera Ornix, Coleophora, and Lithocolletis were very destructive, Eleachista also, especially to grasses, and Lyonetia, Cemiostona, and Nepticula closed a long list of these highly injurious insects. A few genera were then mentioned as feeding on valueless plants, or even on agricultural pests; among them Tinea arcella and T. cloacella, which fed upon rotten wood and fungi; Depressaria, some species of which lived upon hemlock, Gelechia, and Gracilaria. The larvæ of the Pterophorina mostly fed on wild and uncultivated plants, and were therefore to be viewed as beneficial to the agriculturist, though in a small degree. The author thus concluded his paper:—

"I shall briefly recapitulate, in conclusion, the number of species beneficial to agriculture by checking the growth of weeds, and those that injure crops and fruit or forest trees. I pass over as too scarce to be estimated with any measure of accuracy, 1712 species out of the nearly 2,000 butterflies and moths which are found in Britain. I have considered 32 butterflies and 252 moths which are divided as follows. Sphinges, 10; Bombyces, 17; Noctuæ, 38; Geometræ, 40; Pyralidina, 20; Tortricina, 51; Tineina, 72; and Pterophorina, 4; or a total of 284 species, or one-sixth of the entire list of British butterflies and moths. Of the caterpillars of the butterflies, 17, or more than one-fourth of the entire British species, feed on plants valued by man, and 15, or less than one-fourth, on those that are either troublesome weeds or little regarded by him. Of those of the Sphinges, five attack shrubs valued by man, and five weeds, or less than one-sixth of the British species in each case. Of the caterpillars of the Bombyces, 17 feed on plants of economic importance to man, or about one-sixth. Of those of the Noctuæ, 19 feed on valuable, and an equal number on plants valueless to man. Of the Geometræ, 28, or one tenth, feed on trees and other plants useful to man, and only 10 or 12, or one-twentyeighth on those he does not value. Of the Pyralidina only 11, or less than one-sixteenth are injurious, and nine, or more than one-eighteenth of the entire list, are beneficial economically. Of the Tortricina, 39 are injurious to valuable plants, or more than one-seventh of the entire British species, and 12 attack worthless weeds, or rather less than one-twentysixth. Of the Tineina 54 attack plants or goods valued by man, or more than one-twelfth, and 18, those not valued by him, or less than one-thirty ninth the entire British list. Of the common Pterophorina, about four attack plants not valued by man, or about one-ninth of the British species.

Before taking leave of insects I would call your attention again to their value as food for birds, fish, and reptiles. They thus indirectly contribute to the food of man. Some insects, however, in other countries afford direct food to the inhabitants, and one species—the cheese-mite—to the epicures of Britain. Moths and butterflies, like bees and other classes of insects, as they flit from flower to flower, carry about with then that fecundating dust, without which many a blossom, a bright new birth, a fragrant atom, would die and leave no seed. The world cannot bear unchecked vegetation. Man, the chief gardener, claims the choicest fruit; monkeys and birds come next; but ere the debt of Nature is paid, the smallest insect, a day labourer in 'the Paradise of plants,' must have its hire."

The paper was illustrated by the exhibition of specimens of many of the butterflies and moths whose food and habits had been described.

The President, in inviting discussion, remarked that the author had shown himself a true naturalist, in thus accumulating such a vast number of facts.

Mr. S. Barton, President of the Entomological Section, remarked that in the case of the Noctuæ, at all events, it was better and more easy to destroy the larvæ than the perfect moth, as Mr. Napier had recommended. They might be caught by saccharine matter, with which poison had been mixed.

Mr. W. W. Stoddart then read the following paper, entitled, "The Caterpillar Fungus, or Winter-worm-summer-plant," stating that he was indebted to the kindness of a friend for the specimen which he exhibited.

Every naturalist in his researches must have often observed the most extraordinary anomalies in the natural world, sometimes in abnormal forms, sometimes in abnormal habitats. Frequently insects lay their eggs in caterpillars, in which they grow and develope their progeny—others lay the eggs on the hair of mammals, and are licked off and swallowed, only for the larvæ to be living in the air-passages, to the discomfort and death of the unfortunate host. This is too commonly found in our neighbourhood, causing destruction among the calves living in the low districts of the Old and New Passages.

Some plants can only be obtained from the most out-of-the-way substances, e. g, many specimens of Splachnum are only seen on the dung of foxes, or oxen, another lives on the hoof of a dead horse. These freaks of nature are well illustrated in the specimen I have brought to show you to-night, which has been given me by a kind friend. It is half a vegetable and half an animal. The fungus I am going to describe is only found on a certain caterpillar.

The following note accompanied the specimen:—"Fungus Grubs, from Tasmania. These grubs having eaten a species of fungus, go into the ground and grow. Those grubs which do not eat it, live through their different stages."

A very good description of the caterpillar fungus by the late Dr. Pereira is in the *Pharmaceutical Journal*, vol. 2, p. 291, from which I have copiously drawn. In it there are figures of two species, the one found in China and Japan, the "Sphœrium entomorhiza," and one in New Zealand, "Sphœrium Robertsii." The former is described as three inches long, half being the caterpillar, but does not well agree with the Rev. Mr. Berkeley's description of S. entomorhiza in Smith's English Flora, vol. 5, part 2, where it is described as "carnose, *head sub-globose*, &c., &c." My specimen, however, accords well with Dr. Pereira's description of S. Robertsii.

Each individual is about six inches long, the fungus comprising more than half the length. The caterpillar is of the usual shape, having a light yellowish brown colour. The head, segments of the body, and pro-legs are distinctly recognizable. Projecting from the back part of the neck is a long club-shaped body, forming the fungus in question. As I before stated, it is a Sphœrium, probably identical with the S. Robertsii found in New Zealand, and in this opinion I am supported by Dr. Stephens, Stapleton, one of our best authorities on fungi, and who collected one of the first two specimens of S. entomorhiza ever found in England. Like the foreign, the British Sphœria are found on dead larvæ and pupæ of insects. The Sphœrium Robertsii on the table has the capitulum six-tenths of an inch long, elongated and acuminate, though not so vermiform as Dr. Pereira's figure, ostiola in my specimen indistinct from withering, perithecia elongated, asci long, containing a double row of very minute oblong sporidia, mixed with slender paraphyses. Stem, four inches long and a quarter of an inch thick, lighter in colour than the capitulum, which is very dark, nearly black. The base of the stem is furnished with root-like filaments, which are imbedded in the neck and body of the caterpillar.

Although Mr. Berkeley says the British species of Sphœria are formed on the pupæ as well as larvæ of insects, the Chinese, Japanese, and Tasmanian have hitherto only been noticed as existing on the larvæ of Lepidoptera. Dr. Doubleday, of the British Museum, says he thinks the caterpillar bearing the British Spherium entomorhiza is an Agrotis, but that on whose larvæ the New Zealand caterpillar lives is Hepialus virescens. This supposition is further confirmed by the fact that the Sphœrium Robertsii is only collected at the foot of the Rata tree (Metrosideros arbusta) one of the Myrtaceæ, and it is there also that the Hepialus Caterpillar is found.

The Chinese use the Caterpillar Fungus as a medicine. It is known in Canton as "Tong chong ha cho," which means "Winter-worm-summer-plant." In Japan it is called "Totsu Kaso." It is sold in Canton tied up in bundles, each containing a dozen. Du Halde says ('Description Geographique et Historique de la Chine', 3,490) that the insect fungus is scarce, and is regarded at Pekin as a foreign production. He says it grows in Thibet, but is also found on the frontiers of Se-tchuen on the borders of Thibet. Humberg (Travels in Europe, Asia, and Africa, 1770-1779, vol 3, p. 68) says, "The Chinese assign to the caterpillar fungus cordial virtues similar to those of Ging Sing. It strengthens and renovates the powers of the system, when reduced by over-exertion or long sickness." The physician of the Emperor of China says that it is used only at the palace on account of its scarcity. Black, old, rather rotten specimens cost four times their weight in silver.

Their mode of employing it is very singular, and reminds us of the recipes we often find in very old herbals. The belly of a duck is to be stuffed with five drachms of the insect fungus, and the bird roasted by a slow fire. When done, the fungus is to be taken out, the virtues of which will have passed into the duck. The latter is to be eaten twice a day for eight or ten days.

Instead of the caterpillar swallowing the fungus, it is most likely the fungal sporidia find a proper nidus in the dead caterpillar, for I cannot discover in any book that the caterpillar has ever been seen living with the fungus attached.

Much conversational discussion took place on this paper, especially as to whether the fungus grew in the body of the caterpillar during its lifetime, or after its death. The general opinion seemed to be that the fungus began to grow when the caterpillar was alive, but ill, so that this extraordinary parasite was, so to speak, not only the effect, but also the cause of the death of the animal. The occurrence of mould upon flies in autumn was mentioned as another illustration of parasitic growths, and Mr. S. H. Swayne alluded in his remarks to the Ichneumonidæ, which bored into the bodies of other caterpillars, which afterwards lived for a long time with these internal parasites. Referring to the fact that this particular fungus was only found with this species of caterpillar, Mr. W. L. Carpenter spoke of the constant association of a certain species of hermit-crab (Pagurus), with a certain species of sea-anemone (Adamsia), and said that one of these animals was apparently unable to exist without the other.

The proceedings were closed with the usual votes of thanks to the authors, and also to Mr. Leipner for reading the first paper.

MEETINGS OF SECTIONS.

GEOLOGICAL SECTION.

THURSDAY, NOVEMBER 29TH (postponed from 22nd inst.)—Mr. A. LEIPNER in the chair.

Mr. C. F. RAVIS exhibited some specimens of crystals of quartz, and the PRESIDENT gave a short explanation of the probable mode of their formation, &c.

Mr. W. SANDERS, F.R.S., F.G.S., President of the Society and of the Section, then delivered an address upon Fossil Fishes. After stating that the mode of classifying fishes varied with the object proposed to be elucidated by the lecturer, he presented to the Society a table of fossil fishes adapted to show their relation to Geological epochs. The primary divisions separated the Cartilaginous from the Osseous. The first of these comprised the great majority of the fossil, especially of those in the Palæozoic strata, while almost all the species of recent fish belonged to the Osseous division. There were three orders of Cartilaginous fishes. The first, the Plagiostomi, had the mouth transverse across the under part of the head. The gills had five apertures, and the ventral fins were abdominal; the tail was supposed to be heterocercal. Here these characteristic terms were explained, and drawings and specimens of fishes with heterocercal and homocercal tails were shown. This order contained four families: 1. The Cestraciontidæ, containing Ptenacanthus, Psammodus, &c.; 2. The Hybodontidæ, containing Ocodus and Hybodus; 3. The Squalidæ or Shark-like fish; and 4. The Raiidæ, including Myliobates and others. The second order, the Holocephali, had gills with one aperture, fins with a spine, and abdominal ventrals. The one family of this order, the Chimæroidæ, were remarkable for possessing only one tooth in each side of each jaw. The Edaphodus was shown as an example. These two orders had a Placoid exo-skeleton. The third order of fish were covered with Ganoid scales. The four primary divisions, adopted by Agassiz, into Placoid, Ganoid, Ctenoid, and Cycloid, were noticed, and the terms explained. Having given a general account of Ganoid fishes, and of the three orders of the Osseous tribes, the speaker presented a more particular account of various Genera belonging to the two orders of the Placoid. It was then announced that the subject would be resumed on a future evening, and a description would be given of the Ganoid Families of Fish.

ENTOMOLOGICAL SECTION.

Tuesday, December 11th.—Mr. S. Barton, President of the Section, in the chair.

The President exhibited a species of Helœus, belonging to the division of Heleides, family Tenebrionites, from Natal. Also Morpho Adonis, from South America, which, although not a rare species, was one of the most brilliant of all the diurnal Lepidoptera.

Mr. Barber then read a short paper on the genus Quedius. This genus was represented on the continent by 32 species, 28 of which had been met with in this country; 19 species were exhibited by Mr. Barber. The genus might be described as follows:—Body elongate, Head roundish, sometimes oval; Labrum transverse, Mandibles slender, slightly dentate in the middle; Palpi filiform, maxillary palpi four-jointed, last joint more or less acuminate; labial palpi three-jointed, nearly truncate; Antennæ eleven-jointed, straight, slender, first joint elongate, the last nearly truncate or sloping, acuminate beneath; Thorax nearly always straighter than the elytra, round at the base, truncate before, posterior angles obtuse or round, having nearly always rows of punctures; Scutellum triangular, Elytra truncate, Tarsi five-jointed, Abdomen of six distinct segments. The genus might be divided into two sections, in the first of which the thorax had no punctures. There was only one British species in this section, Quedius brevis, with red elytra, antennæ, and legs. This species was found frequenting ants' nests. The other section, which comprehended all the other species, had upon the thorax two series of thin punctures, and might be subdivided as follows:—1st division:—Elytra nearly smooth, having a series of punctures; Species, impressa and lævigatus, the first being of a brilliant black colour, the other a brilliant brown black, and found amongst decayed leaves. 2nd division:—Elytra having an uniform punctuation, with the scutellum punctured; Species—molochinus, rufipes, semi-obscurus, attenuatus. Mostly found under dung. 3rd division:—Elytra having a uniform punctuation, Scutellum smooth. This comprehended the remaining species. Cruentus and seitus were subcortical species. Auricomus was found in wet moss in or near waterfalls; the abdomen of this species was striped with silvery or golden pubescence. The other species might principally be found among dead leaves or in haystacks.

CHEMICAL AND PHOTOGRAPHIC SECTION.

Wednesday, December 12th.—Mr. P. J. Worsley, F.C.S., President of the Section, in the chair.

The Secretary announced that several members had not paid their subscriptions, and it was therefore agreed to strike off the names of those whose subscriptions were more than a year in arrear.

The PRESIDENT said that he had a few small facts to bring forward—as he thought it a pity that any should be lost, though it was difficult to estimate rightly the value of small observations. The first was the production of pure silica on a large scale, as a by-product in the manufacture of super-phosphate of lime. This substance was produced by acting upon coprolites, which were practically fossil bones, by sulphuric acid. It had been often noticed that a very offensive odour was given off during the process, accompanied by the deposit of a white substance. Investigation showed that the vapour was that of hydrofluosilicic acid, from the fluorine in the coprolites, in which there was a greater percentage of that element than in ordinary bones, and that the white deposit was pure amorphous silica, resulting from the decomposition of the acid.

The second fact was the accidental formation of crystals of iron pyrites. Some iron pots used in the sublimation of chloride of ammonium had been thrown out of use for a few weeks, and at the end of that time, in the interstices of the brick and clay surrounding them, were found these crystals. Sulphate, and chloride, of ammonium, had been heated with charcoal in these iron pans, and the mutual reaction of these substances had produced this effect.

A specimen of superphosphate of lime was shown, apparently quite dry, which became pasty and almost liquid, when an attempt was made to powder it. An explanation of the cause of this was sought.

Mr. W. L. CARPENTER exhibited a series of very beautiful photographs of Swiss scenery by Braun, chiefly taken in the Bernese Oberland and the district immediately East of it.

Mr. BEATTIE stated that he had been able to keep a wet collodion plate sufficiently moist for use for eight hours by adding glycerine to a neutral bath, or to one slightly acidified by acetic acid. His formula was 1 oz. of pure glycerine, 1 oz. of water, 1 oz. of a 30 grain solution of nitrate of silver. He also said that the result of many observations led him to believe that the use of decomposed fixing solution, rather than imperfect washing, was the cause of the fading of photographs.

ZOOLOGICAL SECTION.

THURSDAY, DECEMBER 13TH.—Dr. H. FRIPP, President of the section, in the chair.

Mr. S. BARTON exhibited a rare and remarkable Coleopterous insect from Natal, and a specimen, preserved in spirit, of the Phalanger, or Australian (so-called) opossum, taken from the pouch of a female which he had shot.

The PRESIDENT exhibited microscopic preparations of a peculiar Acarus found in a box of bran from the West Indies, remarkable for its curious jaws, adapted for crushing, and for its four pair of legs. It had probably been a parasite on corn.

A set of shells from various parts of the world, presented to the Institution by Miss Jellie, of Redland, was exhibited.

Several joints of bones of the Dinornis, the gigantic extinct bird of New Zealand, lately presented to the Institution by Mr. Joseph Vickery, were laid on the table. Mr. W. Sanders made a few remarks upon them. The earliest published notice of the bird was in 1839, by Prof. Owen, who had examined a fragment of a leg-bone which had been brought first to that Institution, and had decided that it must have formed part of a gigantic bird. Other similar bones had been found in Madagascar. Three species were believed to have existed, all larger than the Dodo. Casts of the leg-bones were shown, and drawings of the other parts. Much time was spent in comparing the phalanges and other bones exhibited, with the drawings in Professor Owen's memoir, and endeavouring to ascertain their exact position and relation to one another. The various joints did not appear to have belonged to the same limb.

BOTANICAL SECTION.

Thursday, December 20th.—Mr. W. Sanders, F.R.S., F.G.S., President of the Society, in the chair.

Mr. J. W. Clarke exhibited a series of microscopic preparations illustrating the fructification of ferns, including those of Davalia Canariense, Nothochlæna nivea, (or argentea), Niphrolepis pectinata, and of two New Zealand ferns, Ligodium articulatum, and Trichomanes elongatum.

Mr. Pockson laid on the table the first part of a work on "The Flora of Devon and Cornwall," by Mr. I. W. N. Keys, curator of the Plymouth Institution, comprising the orders from Ranunculaceæ to Geraniaceæ.

A small collection of British mosses, collected over a period of nearly twenty years by the late Mr. William Tanner, was also presented to the Section, through Mr. Pockson. The collection included nearly 130 species, many in very good condition, showing fructification, &c., and each specimen was labelled with its name, as well as the place and date of its collection.

Mr. T. H. Yabbicom, Hon. Secretary of the Section, then brought forward some notes on the growth and structure of the Hyacinth, and illustrated his remarks with several sketches, and a very interesting series of microscopic preparations, by which the structure of the various parts was clearly demonstrated. Commencing with the seed, the contained embryo was pointed out, and its first development explained. Being monocotyledeous, its first appearance above ground was like a single blade of grass; only one radicle was seen, in which was a small swelling, which subsequently was developed into the bulb, the seed never being transformed into the bulb. The structure of the bulb at the end of the first, second, third, and subsequent years was here explained. At the base was a spongy mass of spiral vessels and raphides, and above were the scales, which were differentiated so as to form the flower-buds. Roots were not absolutely necessary to its development, as flowers had been made to grow downwards into water from an inverted bulb. The structure of the root, leaf, and flower-stem was then demonstrated, and the cellular tissue, spiral vessels, raphides, and numerous stomata pointed out, the unusual fact being noticed that these organs were more numerous on the upper than on the under surface. The flower was then spoken of, the anthers, pollen, and stigma being shown microscopically, the fringe of glands which secreted the fertilising matter being clearly seen on the last-named organ. The abundance of starch in the bulb was then noticed, the size of the granules being between those of maize and of rice; also the abundance of raphides of oxalate of lime, in every part of the plant; and the speaker concluded his communication with some remarks upon the influence of light upon the inflorescence of the hyacinth.

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PROCEEDINGS

OF THE

BRISTOL NATURALISTS' SOCIETY,

(Established 1862,)

FOR THE YEAR 1867.

EDITED BY

WM. LANT CARPENTER, B.A., B. Sc.,

Honorary Reporting Secretary.

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1867.

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List of Errata.

PAGE.	LINE.	
11	12	*for* 'Rhindophidœ' *read* Rhinolophidœ.
12	38	*for* 'Alterolans' *read* Altivolans.
13	1	*for* 'zerotinus' *read* serotinus.
13	9	*for* 'beerimanus' *read* brevimanus.
13	10	*for* 'Rhindophus' *read* Rhinolophos.
14	6	*for* 'brown' *read* black.
14	32	*for* 'Rodrignez' *read* Rodriguez.
18	LINES 4 & 8 from bottom, and page 19, line 1,	*for* 'Apthonia' *read* Apthona.
18	" 4 & 7 from bottom,	*for* 'lutiscens' *read* lutescens.
19	LINE 1	*for* 'Barker' *read* Barber.
21	10	*for* 'ganoid' *read* placoid.
42	10 from bottom,	*for* 'Antigua' *read* antiquus.
42	8 ,, ,,	'Trochii' *read* Trochus.
42	8 ,, ,,	'Scalaris' *read* Scalaria.
42	8 ,, ,,	'Acuminata' *read* acuminatum.
42	5 ,, ,,	'Aplesia' *read* Aplysia.
100	3 ,, ,,	'of' *read* or.
101	13 ,, ,,	'waters' *read* wastes.
103	20,	*after* 'barren' *insert* sand.
104	40,	*for* 'progress' *read* process.
105	16,	*after* 'water to' *insert* keep.
106	6 from bottom,	*for* 'Chew' *read* Kew.
109	25	*for* 'glanular' *read* glandular.
109	25	,, 'tubercles' ,, tubules.
109	29	,, 'tubercle' ,, tubule.
109	30	,, 'oval' ,, anal.
109	40	,, 'securing' ,, secerning.
110	2	*after* 'unreasonable' *insert* to suppose.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

Vol. II. JANUARY, 1867. No. 1

GENERAL MEETING.

THURSDAY, JAN. 3RD, 1867.—Mr. W. SANDERS, F.R.S., F.G.S., President, in the chair.

The HON. SECRETARY called the attention of the Society to the two donations which had been noticed in the report of the meeting of the Botanical Section, at vol. I. p. 97, of the Proceedings.

The HON. TREASURER, Mr. W. W. Stoddart, rose to make some remarks, not, he said, in a grumbling spirit, but with the hope that a full report of what he said would be given in the Proceedings, and so the attention of all members would be drawn to it. He regretted to have to complain of the enormous difficulty he had, even with the aid of a paid collector, in obtaining the subscriptions, and more especially the extra 2s. 6d. which had been resolved upon at the October and November meetings. Last year 600 visits were paid to obtain the five-shilling subscription, and even then there was a large amount in arrear; this year more than 1,000 visits had been paid for the extra 2s. 6d. alone, and he looked forward to having to pay about 1,600 visits this year, if the same unwillingness to pay were shown. This ought not to be in their society, which did not number 300 members. He regretted also to be obliged to say that some members had even refused to pay the increased amount. Each member cost more than 6s. yearly, for the printing, postage, and delivery of the Proceedings in their new form. He sincerely hoped that after these remarks had been read by members, he should have no more difficulty in collecting his money.

Mr. W. L. CARPENTER exhibited some very large and thin sheets of glue, which had become detached from the interior of a cask used for holding paraffin oil. The glue had apparently been rolled about in the empty cask while hot, and had subsequently separated from the wood. In some places minute portions of the woody fibre had been torn off, but on the whole, the sheets presented, even under considerable magnifying power, an exact mould of the structure of the wood, showing both the longitudinal ducts and the transverse markings, so familiar to all who were acquainted with the microscopic appearance of thin sections of wood.

Dr. Henry Fripp then read a paper upon "Recent Discoveries in Insect Embryogeny," of which the following is an abstract kindly furnished by the author.

Dr. Fripp gave an account of the recent discoveries of Wagner, Meinert, Pagenstecher, Ganine, and Leuckart, respecting the propagation of larval broods of Miastor metralous and Oligaries (two new species of Cecidomyiæ), and remarked that fresh instances would probably come to light as observations were extended. On comparing the several accounts of the authors above-named, great diversity of opinion appeared to exist respecting the source of the "germs" or "pseudova," from which the successive broods were produced. All, however, agreed in tracing back a thread of genetic connection between the larval broods and progenitors possessing the characters of maturely-developed and perfect insects. The phenomena were referred therefore to the well-known case of "alternate generations." The points of interest to be discussed involved questions of structure and of function. Firstly, the actual histological facts of the case; secondly, the anatomical interpretation of these facts; and lastly, the physiological inferences that might be drawn from them.

1. The true derivation of the larve-germ. Taking as a starting-point the veritable egg of the female insect, we find that it is remarkably large, and furnished with a micropyle, which sufficiently proves its capacity for fertilisation. It contains a germinal vesicle and vitelline matter, which undergoes the process of segmentation, and an embryo is developed according to the ordinary type of formation. This embryo reaches the condition of a perfect larva. (The very complex and perfect organisation of this larva was described and illustrated by diagrams). From the concurrent testimony of all the above-named writers it may be received as proved, that a portion of the contents of the egg not employed in the formation of the larva was enclosed within its body, and though by Messrs. Wagner and Meinert it was maintained that this residual matter actually became converted into "adipose tissue," the other naturalists agree in considering that it constituted a special organ, in fact, a sexual gland analogous in function with the ovary of a mature insect. This internal organ, therefore, immediately derived from cell elements existing in the original egg, possesses the power and function of a reproductive apparatus. So far, then, a direct continuity of genetic act, and a direct succession of organic elements specialised for a given function, may be assumed. In the next place it is proved that from this reproductive body germ-cells are produced, which histologically correspond with the 'pseudova' of other insects and various invertebrate animals. Within the body of the larva formed from the egg,

five or more larvæ are thus reproduced from an equal number of "pseudova." In the process of development of each pseudovum, a portion of its contents (polar cells) passed into the new larval body, and probably formed the germ-mass or ovary of this secondary larval brood. Meinert indeed objects to the interpretation of this germ-mass as an ovary, because no stroma or structure resembling the ordinary ovary can be discovered. It is, in fact, a mass of granules imbedded in a protoplasm, and contained within a membranous investment, but the development of true cells from these granules is established, and the continuous differentiation of these cells results in the formation of a complete "pseudovum," in which a germinal cell and vitelline mass, as well as "polar cells" are successively to be seen. An indefinite series of broods is thus produced, each parent-larva dying as soon as the complete development of its progeny has been accomplished. Consequently these larvæ never attain to any maturity as insects, although they contain in their interior a reproductive organ, and this body may be presumed to represent by direct descent (through the medium of the polar cells) distinct portions of ovarial organs, the product of original matter in the egg of the female.

2. Anatomically interpreted, the source of the reproductive body in each larva must be referred to a process of organic development, which was commenced in the insect from which the first larva was bred. The substance of the egg destined for the formation of a sexual gland, instead of being completely organised in the primary larva, appears to be organised in successive portions, each of which is transferred to and enclosed in the successive individuals of each brood. The growth of these portions by endogenous multiplication depends on the growth of the larvæ containing them, but there appears to be but a slight anatomical connection of the germ-mass with the tissues of the creature in which it is located. The growth is favoured in the first instance simply by nutritive imbition from the fluids of the parent larva, afterwards by the progeny living upon the parent tissues. In this respect the connection of the germ-mass with the adipose tissue of the parent larva is significant, the material of this adipose tissue being itself derived from residual substance of the egg and pseudova.

3. Physiologically interpreted, the germ-mass must be viewed as deriving its procreating power from the original insect. The act of reproduction commenced by sexually mature insects, is extended over the whole cycle of intermediate individuals, whose participation is limited to being the bearers only of an organ whose powers and functions belong to an antecedent generation. In such larval propagation the larva appears to have only the functions of a 'nurse.' For though provided with a true internal organ of reproduction, the larva, as a sexually immature animal, cannot concur in any generative act. To such an act, the presence and influence of male elements must be considered essential. Its apparent fecundity is therefore

simply an heritage. In view of the recent statements of Mr. Balbiani, respecting the androgynous condition of the Aphis, a question presents itself for discussion; namely, whether the polar cells of the pseudovum can be interpreted as representing male as well as female elements. As far as present observations go, this hypothesis is negatived by every writer, since each of them expressly states that nothing bearing the least resemblance to sperm-cells or spermatozoa could be seen. The several descriptions of the germ-mass or sexual gland point distinctly to its ovarian character, though considerable diversity of opinion is shown respecting the exact analogies of the germ-mass itself, and of the reproductive bodies yielded by it. Histologically the germs correspond with pseudova, and their development without fertilisation (except indeed this fertilisation be supposed to have been already effected in the insect egg) places the phenomena on the special footing of a parthenogenetic process. A particular interest therefore attaches itself to the question whether there be a limit (and what limit) to this procreating power, and under what conditions is it exhausted? Do the phenomena resolve themselves into an act of mere growth capable of being indefinitely prolonged? The doctrine of alternate generation expressly limits the act of propagation to the production of a series of individuals intervening between two generations of sexually mature individuals. The notion of genesis also necessarily implies speciality of power and function, however interrupted by transference from one nurse to another, and can scarcely be reduced to mere repetitive multiplication of immature animals. The fact remains that an insect egg supplies in separate portions materials from which new individuals are formed, and materials which continue the functions of reproduction—ultimately, therefore, many mature individuals must result from this compound egg. In the plan of creation, the multiplication of individuals and continuity of species is equally effective, whether each separate egg becomes a mature individual or a large egg subdivides itself into portions which successively produce a progeny. The genetic relation is equally preserved, and it is a secondary question whether each individual must of necessity be a progenitor by its own act, or simply participate in a particular phase of genetic phenomena already initiated. Reproduction must always remain a specialised function distinguished from the more general act of growth, and the heritage of procreating power is equally distinct from the nutritive life and vitality of a creature capable of an individual and independent existence, though incapable of attaining the perfect form; the final phase of creatures that pass through metamorphoses more or less perfect until they attain the complete type, is usually the performance of genetic functions. But we see in a multitude of instances that metamorphosis belongs rather to the particular life of the individual than to any purpose of continuing species; it is at least, as we see in the case before us, no necessary condition to the perfect fulfilment of the gestating function in unmature creatures, such as our larvæ perform.

Larval propagations can, however, only be interpreted as a partial phase, not as the whole and complete act of genesis.

The PRESIDENT, in inviting discussion, remarked upon the elaborate character of the paper, and observed that the subject treated of in it reminded him of a toy, common in his youth, of a number of eggs, one within another; only, to render the comparison more complete, it would be necessary that each egg should grow and develope while it was being 'skinned.'

Dr. FRIPP spoke of the presence of adipose tissue in the early stages, and of the subsequent discovery of a sexual organ, which might be regarded as a sort of continuation of the original formative matter.

Mr. BEATTIE enquired whether matter was not perfectly passive?

Dr. FRIPP quite agreed with the last speaker in that point, and contended that this rendered the idea of the phenomena of reproduction nearer to that of the phenomena of growth.

Mr. LEIPNER was doubtful to what extent the phenomena described differed from parthenogenesis, in which the male element present was, so to speak, hereditary, while in true genesis the elements were divided between two individuals.

Dr. FRIPP doubted whether there was such a thing as true parthenogenesis; if it did exist, it was not anatomically distinguishable from the other. It was still in dispute whether the Coccus-egg was a true egg, if it was acknowledged that an egg was a thing which required fertilisation before it would convert.

Mr. W. SANDERS enquired whether the development of the seed into the tree was not an analagous process.

Mr. W. L. CARPENTER did not think so, as the seed did not require fertilisation, but developed by a process of growth, or gemmation, a term which had long been used also to describe the mode of reproduction among the zoophytes and other lower animals.

Mr. A. LEIPNER concurred in the remarks of the last speaker, and said that the only correlation in the vegetable kingdom to the process described by Dr. Fripp was among the Ferns, Equisetaceae, &c., the spores of which developed first into the prothallium, which acted as a sort of 'nurse' to the antheridia and archegonia, organs corresponding to the essential parts of the flower in flowering plants; then the antherozoids fertilised the germ-cells contained in the archegonia, and young plants were speedily developed.

MEETINGS OF SECTIONS.

ENTOMOLOGICAL SECTION.

TUESDAY, JANUARY 8TH, 1867.—Mr. STEPHEN BARTON, President of the Section, in the chair.

It having been proposed that if possible the night of meeting should be changed, a conversation ensued on the subject, but since it was found that the present evening of meeting appeared quite as convenient to the majority of members as any other that could be named (if not more so) it was determined that no alteration should be made.

This being the annual meeting of the Section, the members present, in accordance with the rules, proceeded to elect a President and a Secretary for the ensuing year.

Mr. STEPHEN BARTON was re-elected President, and Mr. GEORGE HARDING, jun., Hon. Secretary.

The accounts having been audited, it was found that there was a small balance due to the Treasurer.

Mr. A. E. HUDD exhibited a box containing Acentropus niveosalis, a singular Lepidopterous insect. The larva of this species was aquatic, feeding under water on Potamogeton pectinatus, and forming a cocoon of short pieces of its food-plant woven with silk. The box also contained Crambus Paludellus, from Ranworth fens, and Cnephasia cinctana, a species first taken in England in 1857, near Dover, by the Rev. S. C. T. Beale, which had since been met with in two or three localities near London.

The PRESIDENT said that his remarks on Mr. Napier's paper were incorrectly reported at page 91 of the Proceedings. The words "larvæ" and "perfect moth" had been transposed, thus conveying exactly the opposite idea of what he really said.

CHEMICAL AND PHOTOGRAPHIC SECTION.

WEDNESDAY, JANUARY 9TH, 1867.—Mr. P. J. WORSLEY, F.C.S., President of the Section, in the Chair.

This being the annual meeting, the Secretary made a few remarks on the state of the Section. In 1866 three members had resigned, and three new members had joined. Some few so-called members never attended or paid their subscriptions. The audited accounts showed a balance in hand, out of which it was resolved to give £2 2s. to the general funds of the Society.

The election of Sectional officers then took place, Mr. Worsley being re-elected President, and Mr. A. Noble, Hon. Secretary. A vote of thanks to these gentlemen for their past services was passed, which they each acknowledged the secretary commenting upon the small number of active and working members.

Mr. John Beattie then made a verbal communication upon points of great interest to photographers. After a short review of the latest improvements in photographic printing and lenses, he exhibited some fine specimens of large photographs printed on, and fused into glass, by M. Joubert, and explained the mode of their production. He also showed some specimens which he had prepared of subjects printed upon a new enamelled paper, which was supplied in a sensitised condition, but the preparation of which was kept secret. Photographs on this paper were believed to be more permanent than, and to possess other advantages over, ordinary photographic prints.

Mr. Beattie then described somewhat fully the construction of a new patent portrait lens, just introduced by Mr. Dallmeyer. The great difficulty with portraits had always been to get definition of a distinct yet soft character, free from hardness of texture on the one hand, and from a certain 'fuzziness' on the other; or, as it was technically termed, to obtain proper diffusion of focus. While Landscape lenses, both in this country and in America had undergone many improvements, such as wide angular aperture, equal diffusion of light, freedom from distortion, &c., the Portrait lens, since Petzval's marvellous invention, had not undergone any change in principle until this discovery of Mr. Dallmeyer's. In the new lens, the flint element of the back combination was made to unscrew, and thus to be separated from the crown lens, thereby introducing any desired amount of positive spherical aberration, without disturbing the other necessary corrections of the objective as a whole. In this way any desired amount of softness could be obtained at the will of the artist, who was enabled to secure an equalized diffusion of focus over his whole subject, besides gaining greater penetration. Mr. Beattie considered that this lens would greatly elevate the art of photographic portraiture.

ZOOLOGICAL SECTION.

Thursday, January 10th, 1867.—As only the officers of the Section were present, Dr. H. Fripp, President, and Mr. S. H. Swayne, Hon. Secretary, the meeting was adjourned for a month. An examination of the accounts showed a slight balance in hand.

BOTANICAL SECTION.

FRIDAY, JANUARY 18TH, 1867.—Mr. A. LEIPNER, President of the Section, in the chair.

This was the annual meeting for the purpose of passing the accounts and electing officers for the ensuing year. The attendance was small. The accounts showed a balance in hand, and on the motion of the secretary, a donation of a guinea was voted to the library fund of the Parent Society.

The Sectional officers, Mr. A. LEIPNER, the President, and Mr. T. HENRY YABBICOM, the Hon. Secretary, were then re-elected, with thanks for their services for the past year.

The remainder of the evening was spent in preparing specimens for the Society's herbarium.

GEOLOGICAL SECTION.

THURSDAY, JAN. 24TH, 1867.—Mr. W. SANDERS, F.R.S., F.G.S., President of the Section and of the Society, in the chair.

The accounts of the Section for the year 1866 were read and passed, showing a small balance in hand, from which it was agreed to give a donation of one guinea to the Library Fund of the Parent Society.

The Hon. Secretary, Mr. ASHMEAD, made some remarks upon the state of the Section, from which it appeared that the number of resignations was balanced by the number of new members elected, the present number being 23. A list of the papers contributed, and of the geological walks taken during the year, was read, and it was mentioned that the *Geological Magazine* had been regularly circulated amongst the members.

Major THOMAS AUSTIN, F.G.S., then read the following note on the cast of Camorocystitis punctatus in the Institution —

"On a careful examination of the cast of the so-called Camorocystitis punctatus, I have no hesitation in ascribing the curious external appearance as exhibited on the specimen to the labours of coral polypes, which have affixed their cells on to some substance below, probably the body of a Crinoid, but of this we have no positive proof. The column is undoubtedly that of a Crinoid, as are also the rays, but the external envelope on the intermediate object in every particular repudiates the idea of its belonging to the Crinoidea. In all known Crinoids the lateral plates near the centro-dorsal plate are invariably larger than those near the ventral portion, while in this specimen the reverse of this is the case, the lateral body plates being smaller below, and gradually increasing in size as they approach the rays, a character quite at variance with all previous observations, and as may be seen in the two specimens of Periechocrinus on the table. That the body of a Crinoid lies beneath the incrusting coral (Michelinia) I do not deny, but judging from the external character of the specimen, it appears evident to me that the so-called Camorocystitis is nothing more than an extraneous envelope which covers something that we do not see, and which therefore can only form a subject for conjecture. In conclusion, I must remark that not having seen the original specimen, the foregoing observations are alone founded on the cast of this supposed Crinoid."

After examination and comparison of the specimens by the members,

Major Austin read some observations on some species of Caradoc and Carboniferous Trilobites, specimens of which were exhibited, in illustration of his remarks.

"The brief observations I am about to make, relate more particularly to some specimens of Trilobites which are not generally known, and which appear to me to possess more than ordinary interest. The specimen of Phillipsia ornata, which I obtained from the carboniferous limestone, Hook Point, county of Wexford, is, I believe, the most perfect specimen that has yet been obtained of this species, having the head or cephalic shield, (the component parts of which were so well described by Mr. Stoddart on a former occasion,) the thoracic portion, and pygidium attached, and though the specimen is somewhat distorted, it has the dorsal parts complete. All the other specimens of this carboniferous Crustacean hitherto obtained consist of the pygidium only. The three other specimens on the table from the same locality show the interior of the crustaceous covering of the pygidium, but present nothing very remarkable.

The next specimen, which is from the Derbyshire carboniferous limestone, has a wide tuberculated marginal border around the pygidium. This border appears much more expanded when compared with the generality of specimens, and I cannot avoid thinking that some little confusion prevails in identifying and referring species to the genus Phillipsia, as specimens differ so much in respect to this marginal border, some having a plain wide margin, others a wide tuberculated one, while in others it appears as only a narrow contracted edge, as may be seen in the various specimens on the table.

The Silurian specimen of Salteria involuta, from the Caradoc beds at Little Newtown Head, near Woodstown, County of Waterford, has only recently been named, although it was first discovered by me in the year 1839, as was also the Acidaspis Jamesii, which latter fossil is peculiar to this particular locality. Ampyx Austinii, (Portlock's Geol. Rep.) I likewise discovered at the same time and in the same rocks.

Prof. E. Forbes considered A. Austinii as identical with A. mammillatus of Sars, but it is not so, the latter species having long lateral appendages, which are wanting in A. Austinii. Up to the period named, the genus Ampyx had not been known as occurring in the United Kingdom. Several species of Trinucleus and other forms occur in the same locality, T. seticornis being abundant. Calymene Blumenbachii, variety brevicapitata, is not scarce in the same strata, and although the patch of rocks which have been denuded to a level with the sandy shore is not much more extensive than the area of our museum, yet thousands of fossils pervade the very limited mass. In the same beds I found several specimens of Bellerophon perturbatus, with hundreds of the small Orthis striatula, which are most beautifully preserved. These rocks, which have yielded so many interesting specimens, are covered at high tide, and had altogether escaped the notice of the Geological Surveyors, until I pointed them out to Sir Henry James, then employed as an officer of Engineers on the Survey. The measured section of Little Newtown Head shows the limited area occupied by the fossiliferous portion of rocks. The more extensive beds of stratified deposits appear to have been acted on by the adjacent trap dyke when in a state of fusion, until the more siliceous portions became converted into a quartzite, and all traces of organic forms were obliterated.

It may here be observed that I lent my specimens to General Portlock, who figured several of them in his Geological Report of Londonderry and Tyrone, one of which specimens he named Asaphus dilatatus, pl. 24, fig. 2; he also alludes to my discoveries, at page 293, in the following words—"communicated by Major Austin," yet notwithstanding this clear acknowledgement of the source from which the specimens were derived, Mr. Salter has renamed the A. dilatatus, calling it Ogygia Portlockii, *dedicating it to the General as its discoverer!* Decade 2, t. 7."

The paper concluded with some remarks upon Trilobites generally, their habits, probable position in the animal kingdom, &c.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

Vol. II. FEBRUARY, 1867. No. 2

GENERAL MEETING.

Thursday, February 7th, 1867.—Mr. W. Sanders, F.R.S., F.G.S., President, in the chair.

The Hon. Secretary announced the donation to the Society's Library of a Catalogue of British Mollusca, compiled from the first three volumes of Mr. Gwyn Jeffries' Conchology, by Mr. H. K. Jordan, F.G.S., presented by the compiler.

Mr. Thomas Graham Ponton then read a paper on some of the less known British Mammalia. The animals which formed the subject of this communication, which was illustrated by a number of specimens from the Museum of the Institution, and by several drawings, were included in four orders and seven families, viz. :—*Felidæ*, *Mustelidæ*, *Vespertilionidæ*, *Rhindophidæ*, *Erinacidæ*, *Muridæ*, and *Arvicolidæ*, numbering seventeen genera in all.

Felidæ. *Felis Catus*, the wild cat, at one time so common, was almost extinct. In 1864 a specimen had been captured in Inverness-shire. The majority of the so-called wild cats were either domestic cats run wild, or their descendants. Characteristics; head triangular and strongly pronounced; ears large, triangular, and pointed; fur soft, long, and thick; colour, on the face greyish yellow, black-spotted on the muzzle, head grey, rest of the body grey, with darker stripes, and a dark line down the back, tail ringed with grey and black, feet and inside of the legs yellowish.

Mustelidæ. *Lutra vulgaris*, the otter, was still to be found frequenting retired trout streams and salmon rivers. Its natural food was fish, for the capture of which, its narrow cylindrical body, short fin-like legs, oar-shaped feet, and rudder-like tail, were beautifully adapted. In frosty weather it occasionally carried off small birds or animals from farm-yards. Head broad and flat, neck thick, eyes and ears small, feet webbed, fur short and thick, dark brown, with four white spots on the face.

Mustela vulgaris, the weasel, the pest of game preserves and poultry yards, followed its prey both by the eye and by scent, and when at fault, quartered over the ground like a dog. Birds of prey occasionally attacked the weasel, but not always with success. The weasel was reddish above, white beneath, occasionally changing to a dull yellowish white in winter, when it became the *Mustela nivalis* of Linnæus.

Mustela erminea, the stoat or ermine weasel, was larger and more rapacious than the last. Colour in summer, dull reddish brown above, white beneath, in winter wholly white, tip of the tail always black. In a mild winter the change of colour did not take place, showing that the colour only, and not the fur itself, was changed.

Putorius fœtidus, the pole-cat, fitchet, or foumart (*i.e.* foul marten, as opposed to the true or sweet marten) might be distinguished from the two last by its stouter build, and broad head. It was also much more rapacious.

Martes foina (Beech, or stone marten) and *Martes abietum* (Pine marten). The main distinction was in the colour of the throat, that of the former being white, and of the latter yellow, the fur of which last was generally considered superior. Dr. Gray, however, considered them even as distinct genera, founding his distinctions upon the forms of the skull and some other particulars. These animals were similar in their habits to, but not so destructive as, weasels, and were comparatively rare in Britain. Head triangular, eyes large and lustrous, body long and flexible, tail long and bushy, colour of fur a rich umber brown—usual length 27 inches.

Meles Taxus, the badger, was still to be found in Britain, especially in Devonshire. It was a most maligned animal, being accused of destroying rabbits, game, and lambs, whereas from the whole structure of the animal it was evident that its food was greatly, if not entirely, vegetable. Head elongated, body broad and flat, legs short and muscular, toes five in number, short, strong, deeply imbedded in the flesh, armed with flat powerful claws. Colour grey above, black beneath, head white, with a black stripe passing along the cheek to the neck. Its habits were very solitary and nocturnal.

Of the Vespertilionidæ or bats there were seven British genera, and the number of species was numerous, though many were rare, in some instances only known by isolated specimens. For this reason, it was much to be desired that every bat caught should be carefully examined.

Noctulinia alterolans, the noctule; Head flat and broad, muzzle long and obtuse; ears oval, wide apart, shorter than the head; tragus or ear-covering narrow at the base, expanding into a reniform top, covered with papillæ; fur reddish brown, soft and long. This bat was gregarious in its habits, and common in many parts of the country: it measured 14 inches in extent of wing.

Scotophilus Leisleri, S. discolor, aud *S. zerotinus* were three very rare species, the first two being only represented by single specimens.

Myotis murinus, the largest British bat, measuring $5\frac{1}{2}$ inches in length of body, and 15 inches in extent of wing, was confined to the gardens of the British Museum. Head long and hairy, nose and face nearly naked; eyes large; ears oval, pointed, inclining backwards; tragus falciform. Several other rare species of bats were then noticed, as well as some of the more common; among them were *Plecotus auritus,* the long eared bat, the ears of which were twice as long as the head; *P. beerimanus,* and *Barbastellus communis.*

Rhindophus ferrum equinum, and *R. hipposideros,* the horse-shoe bats, distinguishable at once by the cutaneous developement on the nose, consisting of two portions, one erect and hastate, placed at the base of the forehead, the other shaped like a horse-shoe, bordering the upper lip and extending backwards till it reached the other portion, thereby including the nostrils within its arch. The dentition also of the first species was peculiar, the incisors being very small, far apart, and falling early.

ERINACIDÆ. *Sorex fodiens,* the water shrew, found in several countries, lived chiefly on aquatic insects. It was a very shy animal, living in a burrow close to the water's edge. Feet broad, with a lash of stiff white hair on the edge of the toes. Fur silky, brownish black above, white beneath. *S. araneus,* the common shrew, frequented dry sunny places, and fed upon worms and insects. It was said to be a very pugnacious animal, and curious superstitions connected with it and with the shrew-ash-tree were noticed. *S. remifer,* the oared shrew, was the largest British member of the genus. Little was known of its habits, which were more or less aquatic. Colour black, but breast, throat, and abdomen were yellowish, the feet and tail being densely covered with stiff white hairs.

MURIDÆ. *Myoxus avellanarius* (hazel-eater), the dormouse. Head large; eyes prominent; body round, plump; tail flattened, rather bushy; colour of fur dull red. Habits gregarious, hybernating in winter, easily tamed. In feeding, it held its food in the forepaws, sitting on its haunches like a rabbit.

Mus sylvaticus, the field or wood-mouse. Head long and raised; muzzle tapering; whiskers very long; eyes remarkably large. This was a very destructive mouse.

Mus messorius, or harvest-mouse, the smallest British quadruped. Length of body $2\frac{1}{2}$ inches; of tail, 2 inches. Weight only 80 grains. The Rev. Gilbert White's description of its beautiful little nests was quoted, and it was stated that though it ate corn, grass, and seeds, insects were its favourite food.

Mus rattus, the black rat, common in England in 16th century, was supposed to have come from the East, but was now nearly extinct, having been extirpated by the *Mus decumanus,* the brown, or Norway rat. It was almost unknown in Norway, and only appeared in England 160 years ago, being probably introduced by vessels coming from India and Persia. It had penetrated to the Hebrides, and was not confined to towns, establishing colonies by riversides, farm-yards, &c., to the feathered inhabitants of which it was very destructive. In Paris, 16,000 were killed in one 'abattoir' in a single month. Its total length was 19 inches, that of the brown rat, 15½ inches.

ARVICOLIDÆ. *Arvicola amphibius*, the water-vole, often but erroneously called the water-rat, being perfectly distinct from rats, both in dentition and general appearance. Head short, thick, and blunt; eyes small; ears very small and inconspicuous; incisors yellow in front, strong, chisel-shaped; toes of hind feet not truly webbed; fur thick and glossy, umber above, yellowish grey beneath. All the best naturalists agreed that it was strictly a vegetable feeder, most of the depredations assigned to this animal being due to the brown rat.

Arvicola pratensis (or *rufescens*), the bank-vole, smaller than the common vole, and differing in internal anatomy. Eyes prominent; ears longer; body bright rust-colour on the back, ash-grey at the sides.

Arvicola agrestis, the meadow-mouse or field-vole, the most destructive of all British Rodents. In 1813 and 1814 they did immense damage in the Forest of Dean, and over 100,000 were killed. Head large; muzzle obtuse; ears very short; body thick, full; colour of upper parts reddish brown, of the lower, ash grey: total length 5½ inches.

Mr. Ponton thus concluded his paper—

> "Such is a short account of some of the less known British Mammalia. With the rapid advance of agriculture and civilization they are yearly becoming more and more scarce. It is advisable therefore that any information respecting them, and any specimens of them, should be carefully collected and treasured up; for the time may come when the wild cat, the otter, the marten, and many others, will be unknown in Britian, except by as scanty remains as the Moa of New Zealand, the Dodo of Mauritius, and the Solitaire of Rodrignez."

The PRESIDENT said that some years ago he saw a wild-cat which had been killed in the country, South of Wells; also that a few years ago the black rat was very common in a warehouse in Lewin's Mead. He was very much obliged to Mr. Ponton for his concluding remarks, and observed that new specimens of many of the animals described in his paper were much wanted for the Museum.

Mr. STODDART mentioned an otter having been shot at Bath in 1850 and another at Keynsham in 1866.

Mr. S. H. SWAYNE said that badgers were not uncommon in Herefordshire; he had watched them from a yew-tree coming out of their holes about 9.0 p.m., and was disposed to doubt their vegetable feeding.

Mr. THOMAS PEASE had seen several badgers on a hill at Tenby, and had also frequently noticed mice lying dead on the footpaths.

If the Arragonite had been covered by a thin film of quartz, it would thereby have been decomposed, and the deposition of the calcite upon the film we should easily understand, but not a trace of a siliceous film can be detected.

Nicol, in his mineralogy, states that Arragonite falls to pieces at a low temperature, but admitting that a low temperature had occurred should we not expect to find the fragments of the Arragonite left in the Pseudomorph. The only feasible idea that presents itself to my mind is, that after considerable decomposition—which left the surfaces of the Arragonite very uneven and jagged—a deposition of, it may be, the same Carbonate of Lime took place, covering the *salient points* of the original crystal (not entirely investing it) with crystals of Calcite.

After the Carbonate of Lime in solution had thus been deposited, the liquid became acidified and decomposition was renewed, no doubt the newly formed crystals of the Pseudomorph were now affected, but not sufficiently so as to dissolve them entirely. As soon as the solvent became saturated, a second deposition took place; this time, it may be, to largely increase the number of the crystals and to connect them together, still however, leaving many interstices such as we see in the Pseudomorphs on the table. A repetition of these actions would in time entirely decompose the Arragonite and form the Pseudomorph.

But whether this is nature's *modus operandi* I wish to know, and I sincerely hope that the members of the chemical section here present will be able to give us, if not a full explanation—at all events some suggestion as to the probable manner in which this highly interesting and somewhat rare pseudomorph was formed. It is a remarkable fact that no work on mineralogy with which I am acquainted explains the pseudomorph. Brooke and Miller, in their last edition of "Phillips' Mineralogy" (which probably is the best work of the kind published in the English language) simply mention it, but offer no explanation or remark as to its probable formation.

Mr. Jordan concluded his paper by indulging in a few æsthetical considerations suggested by the analogy between the mutations which occurred in the mineral kingdom with those that occurred in the vegetable world; which all tended to show the harmony of Nature and the ineffable wisdom and skill of Him "who made all things, and by whom all things consist."

The President remarked that the subject of Pseudomorphs was very difficult, and required much thought and study. Mr. Jordan had well described the six systems of crystallisation, and it was a great misfortune that there were several names in use for the same system, by different writers. So far as he could see, he considered that the formation of pseudomorphs was due to a gradual replacement of one set of atoms, singly and separately, by another. In the case of the stone-lilies, or Encrinites, so abundant in the limestone quarries of the neighbourhood, the stems of the living animal were formed of detached plates, but they had become truly petrified, and calcareous spar had taken the place of the whole substance of them so completely, that planes of cleavage in the rock would frequently go through several of these individual plates without detaching them from one another. He apprehended that the formation of pseudomorphs might go on in somewhat the same manner.

Mr. W. W. Stoddart spoke of the great difficulty of imitating in the laboratory natural processes of this kind, owing to the length of time required for the operation to continue, in order to produce any satisfactory result. Had he understood that mineral pseudomorphs were to be the subject of the paper, he would have brought down some illustrative specimens. Arragonite and quartz crystallised in two states, as regarded their action upon polarised light, being both right and left handed ; it was difficult to account for this, as the difference could only be detected optically, not by the external configuration. The speaker concluded by expressing his opinion that, since when a solution crystallised freely, it was always in one system, pseudomorphs were a collection of small crystals of the proper system forced into a mould, as it were, belonging to another system.

Mr. W. L. Carpenter corroborated Mr. Stoddart's remarks about the length of time, and said that as the elucidation of the subject had only attracted attention comparatively few years ago, when chemical and microscopic analysis had attained more perfection than previously, the experiments which, it was hoped, would throw light upon the matter, were still in progress. Dr. Percy, in a recent course of lectures on metallurgy, had referred to this, and closely connected with it was the deposition of minerals in veins, a subject hitherto little understood.

MEETINGS OF SECTIONS.

ENTOMOLOGICAL SECTION.

Tuesday, February 12th, 1867.—Mr. S. Barton, President of the Section, in the Chair.

Two volumes of the Magazine, and one volume of the *Entomologist* having being bound, the Hon. Sec. was desired to pass them to Mr. Leipner, for presentation to the library of the Society.

Mr. Barber exhibited a box containing several new and rare species of Coleoptera, and read the following note upon one of the new species exhibited, Apthonia nigriceps. "This species somewhat resembles Apthonia lutiscens and Thyamis atricapilla, but is much smaller, it is most like the latter species in form and color, but may be distinguished by the shorter and broader basal joint of its hind tarsi and its shorter hind legs. It may be distinguished from Apthonia lutiscens by its shorter oval form and its not being so flat as that species, also by its black head and scutellum, and having no black patch on the hinder femora, and by the antennæ not being so stout or deep black."

Mr. LEIPNER accounted for this by supposing that cats killed more than they could eat.

Mr. CARPENTER thought that these might possibly be shrews, which were often killed by dogs and cats in mistake for mice.

Mr. HENRY K. JORDAN, F.G.S., then read a paper upon Pseudomorphs. After some introductory observations, he said that all inorganic substances which crystallised—and but few were amorphous—crystallised in one or other of the six systems of crystallisation, the characteristics of which he pointed out; as a rule the crystals were of one system only, when the substance was said to be monomorphous. Several minerals, however, crystallised in two systems, or were dimorphous, as sulphide of iron, carbonate of lime, and others.

The author thus continued—

A Pseudomorph is a mineral which has not its own proper form, but a crystallographic form belonging to another mineral.

Thus we have Oxide of iron, which crystallizes in the Hexagonal system, in the form of Iron Pyrites, belonging to the Tesseral system. Again we have quartz, which belongs to the Hexagonal system, in the form of Fluor spar, which is a Tesseral mineral. These are Pseudomorphs.

Pseudomorphs may be classed under five heads, namely—

1st,	Pseudomorphs	by incrustation.
2nd	,,	by replacement.
3rd	,,	by loss of an ingredient.
4th	,,	by the gain of an ingredient.
5th	,,	by exchange of ingredients.

1st. A Pseudomorph by incrustation is formed when a mineral is deposited from a solution upon another pre-existing mineral, the form of which it assumes; the original mineral sometimes remains, but very often decomposes, leaving an empty Pseudomorph. This class of Pseudomorphs can only be formed in the cavities of a lode or vein.

2nd. Pseudomorphs by replacement are formed by a mineral being deposited from a solution, and filling up a cavity produced by the decomposition of a pre-existing crystal.

3rd. Pseudomorphs by loss of an ingredient often occur, and are in most cases easily understood. Crystals of Sulphide of Iron, exposed to the atmosphere, or to oxygen, lose their sulphur by its oxidation—oxide of iron only remains.

Oxide of Copper, by loss of its oxygen, is turned into metallic copper.

A mineral called Heulandite, by the loss of its Alumina and Lime, becomes quartz.

4th. Pseudomorphs by gain of an ingredient. I can illustrate this class of Pseudomorphs with the specimens of carbonate of copper after red oxide of copper. These crystals were formerly oxide of copper, the colour of rubies, but carbonic acid having been generated by some mineral decomposition, and brought into contact with the crystals, chemically combined with them, and changed them into green carbonate of copper. Crystals of Galena (sulphide of lead) are converted into sulphate of lead by the addition of oxygen. Anhydrite by the addition of water is converted into gypsum.

5th. Pseudomorphs by exchange of ingredients are by no means uncommon. Galena (sulphide of lead) becomes Pyromorphite (or phosphate of lead) by the exchange of sulphur for phosphoric acid, and *vice versa.* Carbonate of lead (cerusite) becomes sulphate of lead (anglesite) by exchange of carbonic acid for sulphuric acid. Malachite, which is a carbonate of copper, becomes sulphide of copper by the exchange of carbonic acid for sulphur. These resulting minerals appear in a crystallized form not belonging to them, but belonging to the original mineral, and they are thus Pseudomorphs. We can explain many of the changes that have taken place underground. The decomposition of sulphide minerals, such as iron pyrites, results in sulphuric acid being formed, and the action of this acid greatly changes the character of the minerals. All the carbonates in that lode or vein would be dissolved and afterwards crystallized as different substances and in different forms. Thus, calcite would be connected with gypsum. Oxides and carbonates would become sulphates, and so on. It is, however, impossible to say what cause induced the first decompositions.

I have now given a brief description of Pseudomorphism, and come to the subject to which I alluded in the commencement of my paper, viz., how to account for the occurrence of an incrustating Pseudomorph of Calcite after Arragonite.

I had perhaps better repeat what I have previously said respecting these minerals. Both are exactly the same chemical substance, namely, carbonate of lime; both are chemically expressed by the same formula, $Ca\,O, CO_2$ But they differ mineralogically in these respects—Calcite crystallizes in the hexagonal system, and has a hardness of 3 in the mineralogical scale, whilst Arragonite crystallizes in the fourth or rhombic system, and possesses a hardness of 3·5 to 4, and a slightly greater specific gravity than Calcite. Both are soluble in acids, but Calcite perhaps more readily so than Arragonite.

When at Cleator Moor, near Whitehaven, some years ago, I got a goodly number of specimens of Arragonite, which occur there nicely crystallized in fair abundance, associated with Hematite. I also obtained some Pseudomorphs by incrustation of Calcite after Arragonite. The Arragonite had entirely decomposed, and had left the Calcite as a hollow form.

Now, the question is, by what agency was this effected? We have seen that both minerals are soluble in acids, how is it, then, that the investing mineral Calcite remains, whilst the original substance, which is somewhat more difficultly soluble, has decomposed? Would it not seem to us probable that the exposed Calcite would have been more liable to decomposition than the protected Arragonite, and should we not be inclined to say that the agent which affected one substance would have affected the other?

Quartz pseudomorphs by incrustation, after soluble minerals such as Calcite, Dolomite, Chalybite, Fluor spar, &c., are common, but these we can understand because the investing substance, Quartz (i.e. silica), is insoluble in acids, and further it is probable, if not certain, that the decomposition of these minerals is caused by the deposition of the Quartz; for a hot solution of silicic acid decomposes Carbonates.

Another new beetle exhibited by Mr. Barker was Apthonia atratula. "This insect appears to be allied to A. herbigrada, but is black with a transverse thorax which is also more finely punctured."

Mr. Barton exhibited fine species of Carenum, from Victoria, and remarked upon the difficulty of dividing species by the punctures upon the elytra—a mode of multiplying species very prevalent at present—and instanced one species exhibited, Carenum marginatum, some with the elytra perfectly smooth, and others deeply punctate-striate; these by some had been divided into species, but having seen specimens run gradually from deeply punctate-striate to perfectly smooth individuals, he had but little doubt that they were one and the same species.

C. Spencii and C. tenitilatum. These species were rare, and the very few examples captured were not sufficient to ascertain whether they varied in the same manner as C. marginatum.

Mr. Barton also exhibited four specimens of Bolbocerus mobilicornis, and two of Bolbocerus testaceus, an insect which he thought would prove a variety of B. mobilicornis, and drew attention to the great variation in size of the insects exhibited, also remarking that the time would soon arrive when this rare species might be taken, if a little time and labour were spent in looking after it. Mr. Barton's specimens were taken in the neighbourhood of Baptist Mills and the Boiling Wells.

Mr. George Harding, the Hon. Sec. of the Section, then read a short paper upon the Dupanulæ. The Dupanulæ were a smaller order of moths, commonly known by the popular term of "hooktips," from the hooked form of the upper wing; they had a great resemblance to the Geometræ in the perfect state. *Larva* of the whole of the species smooth, with fourteen legs, and pro-legs wanting; pupa enclosed in a cocoon. *Imago*, antennæ of male pectinated; female generally filiform, abdomen slender in both sexes, wings comparatively broad, generally hooked at the tip. All the species, with perhaps one exception, appeared to be double-brooded. One species—Unguicula—flew commonly in the day-time in the beech wood at Stapleton, and two others—Hamula and Facula—might occasionally be seen flying by day. The author, after remarking that the Bristol district was the only one in the kingdom in which the whole of this family might be taken, took each species separately, and after describing the different larvæ and food plants, entered into abundant detail as to how, when, and where each species might be captured, and mentioned the uncertain appearance of some species of this group. Thus Unguicula might be found in great abundance during some years, while in other seasons not a single example could be obtained. Sicula was another species mentioned as of very uncertain occurrence; this fine species was first captured in the kingdom in May, 1837; a single specimen being taken by Mr. Metford on the slope over the river at Leigh. This insect was unique in the Rev. H. Burney's collection, to whom Mr. Metford presented it, till 1856, when two specimens were again met with at Leigh Woods. Again in 1859 several specimens were captured by the author and by Mr. C. Butler, thirteen altogether. The species had not been met with since, though constantly looked after, and not having occurred elsewhere, might be claimed as peculiarly a Bristol species.

CHEMICAL AND PHOTOGRAPHIC SECTION.

Wednesday, February 13th, 1867.—The attendance of members was so small that the meeting was adjourned for a month, until March 13th; and it was announced that a paper on Disinfection would then be read by the Hon. Secretary of the Section, Mr. Alfred Noble, F.C.S.

ZOOLOGICAL SECTION.

Thursday, February 14th, 1867.—Mr. Thomas Pease, Vice-President of the Society, in the Chair.

Being the adjourned Annual Meeting, a summary of the proceedings of the past year was read and the audited accounts were presented, showing a balance in favour of the Section of £2 7s. 7d.

Dr. Fripp was re-elected President, and Mr. S. H. Swayne, Secretary of the Section for the ensuing year. It was resolved to purchase vol. I of Günther's Zoological Record, to present it to the Society's Library.

Mr. Leipner read (for Mr. Ponton) the following paper by Mr. T. Graham Ponton, on the Classification of Fishes, with especial reference to the form of the scale as a means of determining genera.

"The classification of Fishes has always been a matter of great interest, and from the many difficulties connected with their anatomy, they have proved a fruitful field for the exercise of the ingenuity of Naturalists.

I propose this evening to consider very shortly the merits of the various different modes of classification, which have been from time to time proposed by various authors; confining myself, however, entirely to the *osseous fishes*.

Four different systems, namely those of Cuvier, Agassiz, Günther, and Owen, are up to the present pre-eminently in vogue with naturalists; although others have been proposed and to some extent adopted.

The first is that of Cuvier, or rather the modified form of his original scheme, which has of late been employed. This system, although to some extent convenient, is in many respects artificial, more especially the subdivisions of the Order Malacopterygii.

The next, that of Agassiz, although very convenient for the identification of fossil fish, for which purpose it was originally intended, fails when applied even in a modified form to recent fishes, to fulfil the necessary conditions of naturalness and convenience. In this system the osseous fishes are divided into two great sections, dependent on the form of the scale; the second of these being again sub-divided into the Cuvierian divisions of *Acanthopterygii* and *Malacopterygii.* This system is, as before said, found when applied to recent fishes, to be artificial; for example, the *Pleuronectidæ* are, on account of the form of the scale, separated from all the other Malacopterygii, and placed in the Ctenoid division, which is otherwise wholly composed of acanthopterygious fishes; with which, both from the nature of their fins and other anatomical differences, they have no natural affinity. In the Pleuronectidæ also genera occur in which the scale is ganoid, (*Turbot*) and also others in which it is cycloid (*Brill*). This would also prove a strong objection to their being placed as a family in the Ctenoid division.

Although these systems were good as far as they went, the rapid increase of late in the number of new genera and species, the recent revision of the older ones, and late anatomical investigations made by Dr. Günther, Professor Kner, and others, had rendered them in a great measure useless, and it therefore became necessary that another system should be devised. This task Dr. Günther undertook, and is considered, I believe, to have performed it most ably. He divides the osseous fishes into six orders, and it will be at once perceived that the number of families has been greatly increased.

Some years ago Professor Owen proposed a plan of classification for the fishes, with especial reference to fossil species. This system does not meet modern requirements; he has, however, proposed another in his recent work on the anatomy and physiology of the Vertebrata, which must be considered, I suppose, as superseding his former one. It is in some respects like that of Dr. Günther, but revives the old Cuvierian divisions of the Malacopterygii, which Professor Owen, in his former system, rejected as being artificial.

While upon the subject of Fish Classification, I wish to refer, shortly, to some investigations recently made by me on the form of the scale, as a means of distinguishing genera. It struck me that although it was not advisable to form orders simply dependent on the form of the scale, still perhaps genera might be determined by that means. With this view I examined some different scales, and found that in each genus the scale had a peculiar form, distinguishing it from the others, and that thus there was a ready means afforded for their discrimination. Unfortunately I have not been able to examine a sufficient number of scales to be able to lay it down as a constant rule that these differences exist. The form of the scale cannot be applied to the discrimination of species, for although certain differences of size generally exist, these are not sufficiently marked to be of service. The drawings on the table will illustrate the subject so far as I have gone."

This paper was illustrated with copies of the tables of classifications referred to, and with several microscopic preparations, drawings, &c.

BOTANICAL SECTION.

Thursday, February 21st, 1867.—The members of this section assembled at the residence of their President, Mr. Leipner, by whom they were hospitably entertained with tea.

After this refreshment the meeting was held, at which Mr. Leipner took the chair, and also delivered the first of a series of addresses upon Ferns. The subject would be treated in two parts—one to embrace a history of the development of the fern, from the spore to the perfect plant; the other a description of the structure of the plant itself. Taking the latter first, the speaker made some observations on the stem, the structure of which was described and illustrated with diagrams, and with a portion of the stem of a tree-fern, particular attention being called to those portions where the speaker's own observations differed from the descriptions usually given in handbooks of botany, the result being that the stem was shown to acquire a longitudinal increase of bulk, and was not during its living state hollow. Ferns might be divided into two classes, viz., those having a creeping rhizome, and those in which the undeveloped fronds formed a circular crown. These latter always had a definite number of fronds to the circle, and the fronds were formed simultaneously, or nearly so; owing to this the number of vascular bundles in the stem was also definite. The shape of these bundles in the frond was similar to those in the stem, and varied considerably; those in the stems of plants with winged fronds, as in Pteris aquilina, being horse-shoe-shaped, and an attempt had been made to classify the genera in this way, but had failed in consequence of difference of form. The venation of ferns was characterized by continual forkings. The reproduction of ferns was accomplished either by budding or by spores. Of the budding process there were four divisions. (1). Growing buds formed on the upper surface of the fronds, as in Asplenium flaccidum. (2). Growing buds from the centre of the racis of a winged frond, as in Woodwardia radicans, and in some species of the English genus, Polystichum. (3). Resting buds, formed from the racis as in the genus Cysopteris. (4). Small tubers produced from the rhizome, which afterwards developed into a frond. The true reproduction was, however, by spores, and the varied manner in which these were found on the plants had been used to divide the order into several sub-orders. In the genera Botrychium and Ophioglossum the thecæ were collected into a spike which was shown to be a modification of the structure of the frond. In the Polypodiaceæ the thecæ were surrounded, either laterally or vertically, with an elastic ring, an appendage which prevented the admission of the Osmundaceæ into the former sub-order. The observations, which were illustrated with a number of diagrams, specimens, and microscopic preparations, will be continued on a future occasion.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

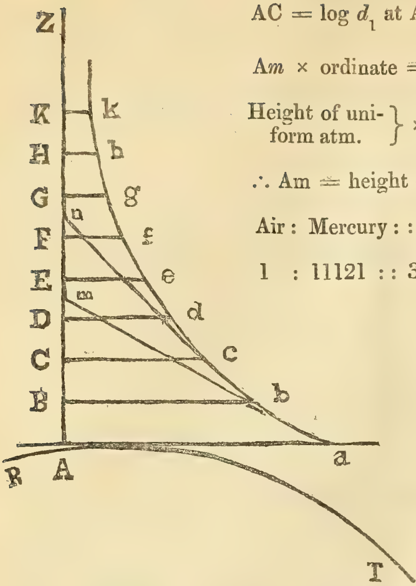
Vol. II. MARCH, 1867. No. 3

GENERAL MEETING.

THURSDAY, MARCH 7TH, 1867.—Mr. THOMAS PEASE, F.G.S., Vice-President, in the chair.

Mr. W. L. CARPENTER, B.Sc., called the attention of the meeting to some fine crystals of Selenite (sulphate of lime) found in the Lias clay now being excavated to form the new reservoir for the Bristol Waterworks Company, at Barrow. He remarked that the crystals were hemitropes, having re-entering angles, and spoke of the optical properties exhibited by thin laminæ of the substance, when exposed to polarised light.

The PRESIDENT, Mr. W. SANDERS, F.R.S., F.G.S., then read a paper upon the Theory of the Mountain Barometer. After some preliminary remarks upon the dryness of his subject, especially to the ladies, he asked all present to follow him closely in the demonstration he was about to give, else, if a step were lost, it would be unintelligible. He would abstain as much as possible from technical terms and signs, and when obliged to use them, would explain their meaning. A synopsis of the whole was contained in the formulæ attached to the annexed diagram, a large copy of which was exhibited, as well as of several formulæ, which would not be found as such in any book on the subject, because the author had made certain corrections and alterations in the form of those taken from different works, in order to compare them all together. Copies of these will be found on pages 26 and 27.



$$AC = \log d_1 \text{ at A} - \log d_3 \text{ at C}$$

$$Am \times \text{ordinate} = \text{whole pressure}$$

$$\left.\begin{matrix}\text{Height of uni-}\\ \text{form atm.}\end{matrix}\right\} \times \text{ord.} = \text{whole pressure}$$

$\therefore$ Am = height of uniform atm.

Air : Mercury : : 30 in. : height

1 : 11121 : : 30 : 27863 ft.

$$\frac{27863}{.43429} = 64020$$

$$AC = 64020\,(\log d_1 - \log d_2)$$

$$= 64020\,(\log h - \log h')$$

The following is an abstract of the Paper :—

Let R T represent the surface of the Earth ; AB, BC, CD, &c., thin strata of air, extending to Z, of equal thickness. Let d_1 be the density or weight of the small column, AB ; d_2 of BC, &c. Then it can be shown that $d_1 : d_2 : : d_2 : d_3 : : d_3 : d_4$, &c. Therefore the densities are in geometrical progression decreasing, while AB, AC, AD, &c., are in arithmetical progression increasing. Or, beginning at K, both series are increasing.

Of these two series, the arithmetical is the logarithm of the geometrical. If we had corresponding tables, we could know AC by subtracting log d_3 at C from log. d_1 at A, *i.e.*

$$AC = \log.\ d_1 \text{ at A} - \log.\ d_3 \text{ at C.}$$

Now let the densities Kk, Hh, Gg, &c., be drawn so that KH, KG, &c., shall be proportional to the logarithms of Kk, Hh, Gg, &c., and draw a curve through k, h, g, &c., then the curve, which is a hyperbola, will be the atmospheric logarithmic curve.

Next—the density at every point of AK = ordinate of that point, $\therefore$ sum of densities, which equals the weight or pressure at A = area on Aa between the curve and the perpendicular. The same at C = Area on Cc ; hence these areas represent the pressures respectively.

If a tangent at a be drawn, meeting the asymptote in m, Am is the sub-tangent, and Cn is the sub-tangent of c ; all sub-tangents are equal.

Also Am is the modulus of the atmospheric curve. The area on Aa is obtained by multiplying Am by Aa. Also the height of the column of homogeneous air multiplied by the density at A (that is Aa) represents the whole pressure at A. Thus—

Am × Aa = whole pressure, or area.

Height of homogeneous air × Aa = same.

∴ height of homogeneous atmosphere = Am = modulus.

Sp. gr. of air : sp. gr. of Mercury : : 30 in. : height, &c.

1 : 11121 : : 30 in.: 27863 ft.

To transfer the atmospheric logarithms into the common logarithms divide the modulus of one by the modulus of the other. Thus—

$$\frac{27863}{.43429} = 64020$$

∴ 64020 (log. d_1 at A — log. d_3 at C) is the height of AC, substituting h & h' for d_1 & d_3

$$AC = 64020 \,(\log. h - \log. h').$$

In practice it is convenient to reduce the constant 64020, so that it may correspond with a temperature of 32° instead of 55°. For this purpose deduct $\frac{1}{435}$ for each degree. Then $64020 - \frac{64020}{435} \times 23 = 60637$.

Ramond gives $\frac{1}{444}$ for each degree in the Pyrenees. Other authors use the fraction $\frac{1}{450}$.

The specific gravity is taken by some at 55°, by others at 60°; also the constant is reduced in some cases to 32°, and in other to 28°. Hence arise discrepancies in the formulæ.

The modes of calculating heights as given by three authors, I have adjusted by using feet and Farenheit's scale, for fathoms and the centigrade, and by some other changes, so as to present them in the same form, and thus to facilitate their comparison.

The first correction, n, is of the upper barometric column h', by assuming the expansion of the mercury, minus that of the scale, to be $\frac{1}{9000}$ or $\frac{1}{10000}$ of the column for each degree of temperature. Glaisher's tables give $\frac{1}{11,000}$ as nearer the truth; n is positive or negative according as a is greater or less than a'.

It will be noticed that the constants differ, as well as the corrections for temperature. This correction is required by the varying height of the uniform atmospheric column, according to temperature, that is, the length of Am on the diagram. The next correction is for the difference of gravity and centrifugal force in different latitudes. In the second formula this is simplified by taking advantage of the corresponding diminution of mean temperature and $x = \frac{\text{mean temp.}, -32}{5}$. This correction is unimportant, and is omitted in the third formula. It will be seen that each author has so adjusted the corrections, that the corrected constants are very nearly alike.

The transfer made by Phillips of the formula with logarithms into one without them, is effected by well known algebraical processes, but too technical for a general audience.

Four examples are appended, and the results of each method stated. It may be noticed that those by Phillips's formula are slightly in excess of the others. Probably the constant is taken too high.

Formulæ.

Formula 1. Penny Cyclopædia, "Heights" (La Place.)

$h' \left(\frac{a-a'}{9990}\right) = n$, correction of column of Mercury.

$$60{,}162 \left(1+\frac{d+d'-64}{900}\right) \left(\frac{1}{1-\cdot 00259 \cos. 2\lambda}\right) (\log. h - \log. \overline{h'+n})$$

$$60{,}162 \left(1+\frac{d+d'-64}{900}\right) 1\cdot 0007 (\log. h - \log. \overline{h'+n}) = z.$$

Formula 2.—Encyclopædia Britannica, 8th Edition, vol. 4, p. 466.

$$\left(\frac{10}{9}a-a'\right) \cdot 0001\, h' = h' \left(\frac{a-a'}{9000}\right) = n \qquad x = \frac{\textit{mean temp.}-32^\circ}{5}$$

$$60{,}000 (\log. h - \log. \overline{h'+n}) = z'.$$

$z' + \left\{\frac{10}{9}(d + d' - 64) + x\right\} \cdot 001\, z' = z$, height of upper station.

$$60{,}000 \left(1 + \frac{d + d' - 64}{900} + \frac{x}{1000}\right) (\log. h - \log. \overline{h' + n}) = z.$$

Formula 3.—Pryde's "Practical Mathematics" (Chambers).

$$h' \left(\frac{a - a'}{10{,}000}\right) = n$$

$$60{,}150 \left\{1 + \frac{9}{4000}\left(\frac{d + d'}{2} - 32\right)\right\} (\log. h - \log. \overline{h' + n})$$

$$60{,}150 \left(1 + \frac{d + d' - 64}{889}\right) (\log. h - \log. \overline{h' + n}) = z.$$

Formula 4.—Phillips.

$$(a - a') \cdot 0001 \frac{h + h'}{2} = \frac{h + h'}{2}\left(\frac{a - a'}{10,000}\right) = n.$$

$$\frac{(1000 + d + d') \left\{ h - (h' + n) \right\} 24 \cdot 9.}{\frac{h + h'}{2}}$$

$$\frac{\left(1 + \frac{d + d'}{1000}\right) (h - \overline{h' + n}) \; 49800.}{h + h'}$$

$$49800 \left(1 + \frac{d + d'}{1000}\right) \frac{h - \overline{h' + n}}{h + h'} = z$$

The constants when corrected for temperature and gravity become, when calculated for example 1, as follows: for Form. 1, 64900; Form. 2, 64920; Form. 3, 64901, and for Form. 4, 56473.

EXAMPLES.

Let h be the height of the barometer at the lower station.
— h' ———————————— upper ——
a & a' be the temperatures indicated by a thermometer attached to the barometer.
d & d' ———————————— by a detached thermometer.

Example 1.—	$h = 30 \cdot 040$	$a = 72 \cdot 5$	$d = 72$
	$h' = 26 \cdot 575$	$a' = 63 \cdot 5$	$d' = 62 \cdot 6$

According to Form.	1	2	3	4
the resulting height is	3432 ——	3427 ——	3433 ——	3434

Example 2.—	$h = 30 \cdot 037$	a or $d = 55$
	$h' = 28 \cdot 920$	a' or $d' = 53$

Form.	1	2	3	4
	1033 ——	1033 ——	1033 ——	1040

Example 3.— $h = 30{\cdot}037$ a or $d = 55$
$h' = 29{\cdot}508$ a' or $d' = 55.5$

Form. 1 2 3 4
490 —— 491 —— 490 —— 492

Example 4.—$h = 30{\cdot}037$ a or $d = 58{\cdot}5$
$h' = 29{\cdot}508$ h' or $d' = 55{\cdot}5$

Form. 1 2 3 4
481·7 —— 481·3 —— 481·8 —— 484·4

In commenting upon the examples, Mr. SANDERS said that the second and third examples were calculated from observations made by him at Cheddar, at an excursion taken by the Society on Aug. 29th, 1865; the fourth was an experiment, to show the importance of observing temperature, for the barometric heights were the same as in example 3, and yet there was a difference of 9 feet in 480. At a future meeting, Mr. Sanders hoped to describe the "Practice" of the mountain barometer, as well as the construction of, and amount of reliance to be placed upon, the Aneroid barometer, and also to explain an important correction, mentioned in no published treatise, for the normal diurnal change in the barometric column.

The VICE-PRESIDENT, in thanking Mr. Sanders for his admirable paper, regretted the absence of his colleague, Canon Moseley, who would have been better able than he was to discuss it.

Some conversation ensued upon aneroid barometers, the determination of the relative densities of air and mercury, &c., and a further explanation of some points in the theorem was given by Mr. Sanders in reply to the inquiries of members.

Mr. W. W. STODDART, F.G.S., then exhibited with the aid of the oxy-hydrogen microscope, some beautifully delicate specimens of sea-weeds, showing the fruit, &c. The following directions for the process of mounting them were given:—Float the sea-weed out in the usual manner, dry almost completely with blotting paper, transfer to a glass plate, and moisten with turpentine; after some time, cover the sea-weed with a thin mixture of Canada Balsam and Chloroform, place a second glass plate on the top, allow the whole to stand for a week or two, and varnish the edges with any suitable cement. Mr. Stoddart said that this method could be applied to plants, if they were not too thick, to moths and other insects, softening the bodies, when required, with potash. He admitted that the minute structure of the sea-weed was altered, owing to the contraction of the cells caused by the greater density of the medium; this, however, could only be preserved in the gelatine medium, and slides thus prepared could not be used in the gas microscope on account of the heat. The gelatine medium was the best he was acquainted with for preserving the soft-bodied Infusoria.

Mr. LEIPNER said it was impossible to predict which method of mounting would best suit any given species—and therefore it was well to prepare microscopic specimens in both ways. The Polysiphonia vestigiata, for example, could only be preserved in gelatine.

Mr. C. O. GROOME-NAPIER, F.G.S., exhibited several very beautiful photographs of gems, coloured with the transparent aniline colours, the effect of which was remarkably good, and decidedly superior to the best engravings of the same subjects, coloured by hand in the usual way. He explained the difficulty of getting good photographs of gems, owing to the 'cross-lighting.' Mr. Napier also, in order to show the applicability of photography to the illustration of books, laid before the meeting a large number of small photographs of various natural history subjects, anthropological, entomological, geological, microscopic, zoological, &c., some of which were taken from the subjects themselves, others from pictures of them.

MEETINGS OF SECTIONS.

GEOLOGICAL SECTION.

THURSDAY, FEBRUARY 28th.—Mr. W. SANDERS, F.R.S., F.G.S., President of the Society and of the Section, in the chair.

Mr. W. W. STODDART, F.G.S., read the following paper upon the Geology of Dundry Hill :—

The Jurassic series of rocks, of which the Dundry beds form a part, occupy a very large tract of English ground—they are found ranging from Dorsetshire through Somersetshire, Gloucestershire, Oxfordshire, Northamptonshire, and Rutlandshire, to Yorkshire. The Oolites always form very elevated hills, with fine bold escarpments, which tell plainly of the remains of gulfs, bays, straits, and other evidences of marine existence. Such views as these may be plentifully observed near Bath, Gloucester, Cheltenham, and Stroud, the highest being in Yorkshire. From this county the thickness of the rocks gradually declines to the West of England; Dundry Hill is about 700 feet above the sea level. The Jurassic rocks are thus divided, reckoning from the base,

Lower Lias (averaging a thickness of 600 feet) :—	600
Marlstone, or Middle Lias	200
Upper Lias	300
Inferior Oolite	230
Fullers Earth	130
Great Oolite	130
Cornbrash	80
Oxford Clay	600
Coral Rag	180
Kimmeridge Clay	600
Portland Beds	170
Purbeck Beds	150
Making a total of	3370 feet

The term Oolite is, as you are aware, formed from two Greek words, signifying egg-stone, because the stone resembles the roe of a fish in its structure. The true Oolite differs very distinctly from all the Liassic deposits, both lithologically and palæontologically. The Lias rocks are those of quietly deposited mud and tranquil water, while the Oolites were evidently deposited under the influence of strong currents and strong sea waves.

This singular Oolitic structure may be now seen forming at the dock gates at Birkenhead. Each little grain contains as a nucleus a bit of sand or shell. The Oolitic limestones of the Carboniferous rocks most generally contain a Gasteropod or Foraminifer, but in the Oolitic rocks I have not yet succeeded in finding more than a minute particle of sand or mud.

The beds from the Inferior Oolite differ greatly from those of the Great Oolite in possessing a large proportion of peroxide of iron. In some instances very rich beds occur, affording rich ore well adapted for smelting and gas purifying. As a rule the Oolitic beds dip to the S E. In lithological structure they vary greatly, from the small white grains of the Great Oolite, to the large pea-pellets of the Pisolitic beds at the base of the Cheltenham series. Now and then the beds are separated by marls. At one point a bed of marls occurs 7 feet thick, and well marked by Terebratula fimbria.

Like the beds of the Lias, the Oolite has been stratigraphically arranged by means of the fossils, especially the Ammonites. This was first pointed out by Quenstedt, and brought into use in this country by Dr. Wright, of Cheltenham, who has divided the Cotteswold Hills into zones, viz., Jurensis, Murchisoni, Humphriesianus zones.

We must therefore regard our Dundry Hill top in relation to them. And a most instructive ground it is for the Bristol geologist. It is full of beautiful fossils. Indeed, it contains more species than any other rocks of the same extent in the West of England. Our neighbourhood, too, gives some good examples of faults in the Jurassic beds. For instance, a very good one occurs near Paulton, where the Inferior Oolite beds are thrown down 20 feet to the north, according to Mr. Conybeare. The life which existed during the Oolitic age was very different from that which existed before, and very greatly resembles that of Australia at the present day, where we find living the Port Jackson shark, the only remaining example of Cestraciontidæ, and where the Marsupials abound which characterised the Oolite. In the Australian seas live the Terebratula and Trigonia, and in the Australian forests grow the Zamia, Cycas, and Araucaria, all which have left their remains plentifully scattered throughout the Oolitic rocks.

The two families of corals, Turbinolidæ and Oenlinidæ first appeared at this period. Conchifera, or bivalves, became much more numerous, and also carnivorous Gasteropods, which are thus known by the notched lip and canals to the mouth. Here the Oolitic Cuttlefish, the Ammonites, flourished, lived, and died, and as we find whole generations present, of all ages, it follows that the deposition of the Oolitic beds must have occupied a very long time. The Belemnites, which resembled our Squids, were, if possible, still more abundant, and we very frequently find their ink-bags, containing the sepia, as serviceable for painting as ever. The Encrinites now are decreasing, only one species is found at Dundry, the Pentacrinus Milleri.

But on the other hand, the sea urchins are very numerous, more than 600 having been described from the Jurassic strata. Crustaceans, like our own lobsters, occurred in considerable number ; one, Glyphea rostrata, is found in the Dundry beds. Now and then beautiful remains of insects meet the collector's eye, especially at Stonesfield. Homocercal fishes bear about the same proportion to Heterocercal as in the present day, the latter having before been the most abundant. In these strata the paleontologist first meets with the *true* sharks and rays (Squalidæ and Raiidæ). Most of the fish, however, are Ganoid. Reptiles attain their greatest size and number at this period—Ichthyosauri, Plesiosauri, and Teleosauri abundant in the water and on banks, while on the land stalked the immense Megalosaurus, about 30 feet long. The teeth of this animal were very peculiar, being sharp, serrated, and recurved, they had the properties of sabre, knife, and saw. The singular flying reptile was a companion to these, the Pterodactyle, a true Saurian, with long jaws and sharp teeth, four legs and claws. The fifth digit of the fore-paw was elongated, from which a webbed skin extended to the hind leg, so that the animal could skim along like the flying squirrel of America.

The Dundry Oolitic beds have the same dip as the turnpike road, so that after passing up the hill over the Lower Lias, which has a thickness of 500 feet, the first thing to be noticed is the

MARLSTONE, which has been said by Mr. Etheridge, and others, to be altogether absent. I have here, however, a piece of the rock with the Ammon. Thomasensis, radians, Aalensis, variabilis, &c., and this specimen you could not distinguish from the other collected at Stroud. Instead of the thickness it is found there, it is only from 8 to 12 inches at Dundry. It may be seen at the cross roads, and by a stile, in a lane to the west of the village. Above this are about 7 or 8 feet of

UPPER LIAS CLAY, a stiff bed of blue clay, on which is Belemnites bipartitus, Am. bifrons, A. communis, Pholadomya, and Modiola.

UPPER LIAS SANDS lie above this, and attain, on the south and west of the hill, a thickness of a couple of feet. In the upper portion of these, just under the Ironshot bed, have been found several new species of Thecidium, Zellania, and Spirifera, also a small branching zoophyte, Heteropora ramosa. In these also occur Modiola plicata, Pholadomya arenacea, Lima bellula, Belemnites irregularis, and B. compressus.

THE IRONSHOT BED next appears, and, as its name denotes, is full of the ferruginous granules. It has a thickness of three feet, and is the richest of all in fossils, which are collected with the shell on. It is here that the beautiful Pleurotomariæ are found, with most of the Gasteropods. This bed passes insensibly into the

AMMONITE BED, which is full of the characteristic Ammonites, Humphriesianus, Dundriensis, Braikenridgii, &c. It also contains a few of the Conchifera.

THE CONCHIFERA BED overlies the Ammonite bed, and is remarkable for the Dimyaria it contains. The limestone is different, being smooth and hard. It is 13 feet in thickness. In this are obtained Pholadomyas, Goniomyas, Isocardia, Myoconcha, Trigonia, Gervillia, and Pectens. These three beds correspond with the Humphriesianus zone of the Cotteswolds. The two last zones, the Jurensis and Murchisoni zones, of the Cotteswolds, are not represented as distinct beds at Dundry. Their place would be *under* the Ironshot bed. The

RAGSTONES come next, and contain the characteristic fossils of the Parkinsoni zone. They are loose marly limestones, having the same fossils as the Conchifera bed, but badly preserved, being only moulds or casts. In about the upper third of the Ragstone beds, is a Coral bed very rich in Isastrea, Stylina, Thecosmilia, and Axosmilia. It is also in the Ragstones that the beautiful and varied forms of Echini occur, of which 16 species have been collected. In these beds it was that Mr. Worsley found the Ammonites mentioned in his manuscript. Over the Ragstones lie 5 ft. of beautiful building stone, very soft, and resembling Portland stone. It may be seen very well in a quarry near the church. It contains very few fossils. Over this are found the

FREESTONE BEDS, which are fine beds of limestone, composed of comminuted shell-sand and debris of one kind or the other. It forms the cap of the whole, and attains an average thickness of 12 feet. It contains few fossils, but yields six species of Corals. When weathered the broken fossil contents shew out very distinctly.

I have been able to ascertain 87 genera, containing 256 species of fossils, from the Dundry beds, viz. :—

Spongidæ	..	..	..	1
Zoophyta	..	..	..	15
Echinodermata	..	...	..	16
Articulata	..	..	..	3
Bryozoa	..	..	..	1
Brachiopoda	..	..	..	23
Conchifera	..	..	..	106
Gasteropoda	...	..	...	33
Cephalopoda	..	...	..	54
Pisces ..	...	..	..	4
				256 species

Mr. Stoddart illustrated his paper with a section of Dundry Hill, and a palæontological chart of the fossil contents of each zone, so arranged as to correlate with the equivalent beds of the Cotteswold Hills. He also explained an elaborate catalogue of the Dundry fossils, prepared by himself, and called attention to the collection of illustrative fossils from the museum of the Institution. Mr. C. O. Groome-Napier, F.G.S., also exhibited a few Oolitic fossils.

The PRESIDENT, in thanking the author of the paper, said that he hoped many of the sectional walks in the summer would be devoted to working out the Dundry beds.

ENTOMOLOGICAL SECTION.

ERRATA.—In the report of the February meeting of this Section, pp. 18—20,

Page 18, lines 8 & 12 of the report, and page 19, line 1, *for* Apthonia *read* Apthona. Page 18, lines 9 and 12, *for* lutiscens *read* lutescens. Page 19, line 1, *for* Barker *read* Barber.

TUESDAY, MARCH 12TH.—Mr. STEPHEN BARTON, President of the Section, in the chair.

Mr. BARBER exhibited two specimens of Trogosita Mauritanica, a foreign species of Coleoptera, often imported in ships' stores; the specimens exhibited were captured in Dowry-square. Mr. Barber also exhibited a box containing two specimens of Cryptocephalus 10-punctatus, a species first captured in Britain in June, 1865, near Camach-gouran, Loch Rannoch, the species was beaten from dwarf sallows. Last season the species was again met with, this time in Staffordshire, frequenting birch. The box also contained an undescribed species of Sitones, and the following eight species of Scydmœnidæ—thoracicum, scydmœnoides, scutellaris, collaris, elongatum, Sparshalli, hirticollis, and tarsatus.

The Hon. Secretary exhibited a box containing among other species two specimens of Dasypolia Templi, bred by H. Doubleday, Esq., of Epping, the larvæ feeding upon Heracleum. Also, a fine series of varieties of Bombyx castrensis, bred from larvæ found at St. Osyths, Essex; Acidalia strigilata, from Folkstone, Scoria dealbuta, from Faversham, and several species from Perthshire.

Mr. CLARKE exhibited a specimen of a most brilliant species of beetle, from the Brazils, being one of the species so much used now for mounting in brooches, pins, &c.

A long discussion then took place with respect to the summer excursions and the weekly meetings for collecting, and it was eventually determined that the next meeting of the Section should be held at the Institution, and that the consideration of the question should be adjourned.

Chemical & Photographic Section.—Wednesday, March 13th.

Zoological Section.—Thursday, March 14th.

In consequence of the unusually inclement weather, no meetings of these sections were held, and Mr. Noble's paper on Disinfection was again postponed.

Botanical Section.—Owing to the inclement weather, the meeting which should have been held on March 21st, was postponed to Wednesday, March 27th.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

Vol. II. APRIL, 1867. No. 4

GENERAL MEETING.

THURSDAY, APRIL 4TH, 1867.—At the commencement of the meeting, Mr. THOMAS PEASE, F.G.S., Vice-President, occupied the chair.

On the motion of Mr. F. V. JACQUES, seconded by Mr. H. K. JORDAN, it was resolved that Messrs. Thomas Turner and Edwin J. Gibbons, be appointed to audit the Treasurer's accounts previous to the Annual Meeting.

The CHAIRMAN observed that the Annual Meeting was frequently a very small one, but as it was important, he urged all members to attend who could make it convenient to do so.

Mr. H. K. JORDAN, F.G.S., exhibited two specimens of meteoric iron, one having been brought from South America; the other had been subjected to the action of nitric acid. He also presented to the Society, for distribution among the members, a quantity of sand dredgings, containing Foramenifera.

The President, Mr. W. SANDERS, F.R.S., F.G.S., then made a verbal communication on the Practice of the Mountain Barometer, in continuation of his paper, read at the previous meeting, on the Theory of the instrument. He exhibited his instrument, which was one of the most perfect yet constructed by Messrs. Negretti and Zambra. It was very portable, and could be carried-about without fear of derangement. In making an observation, it was first to be suspended perpendicularly; if this could be done from a nail driven into a wall, it should be, but if there were no such sheltered locality, the speaker used a light tripod which he had contrived for that purpose, and exhibited to the meeting, and which was to be carried with the barometer. Having hung up the instrument, the first thing to be done was to lower the mercury in the cistern, by a screw at the bottom, and bring it to a certain fixed level, which was determined by causing a little ivory cone to form one continuous line with its reflection in the surface of the mercury, perfect contact being thereby ensured.

At this stage of the proceedings, Rev. CANON MOSELEY, M.A., F.R.S., one of the Vice-Presidents, entered the room, and on the motion of Mr. THOMAS PEASE, was called to the chair.

Continuing his description of the instrument, Mr. Sanders said that the top of the cistern was closed with porous wood, and that it was necessary, in order to equalise the atmospheric pressure and temperature through the whole instrument, to allow ten minutes to elapse after bringing it into position, before taking the observation of the exact height of the column of mercury. This was ascertained by a scale of brass sliding over the glass tube, and he was accustomed always to allow the thinnest possible streak of light between the top of the mercury and the bottom of the scale. This gave a constant error, the same in all cases, but exceedingly slight. The exact height was then read off by a vernier, to 0·001 inch. In ascertaining the difference of height between two stations, it was necessary to repeat the observation at the first station a second time, after having taken a reading at the second station, and if there were any difference between the two observations at the same place, the error was to be divided into as many parts as there were hours of interval, and a proportionate correction of the observation at the second station was to be made, according to the time which had elapsed between it and the first observation at the first station.

He had explained the corrections to be made for temperature and gravity, and he now urged the importance of taking into account the diurnal variations in the barometer, according to the time of day, which might cause an error of 0·020 inch, or in other words, of 19 feet. This point had been noticed in no published treatise, and was therefore fully explained and illustrated by a diagram constructed from some results kindly forwarded in MSS. to the author by Mr. James Glaisher, showing the average hourly variation for every month in the year. The author then stated that he worked out his results by Mr. Phillips's formula, but that, in order to save the time occupied in calculation on each occasion, he had constructed tables from which he could, with very little trouble, read off the corrected result. Abstracts of these tables were exhibited (vid. p 38). It was his habit to make at least two independent observations, and a difference of ten feet in the two results would be sufficient to cause him to go over the ground again; frequently they agreed within two or three feet.

Mr. Sanders then proceeded to describe the construction of the Aneroid Barometer, illustrating his remarks with an instrument kindly lent by Messrs. Husbands and Clarke. It consisted essentially of a flat cylindrical box from which the air was almost completely exhausted. The variations in the atmospheric pressure caused one side of the box to bulge in or out, and the amount of this movement was measured by some very exact mechanism, much finer than watchwork, which magnified greatly an almost infinitely small motion of the side of the box. It was not necessary to hang the instruments perpendicularly, but always to read them in one position, and it was desirable also to free the mechanism by gently tapping them. The index on the face occupied 0·01 inch of space, but with proper precautions, the indications could be read to 0·005 inch, and, with care, good work could be done with Aneroids, though they were occasionally capricious, and unreliable.

Where an absolutely correct result was not required, the following formula for the Aneroid was found to give a near approximation to the truth.

If $S =$ sum of the heights,

$D =$ difference of the heights, then

$$S : D :: 55000 : z' \text{ (height required)}$$

and, where a temperature correction was to be made,

$$\frac{z'}{346} \times (t - 55^\circ) = \text{corrected height,}$$

where $t =$ mean temperature.

This correction was positive or negative, according as t was greater or less than 55°.

Mr. Sanders concluded his communication by recommending Belleville's Manual of the Mercurial and Aneroid Barometers, as containing much good information on the subject.

Phillips' Formula.

$$\frac{24{,}900}{\frac{h + h'}{2}} \times \frac{1000 + d + d'}{1000} \times (h - \overline{h' + n})$$

Table I. (Abstract).

Showing the numerical value of the first two fractions in the above formula.

The top line indicates the sum of the temperatures, $(d + d')$.

The left-hand column indicates the mean height, $\frac{h + h'}{2}$.

	80°	100°	120°	140°
30·5	882	898	914	931
30·0	896	913	930	946
29·5	912	929	945	962
29·0	927	945	962	979

Table II. (Abstract).

Showing the height in feet, as obtained by the application of the number gained by Table I. to the difference of the barometric heights, $(h - \overline{h' + n})$ here shown in the left hand column.

	880	900	920	940	960	980
·010	9	9	9	9	10	10
·050	44	45	46	47	48	49
·100	88	90	92	94	96	98
·200	176	180	184	188	192	196
·300	264	270	276	282	288	294
·400	352	360	368	376	384	392
·500	440	450	460	470	480	490
·600	528	540	552	564	576	588
·700	616	630	644	658	672	686

Mr. W. W. Stoddart, F.G.S., exhibited a small Aneroid barometer in his possession, which he had compared with 19 others, and found none more accurate, provided certain precautions, which he described, were observed in reading it. With several independent observations he had ascertained the actual height of a staircase by it within one foot. The advantage of the portability of this instrument was very great, as well as the saving of time and trouble in making an observation. He also explained the construction of the compensating spring, which obviated the necessity of a correction for temperature.

Canon Moseley referred to Galileo as having first used the barometer for measuring heights, in the Puy-de-dome, 200 years ago. The subject of the paper was an example of the combination of mechanical skill with great scientific knowledge. He considered Mr. Sanders had greatly contributed to accurate results by introducing a correction for diurnal variation, and thought that the fact that different corrections, when applied to different series of observations, brought the ultimate result to uniformity was a sufficient guarantee for their accuracy.

The Hon. Secretary then read a paper by Mr. J. Josselyn Ranson, on Hydræ, or Freshwater Polypes. After referring to the history of our knowledge of this animal, the author continued :—

The true Zoophytes are divided into two classes—the Actinozoa and the Hydrozoa, the sea-anemone being taken as a type of the former, and the Hydra, or fresh-water Polype, of the latter. It is upon the animal typical of the Hydrozoa and the simplest of the Zoophytes that I would offer a few remarks.

In this country there are two species common, *Hydra viridis,* or green polype, and *H. vulgaris,* which is said to be usually of a dusky orange colour, although this would seem to vary with the nature of its food. The former of these is the only one I have ever been able to find during a search extending over a period of now nearly five years, and notwithstanding that this polype is frequently met with, yet in my experience it is not by any means to be found in *every* pond and ditch, as certain writers would make one believe.

The diagnosis of the Hydra is as follows :—A single locomotive polype constitutes the animal; it has tentacles, and a hydrorhiza; the reproductive organs appear as simple processes of the body-wall. The only parts incapable of reproducing are the tentacles. * * * * The following remarks more especially apply to *Hydra viridis,* or green polype, as it is the only species in which I have had the opportunity of verifying the observations of others. The body of the polype is constantly assuming a variety of forms; sometimes when it is attached by its disc with arms extended fishing for its prey, it bears a close resemblance to certain of the fresh water algæ, and when searching for it in my aquarium, I have frequently only been undeceived by its suddenly contracting; then at other times it may be seen as a minute spherical body adhering to the glass, the arms being scarcely observable, and this is the form it generally assumes after having taken its prey. The hydræ move from place to place "by fixing alternately the extremities of their body after the manner of a leech, and they are sensible to the presence of light, which they always approach."—(*Rymer Jones*).

The wall of the body is composed of two distinct layers of a kind of sarcode, the "ectoderm," or outer wall, and the "endoderm," or inner; it would appear as if there was but little differentiation between them, for it has been proved from actual experiment, by turning a polype inside out, the relative position of the ectoderm and endoderm being reversed, that each will perform the function of the other.

Dr. Carpenter's description ("Microscope and its Revelations," 3rd edition, pp. 543, 544) of the "urticating organs" covering the tentacula was here quoted.

The reproduction of the Hydra was then described, the facility with which artificially detached portions of a polype developed into complete individuals being noticed, as well as the gemmation, or budding process, which took place most freely in the neighbourhood of the digestive cavity, and then only under the conditions of warmth and a plentiful supply of food. The continuance of the species during the cold of winter was provided for by a true reproductive process, or act of generation, which was thus described :—

At certain times of the year two sets of cells are developed in the walls of the body, one set at the base of the tentacles, these being the "spermatic capsules," and the other nearer to the base or foot, forming the "ovigerian capsule," which contains in *Hydra viridis* only a single ovum, but in *H. fusca* as many as six or seven ova.

It would appear that occasionally instances occur in which "spermatic capsules" only are developed on one animal, the "ovigerian capsule" being developed separately on another, but the more general rule is, that both are produced on the same polype. By the simultaneous rupture of these cells, the spermatozoids of the spermatic capsule find their way to, and fertilize the ovum, which is seemingly exposed to their influence by a thinning-away of the external membrane.

The ova covered with a horny substance possess a great power of resistance to the cold, thus preserving their vitality until the return of conditions favorable for their existence, when development begins to take place. This proceeds up to a certain point, the covering of the ovum bursting, liberates the embryo, which becomes ciliated, and for some time swims freely in the water; in this condition it is known as a "gemmule." Gradually it becomes elongated, and by one end which tapers away it attaches itself to some solid body, then the development into the polype form quickly takes place. At the unattached end the germinal membrane thins away; ultimately an aperture exists which becomes the mouth, and around it the tentacles or arms soon make their appearance.

Mr. W. W. Stoddart mentioned that H. fusca was to be found in Malago Brook, Bedminster, and H. viridis in ponds on Durdham Down. He found the best way of mounting them for the microscope with their arms extended, was to allow them to spread out in water on a glass slip, and then to drop some gum upon them, which killed the polypes instantaneously, without allowing them to retract their tentacles. The gum could be subsequently dissolved off, and the specimens mounted in the usual way in any preservative fluid.

Mr. WM. LANT CARPENTER, B.A., B. Sc., read the following note (illustrated by a diagram) on the Formation of Air-bubbles in Ice :—

Having frequently occasion to obtain a temperature below 32° Fah., I am in the habit of employing as an easily made and cheap freezing-mixture, a mixture of crystallised sulphate of soda and hydrochloric acid. During the late severe weather, however, I made a mixture of snow and salt, which produced a temperature slightly below 0° Fah. Wishing to test its efficacy, I immersed in it a small cylindrical vessel of pure water, and was surprised to notice the form taken by the lump of ice, which is illustrated by the diagram. It will be observed that the ice has, as it were, piled itself up into a small pyramid or cone on the centre of the top of the cylinder, the expansion which, you will remember, always occurs on freezing, having taken this form, probably because the cold was so intense that a portion of the water froze to the side of the vessel before there was time for the whole mass of the water to cool down to 39° and then to begin to expand regularly.

The most curious point, however, in this experiment, was the way in which the air-bubbles arranged themselves in the congealed mass. Accidentally, the whole apparatus was placed in a room, the floor and walls of which were in a constant state of vibration from some machinery in motion; consequently the particles of the water were very far from being at rest, and their line of motion seems to have been very plainly marked out by the air-bubbles. You will observe that these are arranged radially (like the spokes of a wheel), a small space in the centre only being at all irregular and confused,—and not only are the bubbles radial in their grouping, but to a large extent also in their shape; for, instead of being spherical or only slightly ovate, they are in most cases lengthened out until they have become as much as 15 times as long as they are wide and thick, and the direction of this greatest length is always between the centre and the circumference of the cylindrical block. To assure myself that this arrangement obtained through the whole block, I spilt it longitudinally and transversely, and was greatly surprised at the extreme regularity of the radial lines of air-bubbles, only about $\frac{1}{10}$th of the cylinder, and that in the centre, being at all irregular in structure. I was unable to satisfy myself whether the air-bubbles were very elongated ellipsoids, or parallelopipeds with curved surfaces at the two ends.

One other small point deserves notice. In watching the block of ice, as it stood in a warm room, the air of which was about 52° Fah., and which, without being very damp, yet contained a considerable percentage of watery vapour, I noticed that the air within 0·5 inch of the ice was so saturated with moisture as to resemble vapour or fog, and the currents of air thus rendered visible by the vesicles of water, appeared to be moving downwards, parallel to the sides of the cylindrical block. Whether this was caused by vapour rising from the ice, or by the warm moist air impinging upon the ice, and, being thereby cooled, depositing in a visible form the water which it was no longer able to retain in a state of invisible solution, so to speak, I am unable to decide.

Mr. C. F. Ravis read the following note on the Stapleton Fern, and presented several fronds to the Botanical Section.

Not being a member of the Botanical Section, or a botanist, I take the opportunity of a general meeting of the Society to call attention to a very beautiful and at the same time somewhat rare, species of British fern, the Asplenium lanceolatum, or lanceolate Spleenwort. It grows, I believe, only in the southern and western parts of this island, but is tolerably plentiful in the localities where it is found. It grows in the clefts and crevices of rocks, and in this neighbourhood seems to prefer sandstone to limestone. The roots are mostly so deeply implanted in the cleft that it is difficult, and sometimes impossible, to obtain the plant with the root entire.

About twenty years ago I was, like many young people, fond of collecting ferns, and I paid a visit or two for that purpose to the grounds of Oldbury Court, in the Frome Glen, near Frenchay. The specimen on the table was procured there on one of these occasions. At that time the locality was, I fancy, known to comparatively few persons, and, as a consequence, the plants attained a finer growth than in all probability they would be found to exhibit now. I have gathered many specimens, but these are the largest I have myself obtained.

The Council of the Society, who are engaged in making a catalogue of the natural objects of this neighbourhood, are of course aware of this locality of the Asplenium lanceolatum. Should there be any doubt of its being still, after the lapse of so many years, an inhabitant of the spot, I may say that I found specimens of it about two years ago in the grounds, though I was unable to visit the exact spot where I gathered these fronds, but the plants were poor stunted specimens, not more than about an inch long, and very sparely distributed.

Mr. A. Leipner expressed the thanks of the Botanical Section for the present, and said that this plant was recognised in scientific works as a slight variety from the ordinary Cornish form.

Mr. W. Rich, of London, exhibited a fine series of remarkably aberrant forms of the common whelk, Buccinum undatum, and of Fusus Antigua, closely resembling the ordinary forms of other genera and species, especially of Pleurotoma, Trochii, Scalaris, Dolium, and of the varieties Acuminata and Imperiali. Some curious forms of opercula of the same species were also shown, one of which, if found detached from its shell, would have been taken for a new species of Patella. Another resembled an Aplesia, and occasionally two opercula were found in one shell. Mr. Rich contended that all these different forms of the same shell originated *ab ovo*, and were not due to any subsequent cause.

Canon Moseley, in concluding the proceedings of the evening, observed that the members present had been taken almost a complete round through the sciences. He then proceeded to make some remarks upon the mathematical laws according to which many of these shells were formed. The revolution of a certain curve round its axis, sliding at the same time in the direction of its axis, describing a logarithmic or equiangular spiral, would produce a form closely resembling these shells, the whorls of which were separated from each other by a geometric series of distances. This was a very uniform and simple way of working. In the case of the Nautilus, the form was produced by the revolution of an ellipse round its minor axis, the length of the major axis being simultaneously increased. The spiral on the operculum was probably thus formed: when the operculum was too small to close the mouth of the shell completely, it was twisted round to fit exactly against one side, while the other side was filled up with new material; it did not grow equally on all sides at once.

The time for adjournment having long passed, the meeting separated.

MEETINGS OF SECTIONS.

GEOLOGICAL SECTION.

THURSDAY, MARCH 28TH, 1867.—Mr. THOS. PEASE, F.G.S., Vice-President of the Society, in the chair.

MAJOR AUSTIN read a short communication on the occurrence of Otopteris in the Lower Lias.

According to Lindley and Hutton, who established the genus, Otopteris was probably a simple pinnated plant, with a thickish petiole, to which leaflets were attached by the lower half of the base, the upper half being free and auricled; the leaflets were devoid of midrib, and furnished with veins which originated in the base, and curved right and left to the margins, only forking as they proceeded towards the extremity. All these characters are plainly observable in the specimen on the table, and are also represented in the drawing.

So rare are these fossil plants, that I am only aware of two other specimens of Otopteris ever having been found in the lias, namely, one at Membury, near Axminster, and the other in the same formation at Polden Hill, near Bridgewater, in Somersetshire. Both these specimens were the same species, Otopteris obtusa.

Two other species have been obtained from the Oolite. These are O. acuminata, and O. Beanii, and one or two others from the new red sandstone, but of these different species only one or two specimens of each have been detected.

On my own part, after a very diligent and protracted examination of extensive deposits of the lower lias, I have been enabled to obtain only a solitary specimen of this rare genus of fossil plants. This specimen is probably the representative of a new species, and it exhibits several well-preserved characters of form and structure. Some essential points of difference may be traced between it and other hitherto described species of Otopteris. The leaflets are attached to the leaf-stalk by about half the width of their bases; they are winged, and closely set, partially overlapping each other, not somewhat wide apart, as in Otopteris obtusa, where there is invariably an intervening open space between them. They are also less obtuse at their terminal ends than in O. obtusa, as may be seen by comparing the specimen with the figures of that species in Plate 128, of Lindley and Hutton, in the third volume of Fossil Flora.

From the rarity of the more perishable parts of plants in the lower lias, it may be inferred that they were seldom carried into the ocean, or were decomposed by the action of the sea-water before the accumulating sediment at the bottom of the liassic sea had covered them up; hence it is that perhaps so few vegetable remains are found in the deposit. I have closely examined acres of quarried stone in many different localities, and the specimen on the table is the only one of the kind I have ever met with.

The Otopteris, which is somewhat related to the ferns, probably grew near the sea-coast in the same manner as do the maritime ferns of our own times, and the specimen may have been washed away from some rocky isle by an unusual high tide, or carried by a river flood into the sea, and then covered up by the sediment brought down by the freshet. That it was by some means deposited at the bottom of an ocean can hardly admit of a doubt, because in the same beds are found many species of marine shells, such as Ammonites, Plagiostoma, &c., and also plates and spines of Echinoderms. The drawings of two species of the last-named were exhibited to the members present.

On a casual glance, the specimen has much the appearance of a fern, but upon a more careful examination, it presents characters which appear to separate it from that tribe of plants. I believe that in all recent ferns each leaflet has a midrib, or the veins are so disposed as to impart the appearance of one, and in fossil ferns only one genus of allied forms (Odontopteris) has the veins arranged in a somewhat similar manner to those so plainly shown in the specimen under examination; but Odontopteris has bipinnated leaves, and the leaflets adhere to the stalk by the whole width of their bases, while in Otopteris they are attached by about half their base, the anterior or auricled portion being quite free. From this it will appear that Otopteris seems to hold an intermediate position between ferns, and the allied Odontopteris, the arrangement of its veins differing from the former, and its general form separating it from the latter genus.

Should my specimen prove to be a new species, a suitable name will be suggested. If only a variety of O. obtusa, I would propose for it the name of Otopteris obtusa, variety densa.

Major Austin then proceeded to make some observations on the remarkable effects produced by lightning.

As far back in time as June 17th, 1839, a vivid stream of electric light was seen to descend from a dense dark cloud and strike the green turf in the park of Mrs. Carden, in the county of Cheshire. When the thunder-storm had abated, the spot where the lightning flash had struck was examined, and the effects produced by the electric current presented some interesting and curious phenomena.

In a circle about twelve or thirteen inches in diameter the grass was scorched and shrivelled up as though it had been dead for many years. On removing the brown and withered turf, which was a mere superficial skin of vegetable mould resting on a rock of new red sandstone, it was found that the electric current had penetrated the hard sandstone to a depth of three quarters of an inch, and then became deflected and divided into several smaller streams, which radiated from the central point of contact. Not only had the lightning-flash penetrated right through the greensward and into the hard siliceous sandstone, which it shivered into minute fragments, but it had then separated into several diverging streams, which as they passed along, and through the shivered pieces of rock, converted portions of it into small tubes several inches in length, and about half an inch in diameter, the interiors of which were completely vitrified, as may be seen in the specimen on the table, for which I am indebted to my friend Dr. Baird.

These phenomena show the wonderful penetrating power of electricity, and also prove the extraordinary heat accompanying it, for in this case it was, at the moment of contact with the sandstone rock, sufficiently powerful to convert a hard siliceous material into a number of glazed tubes.

In Sir Charles Lyell's Principles of Geology, reference is made to Dr. Hibbert's work, in which the latter, quoting from the manuscripts of the Rev. George Low, of Fetlar, one of the more northern Shetland Islands, proves that electricity is a powerful agent in producing havoc and ruin among rock masses. The facts, as taken from Mr. Low's manuscripts, are as follows :—At Funzie, in Fetlar, in the middle of last century, a flash of lightning in a moment tore from its bed a rock of mica-schist 105 feet long, upwards of ten feet broad, and in its thickest part from four to five feet. Such was the force of the stroke, that it not only detached the mass from its position, but broke it into three large pieces, besides shivering portions into numerous smaller fragments. One of the larger pieces, twenty-six feet long, ten feet broad, and four feet in thickness, was completely turned over. Another piece, 28 feet long, and five feet in thickness, was thrown across an elevated point to the distance of fifty yards. A third disjointed mass, between thirty and forty feet long, was hurled still further in the same direction, until it fell into the sea.

Major Austin also exhibited and described a portion of a Caligurite found in Cheshire.

A short discussion took place, in which Mr. STODDART pointed out the similarity of form between the course pursued by the lightning-flash and that of a long spark from a Ruhmkorff coil when received in the middle of a metallic plate.

Mr. W. W. STODDART, F.G.S., then shewed a number of specimens from Aust Cliffs, collected from a slip that had lately occurred. Among them were some fine teeth of Ceratodus gibbus, Acrodus minimus, Hybodus minor, Saurichthys; spines of Hybodus, Nemucanthus monilifer; scales of Gyrolepis Alberti, Pholidophorus, &c., and bones of Ichthyosaurus. The teeth of Ceratodus, and one of the Hybodus spines, were especially fine specimens. Mr. Stoddart also put before the members the curious fossil seeds of Chara medicaginula which he had collected from one or two localities in the Isle of Wight. These seeds were so perfect that the spiral markings were plainly visible.

ENTOMOLOGICAL SECTION.

TUESDAY, APRIL 9TH.—No report received up to the time of going to press. *Ed. of Proceedings.*

CHEMICAL AND PHOTOGRAPHIC SECTION.

WEDNESDAY, APRIL 10TH.—Mr. W. L. CARPENTER, B.A., B.Sc., in the chair. The attendance of members was small. After the transaction of the routine business,

Mr. ALFRED NOBLE, F.C.S., read a paper upon "Disinfection." He regretted that there were not more members present, as he was desirous of having a good discussion upon the question, since his remarks were chiefly respecting the supply of pure water, and the disposal of sewage, two subjects very intimately connected, which it was impossible to discuss separately. Quotations from a series of articles in the *Chemical News* for February and March, 1867, on the "London Water, Past, Present, and Future" were read, which tended to show how good the present supply was, having slightly improved within the last few years, that it was practically limitless, and that, in consequence, it was undesirable to entertain any gigantic scheme for bringing water from a distance to the Metropolis. If desired, the hardness could be easily diminished by the "liming" process, but that very hardness rendered the water more safe to store in leaden cisterns, &c. Mr. Noble then pointed out that although it was generally conceded that pure air and good water were the two essentials for healthy living, and although both these could be had in abundance in London, yet that both were poisoned by the defectiveness of local arrangements. For instance, in the smaller houses, two or three days' supply of water was stored in wooden butts, in very close proximity to the privies. Enormous quantities of good water, too, were wasted by being made the vehicle for carrying away the sewage, without in the slightest degree disinfecting it. It was necessary to find some remedy for this state of things, and for his own part, he was convinced that there was no disinfectant so powerful as dry earth, especially dry clay, which, by its porosity, oxidised the decomposing matters. On a former occasion he had described the practical application of this substance, by the Rev. Mr. Moule, of Dorchester, for the disposal of sewage, and he would therefore only now allude to it. Mr. Noble then referred to an article in the last number of the *Quarterly Journal of Science*, in which the state of things in Manchester at present, under the old cesspool system, was described. These cesspools were emptied every night, and hence that city would be a very suitable place to experiment with Moule's process, on a large scale as all the machinery for it was, as it were, ready to hand. The water supply of Manchester was naturally very good, but was greatly injured by the draining and leaking of sewage into it. The difficulties in the way of carrying out the earth-system were purely mechanical and commercial, that is, it was a question of comparative cost—chemically speaking, the process was almost perfect.

Mr. Carpenter spoke of his practical experience with Moule's process for the disinfection of sewage by dry earth, and its use as manure, at the Park Row Certified Industrial School, as well as having seen it in operation at the Kingswood Reformatory, and at the Netham Chemical Works. He also stated that the arrangements in many foreign hotels and inns were such, that a very slight modification would enable them to be worked according to Moule's plan.

Mr. Thos. Coomber, F.C.S., mentioned one or two instances of water which had been sent to him for examination, into which, originally pure, sewage matter had found its way, and caused serious consequences.

A conversational discussion then occurred, in which the members already named, together with Mr. Gillford and Mr. E. J. Gibbons, took part, upon the amount of reliance to be placed upon the permanganate of potash test for organic matter. Mr. Coomber maintained that the results obtained by it, at a constant temperature, &c., did indicate the amount of organic matter injurious to health, though not the total amount, while the confidence of other members in it seemed to have been shaken by some results recently published by Dr. Frankland, F.R.S., who had discontinued using the process. The existence of the old conduits in Bristol was also alluded to, as well as the apparently inexhaustible supply of very good water to be derived from the Mendips, and stored in the large new reservoir at Barrow, now almost complete.

ZOOLOGICAL SECTION.

Thursday, April 11th, 1867.—Mr. Leipner in the Chair.

The Secretary read some additional notes on the British Mammalia by Mr. C. O. Groome-Napier, F.G.S.

The Wild Cat.—I remember seeing a specimen in the flesh, at Honiton, in 1857. It was shot in a wood near that town. It was much larger than either of the Wild Cats in the Institution Museum. The body was of a light grey, and the fur on the tail very wiry. A friend of mine shot one at Dartmouth, in 1860.

The Weasel.—I once noticed a pack of six of these animals in pursuit of a rabbit, near Buildwas Abbey, in Shropshire, which, however, eluded their grasp by springing over a ditch. The *Times* some years ago, chronicled a battle between seven weasels and a man, who was attacked by them. The Albino Weasel is very rare. I have only seen one of them, it had red eyes. The Weasel in the ermine or winter dress is oftener seen, but cannot be called common. The true ermine or stoat in its winter dress, is but seldom seen in the South of England. I observed one at Lewes, during the severe winter of 1854.

The Badger.—I once observed this animal at large at Ladruna, in Devonshire, in 1851. The *Times* also once mentioned a combat between a coast-guardsman and four of these animals, at this very spot. The onslaught was unprovoked by the man, but he succeeded in killing the largest, and the rest decamped. I differ from Mr. Ponton in considering the badger more addicted to a carnivorous than to a vegetable diet. It is probably omnivorous, feeding on roots, vegetables, birds' eggs, game, and other animal substances, but being somewhat lazy, it takes what comes first. I have seen the contents of the stomachs of two badgers. One contained blackberries, a mole, a fieldmouse, and part of a hare's foot. The other contained some cabbage sprouts and moorhen's eggs, and some flesh which we could not determine. Persons judging the badger from its feet might easily suppose it to be little addicted to predaceous habits, for they are ill adapted for seizing live animals; but the badger's mode of attack is with the mouth.

I can offer very few remarks on the bats, a family which has been little studied by British naturalists. I once, however, obtained a specimen of Scotophilus discolor, which was captured at Brighton.

The common shrew has been supposed to be subject to a great mortality a certain seasons of the year, but this has, I think, never been proved. It is probably occasioned thus: the males being more numerous than the females, have frequent battles at the breeding season, and being very tender, many are killed. Cats, if they kill the shrew, usually avoid eating it, on account of the acrid poison it secretes in its singular gland near the tail, but owls and hawks eat it freely. The superstitions connected with the shrew's supposed power of injuring cattle have doubtless reference to the poisonous properties of its secretion, which might affect injuriously drinking troughs in which a shrew was drowned.

The squirrel, the most beautiful of the smaller quadrupeds, varies much in size in its different localities. In the New Forest it is very much larger, and its colour a brighter chestnut than in Devonshire or the western counties.

The Dormouse.—Its nest differs much in form from its hybernaculum, the latter being not above a third of the size of the first.

The Brown Rat.—I believe there is some error in Mr. Ponton's paper or its report in the February number of the Society's journal. 15½ inches is the length of the black rat, and 19 in. that of the brown rat, instead of 15½ inches being the length of the brown rat.

The SECRETARY (Mr. Swayne), exhibited a larva of Myrmeleo, Formica leo or Ant-lion, a neuropterous insect, which had been sent to him in a letter from New South Wales five months ago, and was still living, although it had eaten nothing since its capture. The curious habits of this insect were briefly alluded to, and a passage read from the Rev. J. G. Wood's Natural History, referring to their power of enduring deprivation of food.

Mr. A. LEIPNER remarked that this insect was not uncommon in Germany.

Mr. SWAYNE also exhibited the skull of the gorilla, the uncleaned skeleton (five feet five inches long), and skin of which had been recently sent to the Institution by Mr. Gordon, Gaboon River, W. Africa. In comparison with it were exhibited the gorilla skulls previously in the Institution collection, and Mr. Swayne remarked that the new one was a good typical specimen, being intermediate in certain characters between the two former best male skulls. It belonged to an adult and at least middle-aged male, as indicated by the teeth, the obliteration of most of the sutures, and the usual male characters. The whole skull appeared comparatively long and narrow, the palate long and narrow, with a deep notch posteriorly, and a considerable separation at the junction of the intermaxillaries in front. The teeth were perfect, and showed but little wearing, except the lower canines, which were much worn in front by attrition against the upper ones. In the left temporal fossa an iron slug was to be seen, firmly fixed in the bone, which was discoloured by it, and causing a bulging of the bone on the inside. The animal had apparently been killed by two bullets through the chest, which had fractured two ribs.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

Vol. II. MAY, 1867. No. 5.

ANNUAL MEETING.

THURSDAY, MAY 2ND 1867.—MAJOR THOMAS AUSTIN, F.G.S., in the chair.

The HON. SECRETARY apologised for the absence, on account of illness, of the President, and of one of the Vice-Presidents, Mr. Thomas Pease, F.G.S. He then read the minutes of the last ordinary meeting, and announced that the Council had elected the following gentlemen as ordinary members :—

Rev. William Spicer, Rev. Alexander Poole, Precentor of Bristol Cathedral, Mr. W. R. Browne, Mr. Charles Townsend, Mr. James Busvine Butler.

Also that the following donations to the Library had been received :—

From the Entomological Section : "The Entomologist," vol. for 1864-5; the "Entomological Magazine," vols. 1, 2.

From the Geological Section : "Geological Record," vol I., 1864.

From Mr. John Strachey Hare : "On Radiation," by Prof. Tyndall.

A vote of thanks to the respective donors was carried by acclamation.

Mr. LEIPNER then referred to the paragraph which had appeared in the *Bristol Daily Post* on April 29th, announcing the intended dissolution of the Society. The Council had investigated the matter, and discovered that his (Mr. Leipner's) handwriting and signature had been copied and forged, and an old letter of his also made use of, in order to impose upon the Editor of the *Daily Post*. The document was handed round for the inspection of the members present. Mr. Leipner then justified the views expressed by the Council in their letter which appeared the following day in the *Daily Post.* The hoax was childish, weak, and wicked; weak, because such a statement was only calculated to put even fresh energy into the officers of the Society; and wicked, because the author was endeavouring to diminish the usefulness of a Society which had already done a great deal of useful work, and would doubtless accomplish much more.

The minutes of the last Annual Meeting were then read, after which the following report of the Council was read by Mr. W. Lant Carpenter.

REPORT OF THE COUNCIL.

For the fifth time it has become the duty of the Council of the Bristol Naturalists' Society to lay before the members an account of the doings and progress of the Society during the past year, as well as their estimate of its present condition and future prospects. They feel that the real benefit of such a Report can only be ensured by business-like simplicity of statement, as well as by a perfectly candid expression of their opinion as to the general mode in which the affairs of the Society have prospered.

In the first place, then, the Council would congratulate the Society upon having accomplished a considerable amount of good work at its various meetings, general, sectional, and excursion. There has been no lack of papers at the general monthly meetings, and the discussions which have taken place upon the subjects brought forward have tended to the interchange of a considerable amount of information, and have also evinced the lively interest taken in the proceedings by the various members who attended. Numerous short communications have also been made, both written and verbal, frequently of very great interest, and indicating a laudable desire on the part of the authors to increase the general stock of knowledge by the addition of their observations. It has been well said that Science consists of facts arranged and explained, and a Society like this yields one of the best means for collecting and placing-on-record facts and observations, in such a form as will afford great facilities for the necessary inductions to be drawn from them.

The business of the various sections, also, has been carried on very satisfactorily, though, on account of the small number of working members in each, as well as the extraordinary severity of the weather during a part of the winter, there has been occasionally a difficulty felt by the Sectional Officers not only in providing subjects for the evening's consideration, but also in inducing a sufficient number of members to attend the meetings, and they wish, therefore, to take this opportunity of impressing upon the members of sections the necessity of occasionally making some little sacrifice of personal convenience, in order to keep up the spirit of the Sectional Meetings. The Council, and especially the Sectional Officers, would frequently be glad of suggestions and hints on the management of various departments of the Society, expressed either through individual members of the Council, or through their Secretary, in order that they may be informed as to the feelings of members upon these subjects, and may then, as far as possible, act in accordance with the information so obtained.

Although it has been customary, in former reports, to notice briefly the subjects and authors of papers read at the Society's meetings, the Council do not consider it necessary to do so on this occasion, as full reports of each meeting, in the Society's published Proceedings, have been forwarded to every member. Since further allusion will be made to this publication, in considering the financial position of the Society, the subject will not be pursued here.

The number of members of the Society has not increased during the year, the losses by death and resignation being exactly balanced by the election of new members.

The Council have to regret the loss of two members by death—Mr. William Tanner and Mr. Clement Baber. The temperament of the first-named gentleman was so quiet and retiring, that he seldom or never took any active part at the Society's meetings, but he devoted himself specially to the cultivation of ferns, and to their acclimatisation, endeavouring to render such ferns as were usually considered green-house plants hardy enough to live in the open air. The members of the Botanical Section will long remember with pleasure an evening spent, by invitation, at Mr. Tanner's house on August 18th, 1865, when the opportunity was afforded them of examining his collections, and observing his modes of culture of various plants; and shortly before his death he had expressed his wish to receive the section again at his house, with similar hospitable intentions.

Mr. Baber was prevented by his arduous professional duties from showing more than a general interest in the Society, but the value he placed upon scientific pursuits is evident from the fact that a training in these formed a prominent part in the routine of instruction pursued in his school.

Removal from Bristol caused three other members to resign, and, two having resigned for other reasons, a total is shown of seven members lost to the society; but the deficiency thus caused has been exactly supplied by the election of seven new members.

With regard to the Society's Library, no additions by purchase have been made to it during the year, on account of the state of the general account and funds of the Society, to be presently explained. The Council regret that a larger sum of money is not subscribed annually to the support of the Library, and they wish to remind members that the use of the books is open to all, and not confined to the unfortunately very small number of subscribers to the Library fund. Donations of several volumes have been received during the year, and announced at the Meetings from time to time, especially from the various sections, who have thus generously devoted a portion of their special funds to the use of the whole Society.

The Council regret, too, that more progress has not been made with the proposed published work of the Society upon the Natural History (in its widest sense) of the Bristol Coal-field. Before the first part can be written, it is necessary to make a careful re-examination of certain geological strata at a considerable distance from Bristol, and the inclemency of the weather, as well as the numerous other demands upon their time, have hitherto prevented the gentlemen appointed for this duty from accomplishing their object.

The Financial position of the Society is, unfortunately, a matter of some anxiety to the Council, and demands attention also at the hands of the members themselves. It is scarcely necessary to state that the present state of things is due, in great part, to the cost of the publication of the Society's Proceedings in the more extended form in which they have been issued to members. The Council think it well to remind the Society of the circumstances under which the change was made. During the year 1865, your Hon. Reporting Secretary received both verbally and in writing, several expressions of a desire on the part of members generally, to possess a report of the Society's Proceedings in a more permanent form than that of the newspaper slips, which were then the only published record. Enquiries were made as to the probable cost of this, and with such results that the Council did not feel justified in recommending to the Society the adoption of any plan. Early in 1866, however, these suggestions were again urged upon the attention of the officers of the Society, and the experiment was made of printing one month's Proceedings. This was so much liked, that, at the April meeting of the Society, in that year, it was unanimously resolved that the Proceedings should be published in this form, and reprinted from the previous January. This course was approved of at the Annual Meeting, but no definite resolution was come-to as to how the necessarily increased expenditure was to be met, although several suggestions were made. The question was again brought before the Society at the first general meeting of this Session, October 4th, 1866, when it was resolved unanimously that a payment of 2s. 6d. should be made by each member to cover the expenses of the Society from January, (when the Annual subscriptions were due) till May, 1867, and that the Annual subscription should thenceforth be 7s. 6d. instead of 5s., and should be due at the Annual Meeting in May. This arrangement, and the alteration of Rule IX, were duly published in the Proceedings, and the required notice for their confirmation inserted in the summonses of the November meeting, at which this course was unanimously approved by the members present, and no opinion adverse to it was received by any officer of the Society, or any member of the Council, who therefore hoped that the proposed plan was agreeable to the whole of the members of the Society. They were, in consequence, much concerned to hear, at the January meeting of the Society, of the extreme difficulty your Hon. Treasurer had met-with in obtaining the extra 2s. 6d., and they regret to have to state that, up to the date of this report, more than one-fourth of the members have failed to make this payment, although repeatedly applied-to for it, and that of these several have actually declined to do so. On this account, the Society is considerably in debt to its Treasurer, and this debt will go on increasing unless the subscriptions are duly paid, or the expenditure diminished. With reference to this last point, it may be stated that the Council took considerable trouble to ascertain the lowest scale of charge for printing, and also to obtain advertisements on the cover of the Proceedings, with the view of partly reimbursing the Society, and they think they ought to state, further, that the only criticism which has reached them upon the Proceedings, is that even now they are not sufficiently full. To make them fuller, would, of course, increase the cost still more, and although the Editor feels that it would frequently be more satisfactory that the reports should be more complete, the present state of the finances will not allow of such an extension.

The Council also wish that it should be known that, although they felt it right to authorise their two Secretaries to employ occasional paid assistance, to aid them in the discharge of their duties to the Society, neither of these gentlemen have availed themselves of the power thus given them, and that the whole of their work, has been performed by them without drawing upon any of the Society's funds, and that the labours of the Hon. Treasurer have been rendered much heavier, by the unwillingness of members to pay their subscriptions. The Council therefore trust that the Society will render its officers every assistance in its power, and not hinder the carrying out of a plan undertaken by its express wish; and they would remind the members that the rate of subscription to this, is lower than to that of any other Society or Association of the same kind in England, partly arising from the fact that there is no expense incurred in hiring rooms for the meetings, or a secure place to keep the Society's property, owing to the liberality of the Committee of the Bristol Institution, who have most kindly placed two rooms at the disposal of the Society, when not otherwise engaged. It is a source of great regret to your Council that, in consequence of the present state of the funds, they cannot advise the appropriation of any moneys towards a gratuity to the Institution, according to the custom of former years. It must be remembered, however, that the large balance against the treasurer is more apparent than real, and will partly be covered by a proportion of the annual subscriptions now due, which, under ordinary circumstances, would have been paid in January last.

In conclusion, your Council would congratulate the Society upon the continuance of its steady advancement to a good scientific position, as shown by the number and character of the papers read, and by the other evidences of work done by the members, both in and out of the Sections, and would express the hope that the next Annual Meeting will find it established on as firm a financial, as it now is on a scientific basis.

The Hon. Treasurer, Mr. W. W. Stoddart, F.G.S., then read his abstract of audited accounts for the year (see page 58). He stated that the explanation of the apparently large balance against him of £23 13s. was easy in many ways. £7 was caused by the experimental reprinting of a portion of the Proceedings of 1866, and £12 5s. was due to arrears of subscriptions, almost entirely the extra half-crowns. The time at which the subscriptions were collected, too, had been postponed from January to May, according to the alteration of Rule IX, carried at the last November meeting. If the subscriptions had been collected as usual in January, he would have had as large a balance upon the credit side as he now had on the debit. This showed that the calculation he made at the last Annual Meeting was correct, and, though he had gone carefully iuto the matter, he was quite sure that the subscription of 7s. 6d. would keep the Society always ahead of debt even with its present expenditure. He regretted much to have to complain again of the difficulty he experienced in obtaining his subscriptions, and read a few letters from members who were unwilling to pay. He did not think that any reasonable person would grumble at the subscription, considering the large amount of information given in the journals. Most societies' subscriptions were £1 1s. per annum, instead of 7s. 6d.

Mr. Henry Johnson moved the first resolution—"That the Report now read, together with the Treasurer's Account, be approved and printed under the direction of the Council, and that a list of the Officers and Members of the Society be added thereto." Until he heard their Treasurer's explanation, he had thought the Council's report rather alarming, but he had much pleasure in moving the above resolution. He trusted that the letter referred to by Mr. Leipner emanated from no member of the Society, as it was a lie and a forgery.

Mr. George Morris seconded the resolution. He agreed with the remarks of the last speaker, thought the Treasurer's report encouraging, and hoped the Society would go on and prosper.

The resolution having been carried unanimously,

Mr. H. K. Jordan, F.G.S., moved the second resolution, as follows, —"That the Hon. Secretary be requested to convey to the Committee of the Institution the best thanks of the Naturalists' Society, for the hospitality afforded to them during the past year, and their sincere regret, that the present state of the funds of the Society, does not permit them to repeat for this year their usual donation to the Institution, as an expression of their gratitude." Mr. Jordan said that he rose with considerable trepidation, as he had had the pleasure, last year, of moving a donation of ten guineas to the Institution. There was nothing for it but to put a bold face on the matter; and the Society might also consider the reassuring feature that it was not the *amor pecuniæ* which was the motive prompting the Institution Committee to lend the rooms to the Society, but a desire to foster a love of Science.

Mr. C. F. Ravis seconded the resolution, adding his personal thanks to the Institution, and sincere regrets at the want of means to make the usual donation.

The resolution was carried by acclamation.

Mr. S. H. Swayne moved the third resolution, "That the Honorary Secretary, the Honorary Reporting Secretary, and the Honorary Treasurer, be requested to continue in their respective offices during the ensuing year." The speaker had had the pleasure of moving this resolution at the last annual meeting also, and it gave him great pleasure to do so again. He thought the officers of the Society were worthy of their fullest confidence, and had done all in their power to promote its interests. He referred to the fact that they had not availed themselves of the paid assistance granted to them by the Council, and hoped that every one would sympathise with them about the hindrances which had been thrown in their way. He would not waste much time on the forgery practised on the newspapers, as no one but a dastard could have done it. It was probably more from forgetfulness than any other cause, that members had been remiss in their payments.

Mr. Stephen Barton seconded the resolution. He had not much to say after Mr. Swayne, but he thought that as long as the present officers retained their posts, the wishes of the writer of the paragraph would never be realised.

Mr. H. K. Jordan, F.G.S., supported the resolution, which was carried unanimously.

The ballot was then taken for the office of President, Mr. Leipner and Mr. W. L. Carpenter acting as scrutineers. The announcement that Mr. William Sanders, F.R.S., F.G.S., was unanimously re-elected, was received with much applause.

Mr. Leipner said that Mr. Sanders was much grieved that illness prevented him from being present; he was, however, rapidly improving, and the speaker hoped and expected that he would be able to preside over them at the next general meeting, which he had never yet failed to do.

The ballot was then taken for two Vice-Presidents, resulting in the re-election of Rev. Canon Moseley, M.A., F.R.S., and of Mr. Thomas Pease, F.G.S. Also for three members of the Council, to replace the three retiring members who were ineligible for re-election. Major Thomas Austin, F.G.S., Mr. H. K. Jordan, F.G.S., and Mr. C. F. Ravis, were duly elected.

Mr. Alderman Barnes moved the fourth resolution, as follows:— "That the thanks of the Society are due to its Officers and the members of the Council for their management of the Society's affairs." He thought that with such a body of managers, no words were needed to thank them, as a more happy and better selection could not be found.

Mr. Bolt having seconded the resolution, it was carried unanimously.

Mr. A. Leipner, in returning thanks on behalf of his colleagues and himself, said that it was a pleasure to work for the Society when its affairs went on smoothly, and if necessary, he was prepared to work as hard in the coming, as he had in the preceding year. It was usual at the Annual Meeting to give some information about the excursions, but the Council, at their recent meeting, had been so much occupied with unexpected business, that they had been unable to discuss the matter. He should, however, shortly summon a meeting of the new Council, to consider the arrangements for the summer. He spoke of the increasing difficulty of finding new excursions, and requested that any suggestions from members might be forwarded to him, or to some other member of the Council.

The formal business being thus concluded,

Major Austin, F.G.S., from the chair, expressed his regret at the absence of the President, and his hope that the Society would yet have many Annual Meetings, notwithstanding the *Daily Post* paragraph.

On the motion of Mr. Leipner, a cordial vote of thanks was passed to Major Austin for his kindness in taking the chair that evening.

DR. W. W. STODDART, TREASURER OF THE BRISTOL NATURALISTS' SOCIETY. CR.

1867.	£	s.	d.	1867.	£	s.	d.
To Balance in hand, May, 1866 ...	15	0	2	By Cash—Morris	33	0	0
Subscriptions received to April 27, 1867	27	5	6	" Somerton	2	1	6
Balance due to Treasurer ...	23	13	0	" Morgan	0	7	0
				" Institution	10	10	0
				" Collector	1	11	6
				" Gratuities, Notices, and Sundry Expenses, per Secretary	15	9	9
Audited and found correct, THOMAS TURNER, EDWIN J. GIBBONS.				" Sturge	0	18	7
				" Mardon	2	0	4
	£65	18	8		£65	18	8

LIBRARY FUND.

	£	s.	d.		£	s.	d.
To Balance in hand	13	6	6	By Cash—Williams	0	4	3
Subscriptions to April 27, 1867 ...	3	14	6	" Morgan	0	10	9
				" Mardon	1	0	0
				By Balance ..	15	6	0
	£17	1	0		£17	1	0

LIST OF OFFICERS

AS APPOINTED AT THE ANNUAL MEETING, MAY 2ND, 1867.

President:

WILLIAM SANDERS, F.R.S., F.G.S.,
21, Richmond Terrace, Clifton.

Vice-Presidents:

REV. CANON MOSELEY, M.A., F.R.S., INSTIT. SC. PARIS CORRESP.

THOMAS PEASE, F.G.S.

Members of the Council:

DAVID DAVIES, M.R.C.S.
JOHN BEDDOE, M.D.
WILLIAM POOLE KING.
CH. O. GROOM-NAPIER, F.G.S.
ALFRED NOBLE, F.C.S.
S. H. SWAYNE, M.R.C.S.
MAJOR THOS. AUSTIN, F.G.S.
HENRY K. JORDAN, F.G.S.
CHARLES F. RAVIS.

Treasurer:

W. W. STODDART, F.G.S., 7, King-square, Bristol.

Honorary Secretary:

ADOLPH LEIPNER, Washington Villa, Hampton Park.

Honorary Reporting Secretary:

WM. LANT CARPENTER, B.A., B.Sc., 12, Brighton Park, Clifton.

SECTIONS.

BOTANICAL.

President, Adolph Leipner. *Secretary,* T. H. Yabbicom, Ross Villa, Cotham.

Third Thursday in the month, 7.30 p.m.

CHEMICAL AND PHOTOGRAPHIC.

President, P. J. Worsley, B.A., F.C.S. *Secretary,* A. Noble, F.C.S., 6, City Road, Bristol.

Second Wednesday in the month, 8.0. p.m.

ENTOMOLOGICAL.

President, Stephen Barton. *Secretary,* Geo. Harding, Junr., Stapleton.

Second Tuesday in the month, 8.0. p.m.

GEOLOGICAL.

President, W. Sanders, F.R.S., F.G.S. *Secretary,* F. Ashmead, C.E., 1, Alma Vale, Clifton.

Fourth Thursday in the month, 7.30 p.m.

ZOOLOGICAL.

President, Henry Fripp, M.D. *Secretary,* S.H.Swayne, M.R.C.S. 8, Berkeley Square, Bristol.

Second Thursday in the month, 8.0 p.m.

All Sections are open to any member of the Society, on payment of an annual subscription of 2s. 6d. in each case.

Note.—The following register of meetings, &c., usually held at the Institution during the months from September to April inclusive, may be found useful as a guide, if it is remembered that circumstances occasionally compel the postponement or adjournment of a sectional meeting.

	WEEK OF THE MONTH. I.	II.	III.	IV.
Monday	Scientific and Literary Lectures at the Institution.			
Tuesday		Entomological Section. 8.0 p.m.		
Wednesday		Chemical and Photographic Section. 8.0 p.m.	Bristol Microscopical Society. 8.0 p.m.	
Thursday	General Meeting, 7.30 p.m.	Zoological Section. 8.0 p.m.	Botanical Section. 7.30 p.m.	Geological Section. 7.30 p.m
Friday				
Saturday				

LIST OF MEMBERS.

Ashmead, Frederick, C.E.
Atchley, George F.
Austin, Major Thomas, F.G.S.
Badock, William F.
Baker, Septimus Valentine
Barber, J.
Barnes, Francis K.
Barton, John Perry
Barton, Stephen
Barton, W. H.
Bates, John
Beattie, John
Beddoe, John, M.D.
Beddoe, Richard C.
Benham, William, LL.D.
Bernard, Ralph M., F.R.C.S.
Bernard, Francis Ralph
Berry, William
Bisson, Francis P.
Blackmore, James Chanter
Bolt, Henry
Bolt, John
Boorne, Charles
Braikenridge, Rev. G.W., M.A., F.L.S.
Brightman, Edward
Brittan, Alfred
Brittan, Frederick, M.D.
Browne, Samuel Woolcott
Browne, W. R.
Budgett, John Payne
Budgett, W. Hill
Budgett, W. H.
Burder, John Forster, M.D.
Butler, Cephas
Butler, James Busvine
Butler, Philip John
Caldicott, Rev. J. W., M.A.
Carpenter, Wm. L., B.A., B.Sc.
Carter, William G., M.D.
Cayzer, Thomas S.
Challacombe, J. P., M.D.
Chandler, John Moss, L.S.A.
Chandler, Joseph C.
Charbonnier, Henry
Charbonnier, Theodore
Clark, Thos. E., M.R.C.S.
Clark, William
Clarke, J. W.
Clarke, W. Michell, M.R.C.S.
Cole, T. C.
Colthurst, John, F.R.C.S.
Coomber, Thomas, F.C.S.
Cordeaux, Frederick
Cossham, Handel, F.G.S.
Crichton, James M., L.R.C.S.
Dando, Charles
Davey, James George, M.D.
Davies, David, M.R.C.S.
Day, Alfred, LL.D.
Derham, James
Derham, Samuel
Desprez, Charles
Down, Edwin
Dunn, Charles Bortill
Evans, William
Exley, John T., M.A.
Fedden, William J.
Ferris, Henry
Fiddes, Walter
Fiddes, William

Fox, Charles Henry, M.D.
Fox, Charles Joseph, M.D.
Fox, Edward Long, M.D.
Fox, Edwin F., M.R.C.S.
Frayne, William
Fripp, Henry E., M.D.
Fry, Francis J.
Gale, Rev. I. Sadler
Garaway, J. R.
Gardiner, George, M.R.C.S.
Gardner, Charles E.
Gibbons, Edwin James
Giles, Richard William
Gillford, George
Girdlestone, Rev. Henry
Goodeve, Henry H., M.D.
Gotch, Rev. F. W., LL.D.
Gould, Joseph
Granville, J. Mortimer, L.R.C.P.
Greig, Charles, M.R.C.S.
Grundy, Thomas G.
Halsall, Edward
Harding, George, Jun.
Harding, T. G. Rice
Hare, John Strachey
Harris, Captain Charles Poulett
Hartland, James
Harvey, Edward
Harvey, John, Jun.
Hayman, S.
Herapath, Wm. Bird, M.D.
Higgins, Edmund T., M.R.C.S.
Highett, Charles, M.R.C.P.
Highett, James, M.R.C.S.
Hill, Charles
Hodges, Edward R.
House, Henry
Howard, Thomas, C.E.
Hudd, A. E.
Hudson, Charles T., M.A., LL.D.
Husbands, Henry
Hutchins, J.
Jackson, John Pim
Jacques, F. V.
James, Christopher, C.E.
James, Rev. William
John, Evan
Johnson, Henry
Jordan, Henry K., F.G.S.
Kerslake, Thomas
King, William Poole
King, Mervyn
Kingdom, Edward J. J.
Kitt, Benjamin
Lang, Robert
Leipner, Adolph
Little, Stephen
Lobb, Benjamin N.
Lucas, Charles Phipps
Lunell, John E.
Malthus, Sydenham
Marshall, Henry, M.D.
Martin, Frederick
Martyn, Samuel, M.D.
Masters, Henry
Metford, Joseph S., M.R.C.S.
Miller, Alfred R.
Moore, John
Morgan, Frederick
Morris, George
Morris, J. W., F.L.S.
Moseley, Rev. Canon, M.A., F.R.S.
Moseley, H. N.
Mosely, A.
Naish, Louis
Napier, C. O. Groom, F.G.S., F.A.S.L.
Newton, H. J. W.
Noble, Alfred, F.C.S.
Nunn, E. C.
Ormerod, William, M.R.C.S.
Palmer, Henry Andrewes
Parker, George John, M.R.C.S.
Parker, George John, Jun.
Parson, Thomas Cooke
Parson, Thomas Cooke, Jun.
Parsons, James Gage, L.R.C.P.
Pass, Alfred C.
Pearce, William
Pease, Thomas, F.G.S.
Peck, William
Phillips, George
Plant, Edmund Carter
Pockson, William
Pocock, Rev. Nicholas

Polglase, William
Ponton, Archibald C.
Ponton, Thomas Graham
Poole, Rev. Alexander
Pooley, Charles, M.D.
Pope, Thomas
Powell, Septimus
Poynton, Rev. F. J.
Præger, Emil Arnold
Prangley, Arthur
Prichard, Augustin, F.R.C.S.
Ranson, J. J.
Ravis, Charles F.
Roberts, Rev. H. Seymour, LL.D.
Rogers, John Robert
Saunders, John Naish, F.G.S.
Sanders, William, F.R.S., F.G.S.
Saunders, Joshua
Sawer, Thomas, M R.C.S.
Seed, Frederick
Schacht, Frederick
Sleeman, Philip R., F.R.C.S.
Smart, John S.
Smith, Alfred
Smith, Rev. Gilbert N.
Smith, William
Spicer, Rev. William
Standerwick, Richard Sylvanus
Stansfeld, G. M.
Stephens, Gundry
Swayne, Joseph G., M.D.
Swayne, Samuel Hy., M.R.C.S.
Stoddart, W. W., F.G.S.
Tanner, Henry
Terrell, William
Thomas, Charles
Thomas, Herbert
Thomas, Thomas
Tothill, William, Jun.
Townsend, Charles
Townsend, Henry H.
Townsend John Henry
Tubby, Major I. Hardy
Tuckett, Francis F.
Tucket, Philip De bell
Turner, Thomas
Tylee, J. P.
Usher, Thomas
Vaughan, Philip Henry
Walcott, William B. L.
Walton, Thomas Todd
Warren, C. W.
Webster, Thomas, M.R.C.S.
West, E. F.
Weston, Andrew
Wethered, Joseph
Wheeler, Charles, Jun.
Wheeler, Edwin
Whitfeld, Fred Henry
Whiting, Rev. W.
Whitwill, Mark
Wills, Frederick
Wills, Samuel
Wills, William Henry
Willway, H. P.
Wilson, Rev. George Martyn
Wilson, Henry, M.R.C.S.
Wollaston, Rev. W. C.
Woodward, Augustin
Worsley, Philip John, B.A., F.C.S.
Worsley, Samuel
Wright, Charles Edward
Yabbicom, Thomas Henry
Young, F. Graham

LIST OF CORRESPONDING MEMBERS.

George S. Brady, Esq., Sunderland.

James Buckman, Esq., F.L.S., F.G.S., F.S.A., Bradford Abbas, Sherborne.

William B Carpenter, Esq,, M.D., F.R.S., &c., University of London.

Philip P. Carpenter, Esq., B.A., Ph. D., Montreal.

Robert Etheridge, F.G.S., F.R.S.E., Mus. of Economic Geology, London.

J. P. Galienne, Esq., Guernsey.

Albert Günther, Esq., M.A., M.D., Ph.D., F.Z.S., British Museum.

T. Rupert Jones, Esq., F.G.S., Professor of Geology and Mineralogy, Royal Military College, Sandhurst.

Edwin Lankester, Esq., M.D., F.R.S., South Kensington Museum, London.

Frederick Layard, Esq., late of Ceylon.

William Lonsdale, Esq., F.G.S., Bristol.

Charles Moore, Esq., F.G.S., Bath.

Hugh Owen, Esq., Paddington.

Professor John Phillips, M.A., LL.D., F.R.S., F.G.S., Oxford.

John A. Power, Esq., M.A. and L.M., Cantab.; M.R.C.P., London; F.R.G.S., London.

W. W. Saunders, Esq., F.R.S., F.L.S., &c., Hillfield, Reigate.

H. J. Slack, Esq., F.G.S., London.

Rev. Frederick Smithe, M.A., F.G.S., Highley Vicarage, Bridgnorth.

Frederick Smith, Esq., British Museum.

G. H. K. Thwaites, Esq., F.R.S., Royal Botanic Gardens, Beradenia, Ceylon.

NOTE.—The following errata in the report of Mr. Rich's communication on page 42, which was forwarded to the Editor by Mr. Rich, have been pointed out:—

line	10	from bottom,	for	"Antigua,"	read	*antiquus.*
„	8	„	„	"Trochii,"	„	*Trochus.*
„	8	„	„	"Scalaris,"	„	*Scalaria.*
„	8	„	„	"Acuminata,"	„	*acuminatum.*
„	5	„	„	"Aplesia,"	„	*Aplysia.*

MEETINGS OF SECTIONS.

BOTANICAL SECTION.

THURSDAY, MARCH 27TH.—Mr. J. W. CLARKE in the Chair.

The attendance of members was small, and the evening was devoted to working at the Society's herbarium.

It was subsequently arranged that the first Botanical walk of the season should take place on May 20th, with the Entomological Section.

ENTOMOLOGICAL SECTION.

TUESDAY, APRIL 9TH, 1867.—Mr. STEPHEN BARTON, President of the Section, in the chair.

The PRESIDENT exhibited, on behalf of Mr. Leipner, a specimen and cocoon of a rare Hymenopterous insect, Trichiosoma Laterale. This insect is figured in Curtis, vol. 3, plate 49. The cocoon from which this insect was bred was found attached to a spray of hawthorn; the cocoon much resembled the common hawthorn-feeding species.

The Rev. W. W. SPICER exhibited a living specimen of Machilis polypoda, a species in the Apterous division of the Orthoptera, of comparatively rare occurrence. This species was captured by Mr. Spicer at Leigh, under stones.

It was determined that the first excursion of the section should take place on May 13th, to Leigh Woods; members to meet at the Suspension Bridge at three o'clock. This was subsequently postponed to May 20th.

It was also arranged that several evening meetings for collecting should take place during the present month.

GEOLOGICAL SECTION.

Thursday, April 25th.—In consequence of the illness of Mr. W. Sanders, who was to have read a paper, the meeting announced for this evening was postponed.

CHEMICAL AND PHOTOGRAPHIC SECTION.

Wednesday, May 8th.—Mr. P. J. Worsley, B.A., F.C.S., President of the Section, in the chair.

Mr. John Beattie made a verbal communication entitled "Photographic notes." The first had reference to the "touching" or working-up of negative pictures, either landscape or portrait, but more especially the latter. Many pigments had been tried, and the instrument that gave the best result was a very fine soft lead pencil. Indian ink was also used to great advantage. In this way, a beautifully stippled negative could be obtained, of great softness; every part could be touched except the highest lights.

The second note was upon the use of glycerine in keeping ordinary wet-collodion plates sensitive for several hours. When a period not exceeding three hours was sufficient, the bath might be acidulated with nitric acid, but by the use of acetic acid the speaker had succeeded in keeping a plate sensitive for 10 hours. He believed that the free nitric acid promoted too rapid oxidation upon the plate, destroying its sensitiveness. His formula was 1 oz. glycerine, 1 oz. water, 1 oz. nitrate of silver, 30-grain solution. After incorporating the mixture, and allowing it to stand, it was to be filtered, and was ready for use. The plate should be sensitised in the usual manner, and this solution poured over it. In developing, there was often a difficulty in getting the developer to spread evenly over the plate, and he had reverted to the old plan of dipping the plate into the developer, with very good results. This process was invaluable for interiors, which were necessarily exposed for a long time.

Much had been said and written about the use of gelatin in developers. Mr. Beattie was convinced that an excessive quantity was usually recommended: he was in the habit of using seven grains proto-sulphate of iron seven drops of acetic acid, and 1½ dram of a 1½ grain solution of gelatin, strengthening the picture with pyrogallic acid and silver.

The President exhibited a very beautiful set of Frith's photographs of Swiss scenery, many of the negatives of which had been evidently worked up, as described by Mr. Beattie. He also showed some rough-looking, but very effective photographs, printed upon coarse drawing paper. They were produced by Mr. Taylor, of Marseilles, according to a process which he had invented, termed the shell-lac process—in which shell-lac dissolved in borax was used. Mr. Worsley also mentioned that he had seen lately in Paris a small camera with fixed lenses, without any focal adjustment, which gave with dry plates very good results. The small pictures produced by it were readily enlarged.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

Vol. II. JUNE, 1867. No. 6.

EXCURSION MEETING.

Friday, June 14th.—The first excursion for the season took place this day as arranged, and was attended by several members and lady visitors. Leaving Bristol by the 9.45 a.m. train, the party reached Chepstow viâ the New Passage, soon after 11 o'clock, and were met by the breaks which had been provided to convey them to Tintern. About two miles out of Chepstow, the majority left the breaks, and ascended Wyndcliff by the path leading up from the back of it. The atmosphere being tolerably clear, the extensive view, familiar to so many, was well seen, and a considerable time was spent in admiring it, and in searching the woods for objects of Natural History. We regret to have to note, however, that neither Botanists nor Entomologists were rewarded by the discovery of any objects of special interest. As the route from the top of Wyndcliff to Tintern across the fields was not known to any member present, the whole party rejoined the conveyances which were waiting at the foot of the cliff, and were driven to the beautiful Abbey, to the examination of which, much time was devoted.

Mr. Emil Arnold Praeger kindly made some remarks upon the building, thus adding greatly to the pleasure and information of the party.

He pointed out that the Abbey had been founded about 736 years ago, and was particularly remarkable for the fine proportions of its construction, the great height of the interior, and for the highly finished ornaments which had been applied throughout the whole building with great taste and simplicity.

To obtain great height had always been the aim in pure Gothic architecture, and in this respect also, the Abbey might be considered one of the finest specimens, in imitation of the high forest trees from which this style had been derived. The material had been chosen with great judgement, and consisted of red sandstone strongly impregnated with mica; it had stood the test of time remarkably well.

The whole building had been erected in the same style in which it was commenced, the only exception being the archway leading from the north aisle into the cloisters, which was of a later period, but a masterpiece of design and carving.

The uses of the various niches in the walls were explained as having served as safes for holy vessels, &c.

The refectory was closely scrutinized, the little room to the right in this once beautiful hall, Mr. Praeger supposed to have been a store-room for wine and delicacies, which were brought out on particular occasions when distinguished visitors were entertained; and this supposition was based on the fact of having seen similar arrangements in many convents in Southern Europe. Places were pointed out where sculptures had adorned the walls, probably bas-reliefs representing sacred objects. In comparing this building with the Dome of Cologne, and other similar structures in France, Spain, Bavaria, Austria, and Italy, some interesting details were given of convents and convent life, as also the biographies of several individuals who had escaped from monastic institutions in more recent times.

The sculptured head belonging to the statue of a knight was shown, which Mr. Praeger discovered some short time previously amidst the *debris.* It was to be regretted that the remains of so fine a structure were so carelessly treated; for example, the ivy was allowed to become destructive to the masonry, and even trees grew on walls and arches, the roots of which, together with the action of the weather, would soon bring these splendid relics to the ground.

After having spent the allotted time very pleasantly in the Abbey, the party returned to Chepstow direct, and did ample justice to the dinner, which had been well provided at the Beaufort Hotel, whence also the breaks were hired. Shortly before seven o'clock the vehicles were once more entered, and after a fine drive to Portskewet, the party returned by the last up-train from the New Passage, much pleased with the result of the day.

MEETINGS OF SECTIONS.

ENTOMOLOGICAL SECTION.

Tuesday, June 25th.—First excursion meeting of the season.

The members met at the Bristol and Exeter station, and proceeded by 1.15 p.m. train to Nailsea, walking to Brockley Coombe, then to the Warren, where tea was partaken of; they then crossed the Down to the upper end of Goblin Coombe, returning to Bristol from Yatton station by train, leaving at 10 p.m.

The day was very fine, and consequently, a large number of captures were made.

Among the species captured may be enumerated:

Crytochephalus Moreii
Athous Niger
Argynnis Aglaia
——— Selene
Procris Geryon
Ephyra Punctaria
Ellopia Fasciaria
Acidalia Subsericeata
Eupithecia Lariciata
Pœdisca Bilunana
Retina Pinivorana
Pterophorus Hieracii
Phycis Abitella

Larvæ of Saturnia Carpina feeding on heath, and of Bombyx Neustria on whitethorn.

A fine specimen of the viper, and several lizards were also captured.

BOTANICAL SECTION.

Tuesday, June 25th.—This Section visited, together with the Entomological Section, the neighbourhood of Brockley.

Among the plants noticed were:

Helleborus fœtidus
Listera orata
Pedicularis sylvatica
Epilobium angustifolium
Scrophularia aquatica
Ophrys apifera
Orchis maculata
Gymnadenia conopsea

And on an old wall in the woods, the pretty little "Brittle Bladder Fern" Cystopteris fragilis.

GEOLOGICAL SECTION.

Friday, June 28th.—This section started for the first geological walk of the season, having for its object an examination of the Bradford clay, at Bradford-on-Avon. The members left Bristol by the 3.50 p.m. train.

The quarries were visited, and searched as much as the limited time at the disposal of the party would permit. An exceedingly fine section of the great oolite beds of building stone was noticed. On the top of them was clearly seen the Bradford clay, about 20 feet in thickness, and its characteristic fossils were collected; among these were Terebratula digona, and the beautiful pea encrinite (Apiocrinus rotundus) of which the members brought home a great many specimens. These exquisite sea-lilies were found at the bottom of the clay, disjointed, but with the roots still adhering in an upright position to what was once the stony bottom of the oolitic sea. Many specimens were obtained incrusted with Serpulæ, and a charming little Bryozoon (*Diastopora diluviana*)—the minute polypidoms of which would prove a source of delight to the microscopist. Of course the rags and freestone of the great oolite beds did not escape the fossil-collectors' attention, and some characteristic species rewarded their search. Among others were noticed the Terebratula coarctata, the prettiest of that genus of Brachiopods; a very fine example of Isastræa explanatula, and Montlivaltia Smithii.

The following is a list of the principal fossils seen in the different bags and baskets :—

Diastopora diluviana	Terebratula digona
Montlivaltia Smithii	——— maxillata
Isastræa explanatula	Rhynchonella concinna
Apiocrinus rotundus	——— obsoleta
Lithodomus inclusus	Serpula
Avicula costata	Ostrea
Pholadomya socialis	Several small univalves
Terebratula coarctata	

The members then left Bradford, and walked by the side of the Kennet and Avon canal to Limpley Stoke, in time for the returning train to Bristol. So short was the time allowed, that all felt another visit to the quarries should be undertaken. Altogether a most pleasant evening was spent, all appearing to enjoy the excursion. Only one thing tended to lessen the pleasure, viz., the absence of the esteemed Vice-President, Mr. Thomas Pease, F.G.S., who missed joining the others by an unfortunate mistake which caused him to get out at a wrong station.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

Vol. II. JULY, 1867. No. 7.

EXCURSION-MEETING.

Friday, July 26th, 1867.—The second excursion of the season took place this day, as arranged. During the previous night and the early part of the morning, a great deal of rain fell, and when the members met each other at the Railway station at half-past eight, considerable doubts were expressed as to the advisability of setting off in the rain. A rising barometer, a northerly wind, and the distance of the locality to be visited, were the chief arguments in favour of the possibility of rain not interfering much with the day's outing, and at the last moment, the few members present, with their friends, decided to start. The event proved that their expectations were justified, for after the train had gone ten miles on the road to Gloucester, the rain ceased, and no more fell during the day on the ground traversed by the party. Occasionally there were gleams of sunshine, but during the greater part of the time the air was cool and pleasant, in the highest degree favourable for walking with comfort. A haze in the atmosphere interfered with the distant views, but in other respects the day was all that could be desired, and the only source of regret was that more members were not present to enjoy and take advantage of it.

Arrived at Gloucester, the party waited half an hour, and then took the Great Western train to Longhope, the first station after Grange Court, on the Hereford, Ross, and Gloucester Railway. The object of the excursion was to visit various quarries and sections in which the lower series of strata belonging to the Upper Silurian group were well displayed, and to obtain their characteristic fossils. As the dip of the beds was S.W., and the direction of the route taken by the party was N.E., it follows that the beds first visited were, geologically speaking, the latest, or most recent, while the end of the excursion, the summit of May Hill, was not only the highest ground, but also the earliest, geologically, of this interesting series of beds, being in fact the base of the Upper Silurian series, and known in other localities as the Upper Llandovery rocks. Professor Sedgwick was the first to point out the necessity for separating these beds from the Lower Silurian, and proposed the name of May Hill Sandstone for them—(Geol. Jour., vol. ix., p. 215)—showing that while the Lower Llandovery rocks always adhered to and formed the top of the Lower Silurian series, this set of rocks lay widely unconformably to them, but always lay conformably beneath the beds then recognised as Upper Silurian, with which therefore they ought to be classed.

The first quarry visited was close to the Longhope station, and in it the olive-green micaceous shale of the Upper Ludlow series was well displayed. Owing to the large angle of the dip, the sides were somewhat steep, but the soft shaly character of the rock made it easy to work, and several very good specimens were obtained. The same locality was revisited in the evening, and the following fossils, among others, rewarded the collectors.

Serpulites longissimus, Tentaculites (? annulatus) Orthoceras, 2 species, Lituites, Theca, Orthonota, Lingula (?), Chonetes, Atrypa reticularis, and Rhynchonella, Chonetes being so abundant that in many spots the shale was almost replaced by limestone resulting from the thickness with which these shells were packed together.

Ascending a lane above this quarry, the junction of the Ludlow and Wenlock groups was noticed, a great many fossils being picked up in the footpath, and from the banks under the edges on either side of the lane; many of these were in a fine state of preservation, having been washed out from the rock in which they were imbedded. A great many species and specimens of coral were noticed, as well as the following:—Phacops (a trilobite) Atrypa reticularis, A. hemispherica, Euomphalus funatus, Spirifer.

On the ridge of the hill at the end of this lane are some quarrries in the Wenlock limestone which are worked for the sake of the lime procurable from them. The kilns for burning the lime are close at hand. A few characteristic fossils were obtained in the quarries, but the richest ground was in the bank at the side of a field just above the excavations, the earth in which abounded with minute fossils, chiefly the young of various well known species, some of the prettiest of which were delicately small specimens of coral, as Cyathophyllum and others.

From the ridge of this hill, the party descended through a wood, crossed some fields, and came out upon the high-road, which was followed for about half a mile, after which the ascent of May Hill itself was commenced. At the base, the peculiar conglomerate was noticed, afterwards seen in greater abundance near the top. A heap of stones which had apparently been collected together in clearing the land for agricultural purposes, yielded a great many fossil remains, while at the summit the small quarries and excavations had laid bare one or two fossiliferous beds in the midst of thick beds of sandstone and conglomerate which were quite destitute of organic remains. The most abundant characteristic fossil was Petraia bina, and among others which were found may be mentioned Pentamerus lævis, Orthis, Leptæna, Glyptocrinus and Tentaculites anglicus. The bed in which most of these were found was remarkable for being such a coarse conglomerate.

On account of the mist, which was previously adverted to, the magnificent view was much interfered with, but those who had seen it on other occasions said that the whole course of the Severn was visible from near Bristol to beyond Gloucester, the view being bounded on the west by the Forest of Dean coalfields, but being in other directions very extensive. Ross appeared almost at the spectator's feet, and Malvern apparently close, though really nine miles distant.

While resting on the top of the Hill, the members discussed the provisions which they had brought with them, and subsequently returned to Longhope, revisiting most of the places where they had halted on the way up. The day was not a favourable one for Entomological pursuits, and the Botanists of the party were not numerous. It was observed, however, that most of the flora was the same as that growing on our own carboniferous limestone, Erythræa centaurea and Chlora perfoliata being almost the only plants noticed which were at all uncommon in the neighbourhood of Bristol, with exception of Daphne megerion, which in this neighbourhood grew in the greatest profusion.

The party, which comprised Mr. Thos. Pease, F.G.S., one of the vice-presidents, and the two Hon. Secretaries, with several members, and Rev. James Winwood, Secretary of the Somersetshire Archæological society, was much indebted to Mr. W. W. Stoddart, F.G.S., who was their guide during the day, and who pointed out the localities of the various fossils in a manner that showed his intimate acquaintance with the ground, and which was exceedingly useful to those who had the advantage of being present. The return to Bristol was effected, as arranged, by the 6.20 p.m. train from Longhope, members arriving in Bristol at 8.0 p.m., and all agreeing that a most enjoyable day had been spent.

SECTIONAL EXCURSION - MEETING.

ENTOMOLOGICAL SECTION.

MONDAY, JULY 22ND.—An excursion had been arranged for this day to explore the country between Portishead and Clevedon, and several members left Bristol by the 3.0 p.m. train for Portishead. Unfortunately, however, they were obliged to abandon their intention on account of heavy rain setting in, and they returned to Bristol by an early train, having made no captures worth recording.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

Vol. II. AUGUST, 1867. No. 8.

EXCURSION-MEETING.

Friday, August 29th, 1867.—This excursion had been arranged to take place in conjunction with the Somersetshire Archæological and Natural History Society, which had been holding its nineteenth annual meeting at the Fine Arts' Academy, Clifton, on the three preceding days, and the object was to examine the Geology and Natural History of the gorge of the river Avon, in illustration of a Paper "On the Geology of the Bristol District," which had been read by Mr. W. W. Stoddart, F.G.S., at the meeting of the Somersetshire Society.

Accordingly, a number of members of the two Societies assembled on the Observatory Hill, Clifton Down, at ten o'clock, and shortly drove in the breaks which had been provided for their accommodation to Leigh Court, where Sir William Miles had kindly thrown open to the inspection of the party a splendid collection of his paintings, as well as of antique bronzes, and other objects of great interest to the Archæologists. Advantage was taken also of his kind permission to walk about the grounds attached to the house, and in a little pond in one of the gardens, the Rev. W. W. Spicer collected in quantity that beautiful object for the microscope, Spirulina oscillarioides, a little alga allied to the Oscillatariaceæ.

After spending an hour and a half very pleasantly in the examination of the various objects of interest presented to their notice, the members re-entered the breaks, and were driven back to the place where they had first assembled, and on returning over the Suspension Bridge, the hearts of the members of the Bristol Naturalists' Society were gladdened by the sight of their respected and kind-hearted President, Mr. W. Sanders, F.R.S., F.G.S., sitting out in the fresh air, showing great interest in the proceedings of the party, no doubt wishing to join them, and to resume that esteemed leadership, of which his severe and long-continued illness has deprived the Society for several months.

That portion of the day's work for which the excursion had been specially arranged, was now commenced, and the members proceeded to walk over that division of the Carboniferous rocks which Mr. Stoddart had ably described in the paper previously alluded to, and which few, if any, were more competent to explain and exhibit their peculiarities, and the special points of interest in connexion with them, than that gentleman himself, whose obliging and courteous demeanour, combined with his great local knowledge of the beds and fossils, tended greatly to the enjoyment as well as to the information of the members.

While descending the zig-zag, the Upper Limestone Shales were pointed out, but it was observed that the section on the opposite bank of the river exhibited their peculiar structure better. After this, the thick upper beds of limestone, over which the well-known Hotwell spring flows, were noticed; and the localities where the fine corals and mollusca occur, with which the upper strata abound, were marked, together with the beds which, being full of fossil Foraminifera, contain so rich a treat for the microscopist as their examination is sure to afford.

The next in order were the St. Vincent's Rocks, and much time was spent (as its educational value fully demanded) in the examination of the Great Fault existing here, and the regret of every one was strongly expressed at the ruthless and even goth-like destruction of this noble geological specimen—or monument—which is now being demolished in a manner painful to all lovers of scientific illustrations. The continuance of the St. Vincent's series with that of the great quarry was shown and explained, and it was remarked that the intervening ground was filled up with a mixture of coal-measures, shales, and mill-stone grit, all of which were well exposed in one of the cuttings for the Port and Pier Railway. The Black-rock quarry was next visited, and the beds which contain so many Ichthyodorulites and palates were carefully searched for their fossil remains; a great number of very interesting fossils were collected, among them several teeth of the well known Carboniferous Fish, Helodus and Psammodus. Underlying this series of beds were seen the Lower Limestone Shales, which there attained a thickness of 500 feet, and were excessively rich in fossils, more especially Trilobites, Polyzoa, and Brachiopods. Mr. Stoddart here showed to several of the geological members the bed that he considered equivalent to the Coomhola beds in Ireland, and to some of the so-called Upper Devonian in Devonshire. The former series (Coomhola) are named from a glen in the county of Cork, near Glengariff Harbour, Bantry Bay, where, as well as in county Kerry, the lower portion of the Carboniferous formation attains an enormous developement.

The junction between the Old Red Sandstone and the Carboniferous series was well observed in the railway cutting, the gradual transition from calcareous to arenaceous beds being carefully noted.

A short walk then brought the members to the little station at Sea Mills, and advantage was taken of the passing train to convey them to Shirehampton, where they crossed the river by the ferry to Pill, and again entered a train, on the Portishead Railway, which carried them to that pretty little watering-place, where dinner had been provided, and where they were joined by a few gentlemen who, feeling unequal to the walk along the river, had parted with them at Leigh Court, and then driven to Portishead. By this time the fresh air and exercise had excited a keen appetite in all the party, but before dinner commenced, Dr. Martyn took a few enthusiastic geologists a rapid walk to look at a bed in the Old Red Sandstone which was believed to contain traces of the remains of Fish. This supposition was afterwards verified as a fact by the Geological section, in an excursion taken to the same locality on September 11th, (for an account of which see page 78,) expressly organized for the purpose of properly marking and examining this deposit, and the neighbouring strata.

The dinner, which was well served at the Hotel, was done full justice to, and after the cloth had been removed, a few speeches were made by the Secretary and other members of the Somersetshire Archæological and Natural History Society, thanking the Bristol Naturalists' Society for the way in which it had forwarded the interests of its guests at the meeting in Bristol, thus pleasantly brought to a conclusion. Mr. W. W. Stoddart and Mr. Leipner acknowledged the compliment on behalf of the Bristol Naturalists Society, and after drinking the health of the Ladies, (only one of whom, unfortunately, attended the excursion)—a toast which was acknowledged in a highly humorous manner, by a witty bachelor belonging to the Somersetshire Society, the party returned by the evening train to Bristol, well pleased with the scientific results of the day, as well as with the opportunity thus afforded of cultivating pleasant acquaintance with those of kindred pursuits.

MEETINGS OF SECTIONS.

GEOLOGICAL SECTION.

FRIDAY, AUGUST 23RD, 1867.—Having on a previous occasion met with so much that was interesting in the Bradford Quarries, the Geological Section determined to pay them a second visit, which now took place, and a good muster of the members met at the Terminus, and proceeded at once to the scene of action.

The fine section of Bradford Clay and Oolite was duly examined and sketched, and the lithological characteristics of the various beds of stone were well scrutinized. A large number of fossils were collected, especially Terebratula coarctata, T. digona, T. maxillata, and portion of Apiocrinite. Indeed most of the Mollusca, Polyzoa, and Corals, that occur in that part of the Jurassic series were discovered, and with them an extremely beautiful lot of crystallized Calcite was met with and consigned to the baskets and bags. It was noticed that the crystals were rather unusually grouped together, forming very elegant figures in hollow cavities of the stone.

A very agreeable and useful evening was spent, and would have been completely so had not an unexpected termination to the day's work occurred through the breaking down of a previous train. The rails being blocked up, the Geological students were obliged to fast and wait in the dark recesses of St. Ann's Wood, till the midnight hour had struck.

WEDNESDAY, SEPTEMBER 11TH, 1867.—The Geological Section proceeded to Portishead for the purpose of examining the Old Red Sandstone of that village, in order if possible to ascertain the position of a bed containing the remains of fossil fishes. On arriving at the place, the members (of which a pretty good number were in attendance) soon gave aural evidence of zeal in the cause, and attracted the visitors to the field by the noise of the hammers, especially one of unusual size that was brought by an enthusiastic member, and which did good service by furnishing material for the smaller instruments. After a good search the party were gratified and their exertion well rewarded by attaining the object of their excursion. Many portions of the scale of Holoptychius and Coccosteus were found, and by this means the bed was traced up to a projecting rock from whence the accompanying section was taken.

SECTION OF OLD RED SANDSTONE AT PORTISHEAD.

	feet.	inches.
Red fissile sandstone	12	0
Hard sandstone	2	0
Red sandy marl	0	11
Conglomeratic sandstone	8	0
Sandstone, partly conglomerate	8	0
Sandstone	3	0
Fish Bed, course conglomerate at top, passing into fine sandstone	3	0
Red sandy marl	1	0
Conglomerate	1	0
Sandy marls	8	0
Sandstone	3	0
Sandy marls and thin sandstones	14	0

The rocks in question jut out upon the sea-shore, about a quarter of a mile to the west of Battery point. Here the beds dip to the S.S.E. at an angle of about 30°.

Three or four years ago the Rev. Mr. Blenkiron, of Portishead, picked up on the beach a loose bit of rock, on which he detected the remains of fish scales. He was, however, unable to find the bed from whence it came. This important discovery of Mr. Blenkiron's was announced at a monthly general meeting of the Naturalists' Society, in February, 1863, when the President, Mr. Sanders, pointed out its great value, as fixing the geological date of these beds, Holoptychius being characteristic of the upper of the three great divisions of the Old Red. The present visit was suggested by Dr. Martyn, having lately found fish scales in a conglomeratic bed, that occurs on the beach near to the before mentioned rock. The scale appears to be restricted to the upper portion of the bed, and none having been seen in the lower part which is a fine sandstone. Indeed most of the beds are formed of Quartzose conglomerate at the superior part, while the inferior is free from pebbles.

The strata are much broken and irregular, and have evidently been subjected to strong aqueous action. Many of the blocks of sandstone may be seen in situ, turned completely round and now placed vertically and at right angles to the beds.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

Vol. II. OCTOBER, 1867. No. 9.

GENERAL MEETING.

Thursday, October 3rd, 1867.—Mr. Thomas Pease, F.G.S., Vice-President, in the chair.

The Hon. Secretary, Mr. A. Leipner, said that all present would regret the absence of their esteemed President, Mr. W. Sanders, F.R.S., the state of whose health was still such as to prevent him from attending that evening, and it was to be feared that he would be unable to attend any evening meetings during the coming winter. The Hon. Secretary then read the minutes of the last meeting at the Institution, and alluded to the three Excursion-meetings held during the summer, reports of which were in the hands of the members. He announced that the following gentlemen had been recently elected by the Council new ordinary members of the Society:—Mr. Edward Simpson; Mr. Wm. J. French; Mr. George P. Serocold; Rev. H. H. Winwood, M.A., F.G.S., of Bath; Mr. Wm. Bennett; Mr. Swinfen Jordan; and that Mr. James Phillips had been readmitted as an ordinary member. Also, that the following donations to the Society's Library had been received :—

"Remarks on Pyrula (Fulgur) Carica (Lamarck), &c., by T. Graham Ponton," from the Annals and Magazine of Natural History, presented by the author.

"Proceedings of the Bath Natural History Society and Antiquarian Field-club."

Mr. Francis Fedden, of the Geological survey of British India, then read a paper, entitled "A few observations on the Natural History of Burma," which was very fully illustrated with a large collection of specimens of birds, reptiles, insects, partial skeletons of mammalia, fossils, &c., as well as some of the enamelled coloured betel boxes, and other productions of the natives of the country, which Mr. Fedden had obtained during his seven years' residence in Burma.

The geographical position of the country was first described, being situated between Bengal and Siam, south of Assam, and extending from latitude 16° to 24°. The general strike of the country, both for the ranges of hills and rivers, was North and South. The most important river was the Irawaddee, whose source was unknown; it was flooded in April by the melting of the Himalayan snows, and again in August by the rains, which, setting in about May 18th, lasted till September; the rise was about thirty feet above the low level, and it frequently overflowed the alluvial banks; the current of the river was swift, the inclination being about 1 foot per mile. The Salween river flowed with an inclination of 2.34 feet per mile, in a rocky channel, between mountains 2000 feet high, where indications of floods had been measured at a height of 95 feet above the ordinary level, though usually the rise was not more than 65 feet, and the distance between the shores was not more than doubled at flood-mark. The surface of the rocks in the channel of the Salween had received a high polish from the friction of the sand, and some were coated with a peculiar surface resembling that produced by black-lead, which was probably due to black oxide of manganese. Two principal ranges of hills formed the chief watersheds of the country, the Arracan, or Western Yeoma, lying between the Irawaddee and the coast, and the Pegu or Eastern Yeoma, between the Irawaddee and the Zittang. The Arracan hills presented a very perfect example of a mountain range, the secondary hills and their spurs running off regularly and more or less parallel to each other. Many of the hills were densely wooded, fine teak forests, the property of the Government, growing on the Pegu Yeoma, and bamboos, oil-trees, &c., covering portions of the Arracan hills.

The Geological features of the country were then noticed at some length. The most recent strata were, naturally, the deltas of the rivers, which were still forming, and were composed of gravel, clay, and mud. Below these were found ferruginous aud ossiferous gravels and clays, containing fossil trees, and the bones of many recent and extinct Mammals, as well as other fossils characteristic of the Pliocene series, and also pieces of wood, both rolled and unrolled. The Miocene series were remarkable for containing beds of a curious substance called Laterite, unknown in Europe, which was quite soft when freshly quarried, but which became quite hard on exposure, and frequently honeycombed, nodules of clay falling out. It was largely used for building purposes, and was probably a ferruginous clay containing much silica. The Eocene strata were then noticed; the nummulitic limestone was largely developed in the Shan hills, but the nummulites themselves were small; there were numerous petrifying springs in these hills, charged with carbonate of lime, which produced large beds of tufa, used for the building of pagodas. Several hot springs occurred also, one being as warm as 124° F., and another, nearer Thainee, was said to be poisonous. In the Prome district the shales, blue clays, and sandstones predominated, and in many clay beds large quantities of nummulites were found, as well as of very minute Foramenifera, which closely resembled those now brought up from the deep-sea soundings. Among the sandstones were several beds of salt, which produced brine springs. The oldest strata were of course to be looked for in the centre of the mountain ranges, especially of the Western Yeoma; and here several rocks were found which had apparently been much metamorphosed and indurated, whose age it was difficult to determine; but, from the occurrence of fossils in other localities in somewhat similar beds, the author was inclined to consider these as belonging to the Cretaceous series. There were also found here out-bursts of trap, one of the true volcanic rocks, as well as of serpentine, and steatite.

Among the other geological features of the country, attention was drawn to several interesting examples of the elevation of the land upon the Arracan coast, the proofs of which were found in the remains of coral reefs and oyster banks at a considerable distance above the present sea-level. The curious mud-volcanoes were also described; they were only a few feet in diameter, and in the inside of the crater a blue saline mud was seen, which was frequently projected out in large quantities, accompanied by a large evolution of light carburetted hydrogen gas.

The metallurgical products of the country were not numerous; gold occurred in very small quantities, hardly sufficient to pay for working, in two or three places; at Kyouktat were some silver-lead mines, which had been worked for a long period in a rough way; the galena occurred irregularly in the limestones, it was melted in a cupola, and the oxide of lead removed by an iron rod, and subsequently reduced, while the silver was left. Tin, antimony, and iron also were found in small quantities.

The Petroleum, or "earth oil," occurred in many places in the Irawaddee valley, on the top of a sort of anticlinal in the rocks, as was the case also in America; it was forced up by the pressure of the water surrounding it above. There were two varieties, one of which was quite harmless, but the other gave off much inflammable gas, and was therefore liable to explode in a closed vessel. In many places, only the gas escaped from fissures in the earth, and it frequently burned, being called "spirit-fire," and forming the subject of a curious native legend.

Mr. Fedden then gave an interesting account of the native inhabitants of the country. He stated that there were several tribes differing in language, dress, manners, and religion. The oldest inhabitants of Burma were called Talains; they were short in stature. and had a dark brown skin, while the Karens were tall, more manly-looking and independent, but less cultivated, having no written language until the Church missionaries gave them the Burmese character. The Shans appeared to be a people intermediate between the Burmese and the Chinese. To a person travelling Northwards from the South of Burma, a regular gradation towards fairness of complexion among the inhabitants was apparent, and this was accompanied by slight alterations in costume, weapons, &c. In illustration of this, the transition from the dak, a great knife or chopper, in universal use in Pegu, to the long dak or sword in Upper Burma, then to the true sword worn by the Shan Tagoks, or Chinamen Shans, and finally to the double sword of China and Japan, was pointed out. Several of the betel-nut boxes were shown, and the mode of their manufacture from plaited bamboo, covered with numerous coats of paint finely polished, was explained, and it was noticed that the Burmese box was more highly finished than the Shan box. The manufactures of pottery, and of paper, which was made from pith and resembled that produced in China, were also alluded to, and specimens shown. The Shans were great opium-eaters, and devoted much attention to the cultivation of the poppy on the hills; the manufacture of the opium was very simple—the poppy-head was scratched to about 1-6th inch deep with a three toothed instrument like a comb in the morning, and the juice, which was at first white, but darkened by exposure to light, exuded during the day, and was collected at night.

The author had observed several ordinary English wild flowers in the Shan country, among them the brake-fern, violet, strawberry, butter-cup, arum, &c. He said that it was a fact only recently ascertained, and of which he had had ocular evidence, that the bamboo flowered once in every five years, producing a fleshy fruit about the size and shape of a pear, which the natives boiled and ate. The seeds were oat-shaped. After flowering, the plant died down to the roots, and was generally set on fire; during this flowering the field rats swarmed, to the great detriment of the next year's crops, and to the alarm of the natives.

The Fauna of the country were then noticed at some length. The Elephant was abundant, living in herds on all the hills, and the natives were very fearful of them. The mode of capturing these animals, by means of decoy elephants, and of taming them by subsequent confinement and starvation, was described, as well as the Elephant-fights, which the king and court went to see, like bull-fights. Two varieties of the Rhinoceros occurred, but they were not common; also three or four species of monkeys, buffaloes, and a great variety of deer, including the barking deer and hog-deer. Burma was remarkably rich in birds, a very large collection of which was shown. Mr. Fedden stated that most of the species differed slightly, some even considerably, from the corresponding Indian species, in the measurements of the adult specimens, so that many of the Burmese birds should be ranked as distinct species. Great numbers of very curious insects were found in Burma, the most remarkable, perhaps, being the fire-fly, the habits of which had been carefully noted by the author. The light appeared to come from the under part of the last two or three lobes of the abdomen, and frequently did not cease until long after the death of the individual; the insects frequently collected in large numbers upon one bush, and emitted their light simultaneously, but intermittently,—a fact which was not generally known. Silkworms were largely cultivated, and fed upon the leaves of a species of Hybiscus. The cocoons were unwound in gum-water, whereby several threads were made to stick together and form one larger thread, which was sold in the markets of the large towns, weaving not being practised by the natives. The habits of the white ant were described, and their destructiveness in the wooden pile-built houses, commented upon; when they climbed up any clean surface from the earth, they carried mud with them, leaving it as a thin coating behind. The mason-bee, too, plastered mud upon the windows, in building its curious nest; which was subsequently filled with spiders rendered dormant by stings, to serve as food for the grub. The empty cavities of these nests were frequently used by the ichneumon fly.

Little was said of the lower animals, except concerning some curious detached corals of unknown species, found upon the Arracan coast, and the author stated that Professor Huxley, F.R.S., had been very much interested in them.

The VICE-PRESIDENT remarked that the Society was fortunate in obtaining at first hand, as it were, information collected for Government, which indicated the capabilities of this remarkable country for colonization, &c. He referred to the remains of ancient civilization in Burma, and expressed his belief that the country had probably receded in that particular. The English had long been anxious to obtain possession, and in 1825 had secured a part of the Peninsular, but had only acquired Burma in 1847. He inquired from Mr. Fedden about the climate of Burma, and also about the constitution of the Geological Survey, and its method of research.

Mr. Fedden, in reply, said that the Indian Survey consisted of 18 or 20 officers, who were divided into parties of three or four, but even these were separated when they came to actual field-work. In Burma there were only two officers, but the survey had been established there 15 years. The only possible mode of observation where the jungle was thick, was to follow the water-courses; if the ground were easy, an officer might survey 8000 square miles in a season, but if it were important, only 200 or 300 miles. With regard to the climate, he thought it healthy for those who went from England direct, but it was too damp for Anglo-Indians. The rainy season commenced between May 15th and 20th, and in July and August the rains were so heavy that the country was impassable even for two months after the cessation of the rain in October. Jungle fever was most prevalent at the commencement and end of the rains. About Christmas it was really cold, but the temperature and rainfall entirely depended on the situation. On the coast, from 120 to 200 inches of rain fell per year; he was not aware of any accurate thermometric observations, but the sun's heat was not felt so much as in India, owing to the absence of the hot winds.

Mr. W. W. Stoddart, F.G.S., then made a short verbal communication on the occurrence of the Sutton Lias series near Bristol. The exact position of the so-called "Sutton series," had long been a matter of debate among geologists, one party asserting that it should be placed among the Rhætic beds; while the other maintained that they were more recent than such a position would make them out to be. The speaker had discovered a quarry at the top of Cotham Grove, 25 feet deep, and he exhibited a diagram of a section of the beds found therein; at the top were the typical Ammonites planorbis beds, and the third bed down was the commencement of the Sutton series, the sixth bed of which contained all the characteristic fossils, while below were the Ammonites Johnstoni beds, and the well known Cotham marble, which was an acknowledged line of demarcation. This discovery, it was contended, decided the question, and proved most clearly that the Sutton series were simply Ammonites planorbis beds slightly altered. The beds below the Cotham marble were not yet exposed.

Mr. B. N. Lobb inquired whether the author's conclusions might not have been too hastily drawn, from the observation of too small a district.

Mr. Stoddart, in reply, said that he had traced the series from Cotham

Grove over to Ashley Down, and that the Lias beds extended to Yorkshire. The A. planorbis fossils were found both above and below the Sutton series, and no one had ever yet seen an Ammonite in a Rhætic bed; further, the Cotham marble was recognised by every one as a well-marked boundary line.

N.B.—For a fuller account of this discovery, see the Geological Section's Report, pp. 90—92.

MEETINGS OF SECTIONS.

ENTOMOLOGICAL SECTION.

TUESDAY, OCT. 8th.—At the wish of several members, an excursion was arranged for this afternoon to Patchway, to try the Ivy-blossom in that neighbourhood. Unfortunately, a slight misunderstanding arose as to the place of meeting, and at which South Wales Union Railway Station the members were to assemble, so that the excursion did not take place—neither did members attend at the Institution in the evening, for the meeting which was to have been held, in case the weather interfered with the excursion.

CHEMICAL AND PHOTOGRAPHIC SECTION.

WEDNESDAY, OCTOBER 9th.—The attendance of members was very limited, being confined to the President, Mr. P. J. Worsley, F.C.S., the Secretary, Mr. Alfred Noble, F.C.S., the Reporting Secretary of the Society, and one other gentleman. Mr. Noble stated that it was with extreme regret that he was obliged to resign the Secretaryship of the Section, as the state of his health since a severe illness in the summer, obliged him to give up all extra mental work; he therefore handed over the books and papers belonging to the section to the Reporting Secretary. It was also stated that another active member had been ordered to abstain from work, and that a third had removed from the neighbourhood.

The President and Reporting Secretary therefore request that all members who feel an interest in carrying on this Section, will make a point of attending the next meeting, not on Wednesday, Nov. 13th, but on Thursday, Nov. 14th (to avoid Colston's day) at 8 o'clock, at the Institution. They also invite written communications upon the subject, addressed to them at 12, Brighton Park, Clifton, before the day of meeting.

Mr. Noble had provided a new series of photographs by Frith, kindly lent by Mr. Midwinter, of College Green, and much pleasure was derived from the inspection of these, which had all been taken this summer, and which embraced a great variety of subjects, both English and foreign scenery.

ZOOLOGICAL SECTION.

Thursday, Oct. 10th.—Mr. A. Leipner, in the chair.

The Secretary, Mr. Swayne, read for Mr. C. O. Groom-Napier, F.G.S., who was prevented from attending, a paper on the Dodo (Didus Ineptus). Several coloured illustrative drawings were exhibited, and a series of bones found lately in the Mauritius; also Professor Owen's paper on the Osteology of the Dodo.

The history of the discovery of the islands of Mauritius and Bourbon by the early Dutch navigators was first glanced at; their productions, including the Dodo, were first described by Van Neck in 1598, then by De Bry in 1601, Clusius in 1605, and subsequently by many other Dutch writers and voyagers. Sir Thomas Herbert visited the Mauritius in 1627, and published many editions of his travels; that bearing date 1677 contained the most detailed account of the Dodo. François Cauche's account was also quoted, and it was remarked that the size of the egg, as given by him, was a strong argument in favour of the bird belonging to the pigeon class. Sir Hammond L'Estrange had seen one alive in London in 1638, and the history of a specimen in the Tradescant collection, probably identical with this one, was traced. Amongst the catalogues of the older museums, notices of portions of the Dodo were found. Mr. Strickland, the best authority on the subject, had quoted the last notice of the living Dodo, which was in 1679. The Mauritius was settled by the Dutch in 1644; and in 1693, Legnat, who visited the island, made no mention of this bird; the Dutch evacuated the colony, and the French replaced them, in 1712.

The pictures of the Dodo were then noticed. One was in the British Museum, and there was historical evidence that it had been painted from a living specimen by Roland or John Savery, the distinguished Dutch animal painters. At the galleries of Hague and Berlin, and at the Belvidere museum of Vienna, were pictures of the Dodo, among other birds; this last had been copied by Mr. Strickland; the Ashmolean museum at Oxford, the Duke of Northumberland, and Mr. Broderip, also possessed original pictures. The actual remains of the Dodo now in various museums in this country were then alluded to; the chief were a foot in the British Museum, and a head and foot in the Ashmolean museum.

The position of the Dodo in reference to other birds was then considered, it having long been a vexed question among naturalists. Three families of birds had genera incapable of flight, the ostriches, auks, and penguins; Mr. Strickland considered that it was allied to neither of these, and was probably an exceptional form of some other order; Vigor (Linn. Trans. vol. 14) held that it was a gallinaceous bird; M. de Blainville and Gould, that it was raptorial. To Professor Rheinhardt, of Copenhagen, belonged the priority of the theory now generally adopted by Professor Owen and most naturalists, that it was more closely allied to the pigeons than to any other order. Mr. Napier combated this view at some length, urging that the bird was so peculiar in its structure, and in fact unique, that it ought to have a position by itself. He concluded by quoting from Professor Owen's paper on the Osteology of the Dodo.

The Chairman thought that the conformation of the bird showed clearly that it was not connected with the vultures, as had been surmised, and especially that its habit of swallowing stones, referred to in the paper, showed that its food was mainly, if not entirely, composed of tough vegetable matter, as it implied a strong muscular gizzard. Owen's opinion that it was allied to a division of the pigeons was alluded to, although the members seemed to think that it could not properly be placed with any of the existing divisions of birds.

Time did not allow of the reading of a paper on the Solitaire, also prepared by Mr. Groom-Napier.

BOTANICAL SECTION.

Thursday, October 17th.—Mr. A. Leipner, President of the Section, in the chair.

This meeting was held at the house of the Secretary, Mr. T. H. Yabbicom, Ross Villa, Cotham road, who hospitably entertained the members with tea, in accordance with a precedent established at the February meeting of the Section, at Mr. Leipner's house.

The PRESIDENT said that although this was the fourth session, the section could not boast of much work accomplished during the past year; many specimens still remained at the Institution unprepared for the herbarium—he might mention, as an example, the collection of mosses presented to the Society by Mr. W. Tanner. But little progress had been made in working the district, not 2 sq. miles out of the whole 180 having been properly worked out. The appearance of the Society's publication was delayed by the illness of Mr. W. Sanders, who was to write the first part, which would be chiefly geological, and as soon as that had appeared, the botanical work would be immediately wanted.

Mr. T. H. YABBICOM, the sectional secretary, then made a few remarks upon a series of specimens of marine Algæ, which he had prepared during a ten days' sojourn, during the summer of this year, at Paignton, near Torbay, Devon. They had all been collected between the tide-marks at high and low spring tides, and were beautifully mounted on ordinary drawing paper cut to a uniform size; they were first thoroughly washed in fresh water, then floated on to the paper in a shallow dish of water, and finally dried by pressure between folds of linen and blotting paper. Mr. Yabbicom stated that his specimens were thus distributed among the three great orders into which the Algæ were divided,—

	Genera	Species
Melanosperms	10 ...	14
Chlorosperms	4 ...	10
Rhodosperms	15 ..	25
	—	—
	29	49

He briefly alluded to the distinctive characters of each, and demonstrated their specific differences by a series of microscopic preparations of the seaweeds, mounted in gelatin, a medium which appeared to answer exceedingly well for this class of objects. He did not exhibit these as a complete set, but to show how much might be done in a short period by a little steady work.

GEOLOGICAL SECTION.

THURSDAY, OCTOBER 24th.—Major THOS. AUSTIN, F.G.S., in the chair.

There was a large attendance of members and friends, to hear Mr. Stoddart's paper on the Lias beds at Horfield, for a preliminary account of which see p. 86. The paper was fully illustrated by diagrammatic sections of the quarries, &c., referred to, as well as by numerous fossils characteristic of the Lias series.

After remarking that the Lower Lias beds round Bristol presented a complete epitome of the whole subject, but that they had been very little worked, and had not received the attention they deserved, and that the Palæontology of this part of the Jurassic series was but little known, Mr. Stoddart said that the object of these observations was to form a groundwork for future study. The Lias was an argillaceous deposit, consisting of marls, clays, and solid limestone, which contained from 3 to 20 per cent. of alumina, which gave the Lias lime the property of "setting" under water. The arenaceous and ferruginous beds of the middle Lias, and their occurrence near Bristol, as well as their equivalent in Dundry, were first noticed; a table was then exhibited, showing the order of sequence of the Bristol Lower Lias fossiliferous beds, and their characteristic fossils were mentioned. They were divided into three groups:—the Ammonites Bucklandi, or Lima beds; the A. planorbis, or Ostrea beds, containing the Sutton series; and the Rhætic beds. The line of section which formed the subject of Mr. Stoddart's paper ran from a quarry north of No. 1 Orphan-house, Ashley Down, through Mr. Rossiter's farm at Montpelier, to Cotham Hill; and the beds comprised in it extended from the Am. Turneri zone to the Keuper marls. All the beds dipped 8° to the N.E., and therefore appeared nearly horizontal; as they dipped to the S.E. on the opposite side of the Severn, an anticlinal probably existed near the south bank of that river. The section of No. 1 quarry, Ashley Down, was first detailed, the beds being 17 feet 1 inch thick, and numbered 1 to 4, No. 2 containing many remains of Saurians, was an instance of the fact that a bone-bed frequently divided one set of strata from another. The beds in Mr. Rossiter's quarry reached a total thickness of 32 feet 2 inches, and were numbered 5 to 11, the most interesting being the Echinoderm beds, Nos. 7 and 8, which contained the spines of Hemipedina Bechei, and of Cidaris Edwardsi, as well as the jaws of Hemipedina, and valves of Cytheridæ.

The details of Cotham Grove quarry were then given, the beds being numbered 12 to 18, and attaining a thickness of 14 feet 5 inches, about half of which was occupied by the so-called "Sutton series," the exact geological position of which had long been a subject of argument. When first discovered, as found at Bridgend, Glamorganshire, they were placed by Mr. Tawney and others in the Rhætic series, while on the other hand Mr. Bristow asserted that they belonged to the A. planorbis zone. This section decidedly proved the latter opinion to be correct, as the Planorbis fossils were found both above and below the Sutton fossils, and unless the White Lias beds were included in the Rhætic formation, this was altogether absent in the Cotham quarry, since, as far as the author could ascertain, the Keuper marls immediately followed the Cotham marble. Details of the various beds were given ; the Sutton series were 12 beds of limestone separated by bands of clay containing encrinital joints. The sixth bed from the top contained the most characteristic fossils in the greatest number, viz., Lima Dunravenensis, L. gigantea, L. tuberculata, Pecten Suttonensis, and another Pecten ; it was remarkable, however, that Plicatula intustriata, so abundant in the series at Bridgend, was here absent. Mr. Stoddart stated that Mr. Etheridge and Mr. W. Sanders were satisfied of the correctness of his views. Underneath the Sutton series were beds containing Am. Johnstoni, Pholidophorus, Modiola minima, Myacites, Monotis, &c., and at the base the well known Cotham marble. Underneath were the Keuper marls ; the Rhætic beds, which usually interposed between these two, not having yet been met with in this spot, although as they gradually expanded on leaving the city of Bristol, they could be well studied in the sections exposed at Aust and Almondsbury.

Mr. C. F. Ravis exhibited a slab taken from the topmost bed of the Cotham quarry, which showed traces of the denudation of the Lias referred to in the preceding paper.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

Vol. II. NOVEMBER, 1867. No. 10.

GENERAL MEETING.

THURSDAY, NOVEMBER 7TH, 1867.—Mr. THOMAS PEASE, F.G.S., Vice-President, in the chair.

The HON. SECRETARY, having read the minutes of the last meeting, announced the election of the following new ordinary members:—

Mr. Edward Stutchbury, Almondsbury Hill, near Bristol.

Mr. W. T. Rowden, Professor of Physics at Clifton College.

Mr. Edward F. Willoughby, Surgeon, 8, Oaklands, Redland.

Also, that the following donations to the Society's Library had been received from Dr. Martyn:—

Kirkes' Handbook of Physiology, 4th and 5th editions; 2 vols.

Müller's Archiv für Anatomie Physiologie, und wissenschaftliche medecin. Volumes for 1854-55-56-57.

Mr. EMIL ARNOLD PRÆGER then made a verbal communication upon Neumeyer's newly-invented Gunpowder. After referring to the great prevalence of error as to the inventor of gunpowder, and to the fact that it seems certainly to have been known to the Chinese in very early times, the speaker stated that the new powder was composed of precisely the same materials as ordinary powder, but in different proportions. He then very briefly described the manufacture and purification of the three components,—sulphur, nitre, and charcoal. Sulphur was purified by sublimation and subsequent condensation. Nitre was produced both naturally and artificially, and best in warm climates, it was purified by crystallisation, the crystalline form being that of a hexagonal parallelopiped; English nitre was the best and cheapest. Neither the sulphur nor the nitre could be perfectly pulverised, and there was great difficulty in thoroughly incorporating the three components. Various improvements had been devised in this branch of the manufacture, the most successful being that of Congreve, who introduced the use of a metal or parchment sieve. Most of the accidents in powder mills occurred at this stage of the manufacture. The inventor of the new powder was a large quarry-owner, who, being struck by the number of men accidentally maimed at their work, directed his attention to the production of a powder which should be equally powerful, and less dangerous than ordinary powder. After two years of patient experiments he had perfected his invention. The new powder much resembled the old in appearance, both in the large and small grain, but it was said to be much lighter, specifically, than ordinary powder, and also to be about thirty per cent. cheaper. Bulk for bulk, it was rather the stronger of the two, and the difference in effect where equal weights were used, was very remarkable, being so much in favour of Neumeyer's, and the explosive force was the greater, the more tightly the powder was rammed down. It burnt much more slowly than ordinary powder, and produced much less smoke; both of these properties would render it very valuable in mining, and in military engineering. The diameter of the flame of ordinary powder was 8 times that of the grain producing it, while with Neumeyer's, each grain when burnt made a flash 12 times its own diameter. When burnt in the air, it left a slight residue, but not when burnt in a confined space, as in a cannon or a rock-hole. Mr. Praeger further stated that he believed Neumeyer's powder had less sulphur than, and was not so highly glazed as, ordinary powder; also that it was less hygrometric, or liable to suffer injury from damp, but that if wet it could readily be dried again with very little risk, and that it was equally powerful whether in fine dust, or in large grains. He then read some testimonials, &c., from various persons who had used the new powder, and who reported favourably of it, and he made a few comparative experiments with the new and the ordinary powder, to illustrate the slow rate of burning of Neumeyer's, the great heat produced by its combustion, and the little smoke evolved, as well as the all-important fact that when set on fire in the air, it simply burnt rapidly, without causing any actual explosion, thus giving ample time for any person to escape from the vicinity of a barrel or store of powder accidentally set on fire. Details were given of an experiment at the Crystal Palace, at which 35 lbs. of Neumeyer's powder were burnt in a small house erected for the purpose, and but little damage was done, while the same erection was subsequently almost blown to pieces by the combustion of 3 lbs. of ordinary powder. That very great explosive effects could be produced by Neumeyer's powder, when properly applied, was amply testified by numerous competent persons, who had employed it practically in mining and other operations. In conclusion, Mr. Praeger said that the powder had been invented about four years, and that it had been partly adopted by the French and Russian governments, but that it was under the consideration of the English War-office authorities.

A slight conversation ensued, and a few questions were put to, and answered by, Mr. Praeger. Major Austin, F.G.S., tried this new powder in an éprouvette, but instead of going off with an explosion, the force of which was measured, with ordinary powder, by a very ingenious contrivance, the new powder simply burnt out of the touch-hole. Mr. Praeger observed that this was a most satisfactory proof of the inexplosiveness of the powder in contact with air.

Mr. David Davies, M.R.C.S., then read the following paper "On the occasional presence of the foreign musquito in England."

Several of the smaller animals, as well as insects and plants, have been unintentionally introduced into this island by the way of commercial intercourse, some of which have made their residence amongst us permanent, and others have remained only for a short time, their continued existence here being incompatible with our climate; among the latter I consider the subject of this paper, a species of Mosquito introduced here from Brazil.

My attention was called to this subject about the middle of last September, by the large number of persons who suffered from irritable eruptions of the skin on all the exposed parts of the body, in a limited district of this city, extending from the lower part of Clare-street to Thunderbolt-street, at the end of the Broad Quay. For some days I was puzzled to account for this phenomenon, which assumed many of the characteristics of an epidemic disease, and was finally enlightened on the subject by a youth, who having suffered much from the prevailing eruptions, caught a Musquito in the act of feeding upon his nose. Upon inquiry I found a similar insect was very plentiful in all the houses on the Quay, and that several of the inhabitants attributed the fact to the arrival of the ship "Blaney Brothers," from Bahia, in Brazil, on the 10th day of September. These insects were found in considerable numbers in this neighbourhood until the second week in October, when they disappeared, probably destroyed by the cold. Their attacks on the human skin were made chiefly in the night, and mostly inflicted on the head and face; persons with bald heads suffered extremely. Each bite was followed by itching and a slight inflammation, which subsided in about 24 hours. In one female the irritation from the bites amounted to a considerable degree of erysipelas of the face.

Being unacquainted scientifically with the order Diptera, and being unable to meet with any other who could assist me in classifying this little insect, I applied to several captains of ships who are in the habit of trading to foreign parts, and they all assured me that the insect in question was a true Mosquito, and they could easily distinguish it from the common Gnat (Culex pipiens) which was prevalent at the same time.

Like the common gnat, it belongs to the order Diptera, family Culicidæ, and is very nearly allied to, if not identical with, the species illustrated in Curtis' British Entomology, under the name Culex guttatus. It may be easily distinguished from the common gnat by the absence of two distinct short feathery tufts on the anterior antennæ, by its broader and shorter body, by the greater breadth and brown colour of the head, and by its large black proboscis, and by the absence of the yellow coloured rings between the divisions of the body, and to those who have the misfortune to be bitten, by the more poisonous character of its bite.

I found the best way to clear a house of its presence was to saturate it with the fumes of carbolic acid, which seems to have the property of driving away, if not destroying, this and many other insects which are troublesome to man and the lower animals. Many of the insects which are such pests to the larger animals, among them the "Tsetse," which renders certain districts of Africa impenetrable to travellers with oxen, belong to this order (Diptera). I would here diffidently suggest whether the proper use of carbolic acid might not enable travellers through Africa to ward off this fatal insect from their cattle.

I apologise for the imperfect appearance of the specimens, which have not improved by being kept, and which I have not had leisure to arrange as I could wish. I may here mention that a similar prevalence of Mosquitoes took place some years ago at Cardiff, which was clearly traced to the arrival of a ship from a Mosquito country.

The Vice-President remarked upon his experience of musquitoes in Egypt, and the want of caution displayed in reference to them by travellers on their way to India, who, and especially the ladies, suffered frequently very severely in consequence.

Mr. Leipner remarked that some gnats flying at night made a peculiar humming noise, something like that caused by the musquito; but that Mr. Swinfen Jordan, who was well acquainted with the difference between the two sounds, was certain that he had not unfrequently heard musquitoes in Clifton.

Mr. S. H. Swayne referred to a paper on musquitoes, with good illustrations, in a recent number of Hardwicke's Science Gossip.

Mr. W. W. Stoddart then exhibited a very fine specimen of Echinus Flemingii, caught off the Land's End. It measured $14\frac{1}{4}$ inches round, while the largest mentioned by Prof. E. Forbes, was only $13\frac{1}{2}$ inches in circumference. He briefly referred to the fact that the markings on the shell, and the arrangement of the spines, were the characters used to define the species.

Mr. W. L. Carpenter mentioned that the Echinus was very abundant in Lamlash Bay, Isle of Arran, N. B., and gave a short account of the habits of the animal, as observed by him there, referring to its mode of locomotion by suckers pushed out from holes in the shell between the spines, the pedicellariæ, jaws, eggs, and other points of interest.

MEETINGS OF SECTIONS.

ENTOMOLOGICAL SECTION.

TUESDAY, NOVEMBER 12TH.—Mr. STEPHEN BARTON, President of the Section, in the chair.

Mr. CLARKE exhibited a fine specimen of a species of Heliothis. The specimen when first captured was supposed to be a dark variety of H. armigera, an insect very abundant in the Southern States of America, and often very destructive to the cotton crops, but of comparatively rare occurrence in this country. The ground colour of the wings of Mr. Clarke's specimen being so much darker than that of armigera generally, several members of the section expressed an opinion that perhaps Mr. Clarke's insect would eventually prove to be some other species of Heliothis.

Mr. Clarke also exhibited specimens of Colias edusa, captured at Ashley Hill, in September, and a very pretty variety of Orthosia lota, taken on ivy blossom.

A long conversation then took place with respect to the introduction of foreign specimens into British collections, and the President remarked how much better it would be if collections were made more general, so as to include all European species, instead of being confined to species occurring in the United Kingdom; and several members spoke of the great temptation (to dealers in natural history specimens especially) to introduce foreign specimens and palm them off on collectors as genuine British specimens, since many insects which might, if well authenticated as British, be worth from one to three or four pounds, could be purchased for a few pence on the Continent.

CHEMICAL AND PHOTOGRAPHIC SECTION.

THURSDAY, NOVEMBER 14TH.—The Editor regrets to have to announce that this Section has ceased to exist, since no one but the Reporting Secretary attended the meeting summoned for this evening, to which special attention was drawn at pp. 87 and 88, as well as on the Notice-page, of the last number of the Proceedings.

ZOOLOGICAL SECTION.

THURSDAY, NOV. 14TH.—Mr. W. L. CARPENTER in the chair. The attendance was very limited.

A Paper on the Solitaire of Rodriguez, by Mr. C. O. Groome-Napier, F.G.S., &c., was read by the sectional hon. Secretary, Mr. S. H. SWAYNE. The Solitaire, (Didus solitarius, Gmelin), now extinct, had formerly inhabited the island of Rodriguez, but there were fewer notices of it than of the Dodo. The first account was published in London, in 1708, having been written by François Leguat, who, in company with several French Protestant refugees, visited the island in 1699, and remained there some years. According to this observer, the feathers of the male bird were greyish brown, and of the female fair, and dun-coloured on the breast, and they were carefully dressed and adjusted. The feet and bill were like those of a turkey, and the wings very small, and of no use for flight. In the gizzard of every specimen examined, a large flattish stone was found, whatever the age and sex of the bird. The birds lived in pairs alone, one pair being always at a considerable distance from another; one egg was laid, and hatched in seven weeks, but several months elapsed before the young bird could provide for itself. At a certain age, a number of the young ones were mated with each other in presence of several older ones, and each pair henceforth lived a solitary life.

Since the time of Leguat, very little information had been published about the Island, though it was now inhabited. In 1789 some bones were found there encrusted in stalagmite, and were removed to Paris. In 1831 other bones were found, and deposited in the Andersonian museum of Glasgow, which closely resembled these. Leguat also mentioned another wingless bird, the gelinottes, or wood-hen, of a bright grey colour, with red list about the eyes. Bourbon was also once inhabited by wingless birds. Mr. W. W. Coker, of Poole, Dorset, had copied a picture by a Persian artist, which contained a representation of a white dodo, in a very fat condition, unable to fly. Other birds were described in Leguat's memoir, a "oiseau bleu," a "oiseau solitaire," &c., some of which were alive in 1735. The paper concluded with an endeavour to recal the days when the dodo was the principal bird on the Mauritius.

N.B. The Sectional Secretary wishes it to be understood that unless more interest is shown by the members, by attendance at the meetings, and the preparation of papers, the meetings of this Section also will have to be discontinued.

BOTANICAL SECTION.

Thursday, Nov. 21st.—Mr. A. Leipner, President of the Section, in the chair.

The Chairman threw out a suggestion to the members, that it would be very interesting to investigate the increase of the muscular tissue in plants, which he had reason to suppose was developed from the leaves in a descending order, whether from the cotyledon or true leaves. This might be done by planting seed and making an examination of the stem during the various stages of growth, in the case of exogenous and endogenous plants. Among the ferns, those having a creeping rhizome would be more difficult of examination than those having an ascending stem, and it would be necessary to count the scalariform ducts and vascular bundles when only one frond had been formed, and also notice the increase after the successive formation of others.

The evening was spent by the members in preparing a number of specimens for the herbarium.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

Vol. II. DECEMBER, 1867. No. 11.

GENERAL MEETING.

Thursday, December 5th, 1867.—Mr. Thomas Pease, F.G.S., Vice-President, in the chair.

The Hon. Secretary, Mr. A. Leipner, read the minutes of the last meeting, which were confirmed, and announced that Rev. Frederick Armitage, of Clifton Park, had been elected an ordinary member; also that Dr. Martyn had presented "Carpenter's Human Physiology," to the Society's Library.

He then said that he was sure the Society would learn with regret, that their Honorary Reporting Secretary, Mr. Wm. Lant Carpenter, had felt obliged to send in his resignation, on account of the pressure of business engagements. The Council had unanimously passed the following resolution:—

"That the best thanks of the Council be given to Mr. Carpenter for his valuable services to the Society as their Reporting Secretary, and the Council wish at the same time to express to Mr. Carpenter, their extreme regret at his resignation."

Mr. H. K. Jordan, F.G.S., begged permission to give expression to the sense entertained by the Society of the assiduity and interest always shown by Mr. Carpenter in its affairs, and to propose a vote of thanks to him from the Society generally.

The motion having been seconded,

Mr. W. L. Carpenter rose, and after thanking the Society for the confidence so long displayed in him, and for the votes just passed in acknowledgment of his services, said that the step he had taken had not been suddenly resolved upon, but that ever since the Proceedings had taken their present form, he had been gradually coming to the conclusion that the work required was more than he had time for, consistently with his other engagements. Without wishing to make a merit of it, he would mention that he had frequently been obliged to write reports or look over proofs for the Proceedings, at a time when most people were in bed, and this was very undesirable. He felt that the end of a volume was a suitable time for discontinuing his editorship, and he had therefore chosen this opportunity for resigning. In conclusion, his interest in the Society was unabated, and it had been a struggle to him to cease official connection with it, and he could only say that he hoped there would always be an abundance of papers at the General and Sectional meetings, for his successor to report.

Mr. A. Leipner then stated that the Council recommended to the Society the appointment of Mr. Thomas Graham Ponton, as Honorary Reporting Secretary.

The Vice-President, having briefly alluded to the qualifications of Mr. Ponton, put the motion from the chair, and it was carried unanimously.

Mr. W. L. Carpenter mentioned as a fact worth recording, that a few days previously a perfect human skull had been found at the works of the Avonbank Brick and Tile Co., St. Philip's, Bristol. It was embedded in clay, which was being dug for bricks, ten feet from the surface. About two feet below the place where the skull was found, a bed of peat existed, underneath this another clay bed, and below that again, gravel. Further than this, the excavations had not proceeded.

Major Thomas Austin, F.G.S., then read the following paper on "The Towans of Cornwall, the Dunes of Norfolk, the Sandhills of Holland, and sandy accumulations generally, illustrated with plans and sketches. Also remarks on the occurrence of Double Tides."

Towans, Dunes, and Sandhills, are in fact synonymous terms locally applied to phenomena, identical in character.

In a geological stroll through Cornwall, I availed myself of the opportunity of examining, and collecting much information relating to the manner in which the sandy accumulations have been formed. I had previously visited the Dunes of Norfolk, and before making that investigation had seen the Sand-hills of Holland. To describe the manner in which the Cornish Towans have been produced, is almost tantamount to describing all such deposits of sand, as they mostly owe their origin to causes identical in character; they are in fact accumulations of drifted sand, and which in some places are still in progress. The Towans of Sand-hills of Cornwall attain an elevation of sixty feet. Hayle stands on a flat amid extensive sands, which range with occasional interruptions, along the coast to Padstow. These sands have a large percentage of crushed and broken shells, mingled with other materials, consequently thousands of cart loads are annually carried away from the coast by the farmers to spread on their land, the lime from the shells adding fertility to the soil on which it is spread.

Houses are sometimes buried beneath the accumulations of the blown or drifted sand, and at some future period, owing to the sand shifting, again re-appear. Gwithian and Phillack are partially buried in sand. One accumulation on the barton of Upton, is said to have occurred nearly a century since, and so sudden was the irruption of sand that a large farm was overwhelmed in a moment, and the farmer and his family were obliged to get through the upper chamber window to effect their escape. In 1808 the sand shifting, disclosed the farm-house after being buried for nearly a century. Two fields are now covered to a depth of twelve feet, which a few years since were quite clear.

Sir Henry De la Beche considered the Towans of Cornwall as composed of two parts of different ages. These two portions must have been separated by a period of considerable duration, as vegetable mould and other indications of the cessation of sandy deposits are apparent. Probably after the first period of accumulation, the land became elevated above the reach of sand drifts, and afterwards again became subject to their influence.

The progress of the sand as it emerges from the sea is as follows:—After a storm or very high tide, a large quantity is frequently driven upon the shore, when this becomes dry and the wind blows strongly landward, the advance of the sand in minute undulations or tiny waves is clearly perceptible, and if not arrested in time it rolls over the fertile lands, until it completely covers the superficial surface soil. In time the lower portions of the sand become indurated into sandstones.

The Towans or Sand-hills are supposed by some to arise from other causes, no longer in operation, but the progress of the sand is now so well understood that no doubt can exist on the subject among scientific men.

The most effectual method of arresting the gradual advance of the sand is to form a barrier by sowing the seed, or planting those species of plants that thrive in sandy waters, and whose long creeping roots ramify in every direction beneath the surface, forming a net-work which checks the rapid progress of the sand, causing it to form mounds around the plants, and eventually a barrier is raised which for a time saves the adjacent district from further encroachment.

The plants which are best suitable for arresting the inroads of sand are *Ammophila arenaria* (sea reed), *Triticum junceum* (sea wheat grass), *Hippophæ rhamnoides* (sand thorn), *Cakile maritima* (sea rocket), *Salsola kali* (saltwort), *Sonchus* (sand thistle), and some others.

Wheresoever these plants grow the effect is soon visible, a few of them will arrest portions of sand and collect it into small hillocks, these hillocks, as vegetation progresses, are formed into larger ones, till by degrees a mound of considerable size is formed, and which the matted roots of the plants keep from dispersion. In proof of the influence vegetation exercises over arid wastes, it is recorded that last century the estate of Coubin, near Fores, in Scotland, worth some hundred pounds a year, was overwhelmed with an irruption of blown sand, and became valueless. This was caused by cutting down some trees, and grubbing up the plants locally known as the bent star, which grow on the sand hills, and thus letting loose the material to over-run the more fertile land.

On a portion of the Flintshire shore, the sand-hills are covered with the plants that thrive in sandy deposits, and are thus kept firmly in position.

The Dunes of Norfolk, situated along the shores of Norfolk, between Hunstanton and Weybourne, are a succession of dunes composed of wind-drifted sand, which is held together by the long interlacing roots of the *Ammophila arenaria*, (sea reed), and other plants. These dunes protect several small harbours along the coast which in many parts is rapidly yielding to encroachments of the sea. On the same coast ancient villages have been overwhelmed with sand. It is stated in Mr. R. C. Taylor's Geology of East Norfolk, that Wimpwell, Eccles, and Shipden have disappeared; that large parts of parishes have been gradually swallowed up. Unless recently destroyed, a monument of those inroads of sand marks the site where Eccles once flourished, the ruined tower of the old church still rears its weather-worn top above the surrounding dunes, under which lie the houses which were inhabited in 1605.

South of Happisburg, and extending to Yarmouth, also occur hills of drift sand, which in some degree protect the fertile lands adjacent to the shore; but as the sea frequently makes encroachments along the coast line and alters its contour, the dunes can offer but a temporary resistance to its ravages. The changes along the coast are truly remarkable, cliffs have been washed away, estuaries have been blocked up, manors and parishes which once supported a numerous population are now at the bottom of the German Ocean.

If authentic records point to such changes on land, we may safely conclude that similar alterations are continually in progress in the sea bed. This has been proved by different surveys, one fact, however, I will mention. Captain Hewett, R.N., when sounding along the east coast found a wide channel sixty-five feet deep, which some years previously was only four feet in depth. The shifting of those submerged sand banks makes navigation dangerous to mariners, as at one period ships may safely sail over spaces which in a few years become dangerous shoals. Many years since I narrowly escaped shipwreck by our ship striking on one of the banks situated at some distance from our eastern shore, but thanks to a kind providence, a stout ship, and strong wind, we, after grounding, literally ploughed our way over the shoal. The dunes of Norfolk, like the Towans of Cornwall, have an elevation of about sixty feet.

The Sand-hills of Holland serve as barriers to protect the low grounds near the coast, and owe their present consistency to the long creeping tangled roots of plants which hold the heaps of sand together, in a similar manner to the root bound dunes of Norfolk. No doubt that if the vegetation which now serves to arrest the sand was removed, several parts of Holland would become submerged, as would probably be the case with the small sandy island off the coast of Heligoland.

The agency of man sometimes produces changes of considerable importance. In Jutland by the inconsiderate clearing away of the forests, which in a great measure protected the maritime districts from encroachments, large tracts of fertile country have been transformed into sandy wastes, while at several parts of the coast, the sea has made inroads and swept away large masses of land to be scattered far and wide to form shoals or banks in the North Sea. Some slight checks to further encroachments have been adopted by sowing the seeds of those species of plants which I previously mentioned, and also by planting birch, fir, and other trees.

The church of Skagen, in Jutland, like that of Eccles, in Norfolk, has been buried in a sandy drift.

Movements of sand similar to those described have occurred in many parts of the United Kingdom. Bannow, once a borough town on the eastern coast of Ireland, and situated near the mouth of the river Ban, county of Wexford, now lies buried beneath an accumulation of sand. Although for many years only a single chimney protruded above the drift, the ancient borough continued up to the time of the Union to return two members to the Irish Parliament. As the owner of the property alone possessd a vote, there was no probability of a severe contest for the honour of representing a rickety old chimney and some heaps of barren.

Opposite Bannow, on the western side of the estuary of the river Ban, stand the scanty remains of the once flourishing town of Clonmines, the ruins of its seven churches (so called), and a single farm house, alone mark the site where an active commerce had formerly been carried on. About the time of our Henrys, ships of two or three hundred tons burden could unload at the quays; now this is no longer possible, the tide way has been so blocked up by the accumulation of sand at the bar, that the water of river Ban has to cut a narrow channel through the barrier at its mouth, by which fishing boats may enter the estuary and navigate its shallow waters, or occasionally a small coal-laden vessel contrives to cross the bar during the highest spring tides, and at low water deliver her cargo while lying high and dry on the ground.

So much has the coast line been altered within a comparatively recent period, that a rock, which in the old charts is laid down as a danger for mariners to avoid, is now in shore at least fifty feet from the water.

Although Clonmines itself is not buried in sand, yet its decay was clearly occasioned by the sandy invasion in its immediate vicinity, which destroyed a commodious harbour, and which no doubt was much used by the early English mariners, as it is situated close to Bag-en-Bun headland, where the first band of invaders under the command of Fitzstephen, landed in the year 1172. On the table are sketches of two of the ruins at Clonmines. Beyond the ridge depicted in the larger one lies the buried town of Bannow.

At the head of Duncannon Strand, in the county of Wexford, is a small level sand-covered flat from which much of the sand has been carried away for agricultural purposes; near this spot there is a narrow rivulet which runs down the valley from Clonshara. Some years since this small stream, after an unusual fall of rain, broke down its western bank and cut a new channel through the sandy flat, where it laid bare a number of trees with all their branches as complete as when growing erect, but which were lying prostrate on a bed of clay below the sand. How the trees became felled it is not easy to determine, unless we suppose that a hurricane had devastated the coast and had by its violence uprooted the trees, and at the same time driven a deluge of sand from the adjacent shore, and thus buried the roots, trunks, branches and all. That the trees were speedily covered up can hardly be doubted, for if they had been left exposed to the atmosphere for any length of time the small twigs would in all probability have been removed. It is worthy of remark that no description of trees are now growing in the vicinity of the place, and that in the adjoining bog of Kilbride, oak trees, hazel nuts and wood, are found buried in the peat in abundance. Specimens of the black oak, hazel wood and nuts, were exhibited.

If we extend our enquiries to Africa it will be found that the sands of the Lybian desert have been driven by westerly winds till they have left no land fit for tillage on the western banks of the Nile, unless where protected by elevated ground; and were it not for the ridge of mountains known as the Lybian chain, which extends some distance from, and along, the left bank of the river, and in part forms a barrier against the invasion of the desert sands, the shores of the Nile, on that side, would cease to be habitable. Few persons reflect on the important part sand performs in producing modifications on the globe. In Egypt the traveller may walk over villages now lying beneath the sand, or stumble over the tops of minarets, and mark the sites where proud cities once flourished, but where all is now a barren wilderness—a silent solitude.

The banks formed across the mouths of small rivers, on the eastern shores of England and Ireland are caused by the tidal currents passing along the coast. These currents bear in their course the materials washed from the cliffs, and sea margins generally, and when any obstacle is sufficient to impede and lessen their velocity, such as a river pouring its water into the ocean, the matter held in suspension sinks to the bottom, and a bar is formed in consequence. In this way the mouths of estuaries and rivers have been diverted several miles from their original courses. Two or three instances will be sufficient to illustrate this. Take for example the Norfolk rivers Alde and Yare, which have their outlets further south than formerly, the first named being transferred to a point ten miles distant and the other to about four miles. On the eastern coast of Ireland the same operation is in progress, a carefully measured plan of one of these alterations, the Murragh bank and river Vartray, county of Wicklow, I have here. This bank is chiefly composed of shingles mingled with sand, but the progress by which it has been formed is precisely the same as that which produces the simple sand bank. Its length is nearly three miles.

From careful observations it has been proved that the rivers on the eastern coasts of the British Islands are continually deflected southwards. The cause of this has been well ascertained, and is as follows:—When the great tidal wave from the Atlantic arrives at the shores of the United Kingdom, a small portion of it passes eastward up the English Channel, through the straits of Dover, and then northward to the German Ocean; another part flows northward up St. George's Channel, while the principal body of water continues its course to the westward of Ireland, and passes onwards much beyond our most northern limits. The two detached portions of this large body of water having to force their way through the narrow channels before named, are consequently retarded in their progress, but the main tidal wave which traverses the more open sea with a higher velocity yet having a greater distance to travel, does not arrive at its northern limit till after the time the detached portions have made high water on the shores of the channels they traverse, so that the great tidal wave when it begins to ebb southwardes forces large bodies of its waters between Scotland and Norway, and also down the North Channel which separates Ireland from Great Britain. The immense marine current sweeps along our eastern coasts and transports the material it has despoiled from the shores met with in its progress, and where there is not a sufficiently large and rapidly flowing stream of river water to an open channel, a bank is thrown across its mouth, and the river is either dammed back to form a lake, or the outlet deflected further south, as may be seen in the Murragh of Wicklow. Here we can trace the first process in the Broad Loch, as represented on the plan, and also the subsequent movements and accumulation of material to dam-in the Murragh Loch, and so on till the communication of the river Vartray with the Irish Channel has been diverted nearly three miles from its original position. No doubt at one period the river discharged itself directly into the sea, but as the Murragh of Wicklow became gradually enlarged, the stream began to flow into the narrow lake, now known as the Murragh Loch, which has been formed at its mouth by the bank thrown up by the sea across its original course.* The western shore of the Murragh Loch indicates the former line of sea coast.

This great bank, known by the name of the Murragh of Wicklow, has now become so firmly consolidated that horse races annually take place on it. The race course is marked on the plan. The materials of which it is composed are various, pebbles, gravel, and sand, and much of the matter composing the bank must have been transported from considerable distances. Many fine pebbles are found on this bank, some of which, both polished, and in their rough state, are on the table, and also a measured plan.

Sometimes the natives try to play tricks upon travellers by offering them common worthless pebbles for sale, and which they rub over with oil to give them a shining appearance, and also to bring out any colour they may possess.

The observations made relative to the movements of the great tidal wave which approaches our shore twice in the day of twenty-four hours, will tend to explain the double tides, which are by no means unfrequent on the eastern coast of Ireland. The explanation of this phenomenon is as follows:—When the main portion of the great tidal wave that passes to the westward and on to the north of Ireland, has turned its course southward, and its retrograde movement is accelerated by a strong north west gale, a large body of water is forced into the

* Works are now in progress to convey the water from the river Vartray to Dublin.

Irish Sea through the North Channel which separates Great Britain from Ireland; but sometimes, before this takes place, the detached portion which passes up St. George's Channel from the south has marked high water along all the eastern shores of Ireland, and has ebbed for some time before the great tidal wave comes down from the north after completing its boreal course, the consequence of this apparent anomaly is, when the St. George's Channel current which entered from the south is nearly at half ebb tide, the influx of the marine current from an opposite direction through the North Channel, causes the tide to rise again along the shore, to the great amazement of those dwelling on the coast, who designate these double tides "Dead Men's Waves."

Sometimes when geologizing along the sea shores of Ireland, and the water has receded a considerable distance, I have been surprised to see the tide flowing in with rapidity a second time, and out of its regular course. These double or irregular tides always rise and recede with greater rapidity then the regular flux and reflux of the sea.

In Kewstoke Bay, near Weston-super-Mare, some small low dunes occur, but I did not observe anything connected with them requiring particular notice.

When casual observers look at a series of dunes, or heaps of shingles, they only see in them vast accumulations of sand or pebbles, but the reflective geologist can perceive in the arenaceous deposits, the material to be hereafter consolidated into extensive beds of sandstone, and in the heaps of shingle the rudiments of future massive beds of conglomerate.

Mr. W. W. Stoddart, F.G.S., considered that the effects of sand and mud were the two principal causes of stratified beds in England. At Tenby were many illustrations, where also the sand was being consolidated by the bindweed. Near Sydney, Australia, a church-yard was being washed away by the sea, bodies occasionally being laid bare, and covered up again by the disintegrated old Red Sandstone, which eventually became reconsolidated.

Mr. H. K. Jordan, F.G.S., agreed with the author in attributing many of these sandy accumulations to subaërial agencies, but thought that many also were due to secular variations in the relative level of land and sea, giving as an instance the raised beach at Weston-super-Mare, so well described by Mr. Ravis, in November, 1865. It would be interesting if those parts of the country which would be inundated by a depression of, say, 20 feet, could be coloured on an ordnance map. At Perran was another instance of a church being buried.

Mr. C. F. Ravis spoke of the series of dunes in Chew Stoke Bay, near Weston, the highest of which was 80 feet above the present beach. He considered these to be the dunes of several successive sea-beaches.

Mr. Stoddart remarked that the accumulations described by Major Austin were too recent to have been formed in the manner suggested by the two last speakers.

Mr. DAVID DAVIES and Mr. JORDAN spoke of having heard from the officers of one of H.M.'s vessels, who had been taking soundings in the Bristol Channel, that great changes of level were in progress there, some channels being gradually blocked up, or made more shallow, and others becoming considerably deeper.

Mr. S. H. SWAYNE referred to the accumulations of sand on hill-tops, as instanced by the castle at Oxwich Bay, Gower, which was built on the top of a hill, and partly buried in sand.

The VICE-PRESIDENT in concluding the discussion, referred to the existence of vast sandy plains in central Asia, in Prussia, near Arnheim, and many other places. When this enormous quantity of sand was taken into consideration, as well as the high winds that occasionally prevailed, these accumulations were not to be wondered at. His thoughts were naturally carried back to Egypt, where whole towns were buried in sand, and utterly forgotten. The constant movement of sand there accounted for the frequent re-discovery of monuments and temples, such as those at Memphis and Ipsambool, at intervals of years, the accounts of former discoveries having been forgotten.

Mr. THOMAS GRAHAM PONTON then read the following paper on "The Alimentary System of Tegenaria civilis (one of the house-spiders)."

Tegenaria civilis, the anatomy of whose alimentary system I am about to describe, belongs, as do all the animals popularly called "Spiders," to the Family Araneidæ of the Arachnida Filosa, or Pulmonaria.

Although all my observations will refer particularly to the species I have chosen for illustration, many of them might with propriety be applied to any other member of the Araneidæ.

In such a large family as this, however, there are in every genus minute differences of structure, the description of which would far exceed the limits of a single short paper. I have, therefore, thought it better to confine myself to one in particular, in place of trying to take a cursory view of the whole.

I chose the Tegenaria civilis as the basis of my remarks for several reasons, but chiefly, because it is a very common, if not the most abundant, of our British Spiders, and there must be few of those who hear me to-night, who have not seen it lurking in its web, when they were moving some old articles of furniture, or visiting some remote garret or lumber rooms, and have thus acquired a knowledge of its general appearance at least.

The term alimentary system, I have employed in its widest sense, including in it all organs, directly or indirectly subservient to the nourishment of the animal; such for instance as the spinnerets from which are eliminated those wonderful webs in which the spider snares its prey. With these few words of preface, I will now proceed with the immediate subject of my paper, and commence by describing what are called the *falces*. The "falces" are a pair of jaw-like organs, situated immediately above the mouth, they are attached to the fore part of the cephalo-thorax by a joint, and have a lateral motion like the jaws of insects.

These organs perform somewhat the office of mandibles, and have in fact been thus called by some authors, but improperly so, for they form no part of the mouth.

Their function is to seize and kill the prey, but they do not assist in mastication.

Each falx is composed of two parts, the base and the fang.

The base serves simply as the support for the cutting instrument, and has a groove on its under surface into which the fang is folded-down when not in use

The fang is hard, sharp, and sickle-shaped, and is, in the instance we are considering, armed with a row of thirty pointed teeth on each side, and a smaller number on the under surface.

Attached to the falces is a highly interesting apparatus which is believed materially to assist the spider in the capture of its food.

This consists of two glands composed of a number of filaments united by a membrane into the form of a sac; these are situated in the interspaces of the muscles of the cephalo-thorax,and communicate with the falces by means of a duct.

These glands secrete a fluid which is supposed to possess slightly poisonous properties, and thus to aid in the destruction of the insects on which the spider feeds. Stories are told of the bite of spiders having proved fatal even to man, these are not, however, supported by very reliable evidence. Certainly no English Spider is capable of inflicting a bite sufficiently hard even to pierce the human skin. This I have frequently proved by experiment.

So far as I am aware, no experiments have been made to prove the directly poisonous properties of this secretion. Any such experiments are, in the case of our British Spiders, surrounded with great difficulties; speaking for myself I may say that some I have made in reference to this question have been only in a measure satisfactory, but such as they were, they rather tended to show that this fluid did possess some properties fatal to insect life.

The exact position of the orifice in the fang through which this fluid exudes, has long been a question of dispute.

Very recently a discussion took place in the pages of one of our Scientific Journals on this point. Some of the disputants even went so far as to deny the existence of the glands altogether; but this would appear to have been the result of faulty dissection. The dispute was closed by a communication from the late Mr. R. Beck, illustrated by a drawing, in which he showed the orifice as being on the side of the fang near the point, in this following Leeuwenhoek and some other Arachnologists.

After a very careful examination of many of these fangs, I have come to the conclusion that the appearance believed by Mr. Beck to indicate the position of the orifice really arises simply from the peculiar arrangement of certain striations on the fang. Of course the assigning of the position of a minute orifice on a fang, itself about the 1-50th of an inch in length, is a matter of no small difficulty.

The celebrated Cuvier, and many modern foreign Arachnologists, place this orifice on the *under* surface of the fang near the point, a position on many grounds much more likely for the exit of the duct than that on the side. This position, from what observations I have made on our British Spiders, and also on an example of a large foreign "Bird Spider," I am led to believe to be undoubtedly the true one.

The food which has been captured and killed by the falces is next conveyed to the mouth. This consists externally of an upper and under lip, and a pair of maxillæ or jaws.

The upper lip can only be detected externally by its hairy tip, which is in reality merely the termination of the palate.

The maxillæ are corneous in their structure, and covered more or less with hair, they serve to masticate the food and express the juices which are then sucked in by the lips. In a cavity above the palate is a transparent glandular mass, which secretes a fluid, probably, functionally at least, the same as saliva.

The mouth communicates by means of a short œsophagns with the stomach· This vessel is of a highly complicated and peculiar structure.

It is broad and flat, somewhat circular in form, and possesses on each side five cylindrical cœcæ, which extend up to the roots of the legs and palpi. These cœcæ appear simply to serve the purpose of expósing the food for an extended period to the action of the gastric fluids.

From the stomach the food passes into the alimentary canal.

This, at first narrow, expands at a short distance from the stomach, again contracts, and again expands at its extremity.

The intestinal canal is enveloped on each side by a dark granular mass, which is called the Fat-body.

This Fat-body exists in a greater or less degree in all the Arachnida pulmonaria, and when we consider the precarious nature of their food, and the long fasts which they must frequently endure, we at once see the absolute necessity of some such provision for their support.

That Spiders are capable of existing for a very long time without food has been amply proved. As an instance of the kind, I may give the case, mentioned by Mr. Blackwall in his work on British Spiders, of a female *Theridion quadripunctatum,* which lived for eighteen months in a closed bottle without food.

Embedded in the "Fat-body," on each side of the intestinal canal is a series of dark granular masses, which communicates by a series of tubercles with the canal at its first dilatation. This is the liver, its existence was formerly denied, it having been frequently overlooked in the general mass of the "Fat-body."

Also enveloped by the "Fat-body," and ramifying amongst its substance, are two fine tubes, these unite in a small sac, which communicates by a short tubercle with the intestine near its oval dilatation.

The proper function of this apparatus is doubtful; but it is considered probable, and I think with reason, that it is a renal organ.

At the base of the abdomen, near its extremity, there is resting on the surface of the "Fat-body" a greyish yellow mass. This, when removed from the spider and teased-out, is found to be composed of an immense number of minute tubes ramifying from a series of small glands. These tubes expand several times during their course into small sacs, and finally find their exit in a variable number of jointed mammulæ, in the case of Tegenaria civilis, six, situated externally on the inferior surface of the abdomen.

This is called the silk securing apparatus, and the external mammulæ are named the spinnerets.

Each mammula is studded with a number of minute orifices through which the secretion from the tubes passes. The number of these tubes has been variously estimated at from 400 to 1000; in some specimens of Tegenaria civilis I examined, I found the number was about 720. It has been generally stated, that the whole of the six mammulæ are engaged in the formation of a single thread of spider's silk; this, however, I am very much disposed to doubt, and from what I have seen I am inclined to believe that only one or two of the mammulæ are in action at one time. They are usually arranged in pairs, and I think it is not unreasonable that two act at a time, and that when the secretion of these is exhausted, the next pair come into action, and so on. The thread is of two kinds, or rather composed in two different ways, depending probably on the volition of the animal. The first is simple and smooth throughout its entire length; and forms the longitudinal portion of the web, the other is studded throughout by minute globules or knots, as it were, of the silk secretion, which give it an adhesive character, these form the tranverse threads of the web, and give solidity to the structure. It appears to me that the difference in the two threads is caused solely by the first being spun from as much of the secretion as is emitted at one time, and that the other is the result of successive supplies of the fluid; each emission being marked by the formation of one of the knots or globules. There is no real difference in the secretion composing the two threads, and I cannot but think that the above is the true explanation of the phenomenon.

The threads of spiders' silk are very fine, the simple ones are about the 1-1000th of an inch in thickness, the glutinous ones rather more, and yet each of these is made up of a large number of fine filaments, equal of course to the number of tubercles in the mammulæ which spun them. A single web contains sometimes 300 threads or more; so elaborate is the seemingly simple snare a spider sets to catch its prey.

Such is a short, and I fear very imperfect sketch of the alimentary system of Tegenaria civilis. As an excuse for some of its shortcomings, I may say, that in giving this account I have been very much left as it were to my own resources. The descriptions of the alimentary system of spiders given in various works I consulted, differed so much from each other, being frequently directly contradictory, and that on some not unimportant points, that I soon found they were but lame supports to rest upon. I was, therefore, obliged to see and examine for myself, and the results such as they are, I have here given.

The VICE-PRESIDENT remarked, *àpropos* of the concluding portion of this paper, that this examination by members for themselves was most valuable, and deserved the greatest encouragement.

A VISITOR enquired whether the separate filaments of which the thread of the spider was composed simply adhered together, or were twisted in a rope-like form?

Mr. PONTON was unable to answer the question definitely, but believed, both on *a priori* grounds, and from his observations, that they were simply adherent.

Mr. T. H. YABBICOM said he had on one occasion been able to separate the filaments, which he could not have done had they been twisted.

Mr. S. H. SWAYNE observed that the fact noticed by the author, namely, that the liver was composed of separate glandular bodies, rather than of a glandular mass, had been observed in other animals also.

Mr. J. J. RANSON, of Weston-super-Mare, then read a paper on the Anatomy of the Actiniæ, illustrated with diagrams.

The position of the Actinia in the Animal kingdom was first pointed out. It belonged to the sub-order Zoantharia malacodermata, class Actinozoa, sub-kingdom Cœlenterata, the members of which were the lowest animals in which two or more distinct layers entered into the composition of the body substance. In the class Hydrozoa there was no intervening space between these two layers, but in the class Actinozoa such a space existed, and was filled with the reproductive and other organs. The universal distribution of the Cœlenterata was then alluded to, as well as the fact that they were nearly all marine, and that the formation of all coral was due to certain members of this sub-kingdom.

The Actinia, or sea-anemone, might be taken as the type of the second division, Actinozoa, although it was by no means the most highly organized member of the class, still all its members presented the same structural peculiarities. Its external appearance was familiar to most persons; in its contracted state it might be likened to a more or less depressed cone, rounded above, the base rather spreading; when expanded it might be described as a fleshy column or cylinder usually attached by the base, the opposite end being surmounted by many tentacles disposed in two or more concentric alternative circles, in the centre of which was placed the mouth. From several causes it was enabled to effect some remarkable changes in its form and appearance. Its locomotion was very slow, being performed chiefly by contractions of its base. Some species changed their colour when living in pools, &c., periodically uncovered by the tide, to correspond with the colour of the rock, or sand, to which they were attached.

Externally the body was usually soft and fleshy, sometimes leathery, and frequently covered with wart-like papillæ, which secreted a viscid fluid, and were also powerful suckers. In the mature animal there were more than two distinct tissues, and the principal thickness of the body wall was made up of two sets of muscles, the outer of which was disposed circularly, aud the inner longitudinally; these fibres, however, were not striated, as normal muscular fibre was. The ectoderm was divided into two layers, between which the thread-cells were found, called the dermal and epithelial layers, and immediately underneath the former were found the pigment cells. The stomach was simply an invagination of the body wall, aud possessed essentially the same structure. The tentacles were hollow, and frequently perforated at the extremities, the openings being closed by a sort of sphincter muscle, and the whole having a free communication with the interseptal chambers; their development in the young animal took place in a series of concentric circles, each of which, reckoning from within outwards, contained, the second only excepted, twice the number of tentacles of its predecessor. In some Actiniæ, outside the tentacles, were little wartlike blue bodies, supposed by some observers to be rudimentary eyes; the author, however, did not regard them as such, and found them to contain an enormous number of cnidæ, and amœboid-like particles of sarcode. The mouth was slightly oval in form, and provided with a pair of tubercles (gonidia) whence ran two canals as far as the termination of the stomach, which was a short tube somewhat flattened, hanging freely in the centre of the body, capable of distension, as well as of being closed at its lower aperture by a sphincter muscle. At the upper exterior part of the stomach were some brown granular bodies, which probably discharged the functions of the liver, and the food was completely, but very slowly, digested in the stomach, without passing into the somatic cavity.

The position and function of the mesenteries were then described; the primary mesenteries were partitions which connected the body-wall with the stomach, while the secondary and tertiary mesenteries had no attachment to the stomach; on the faces of these mesenteries, the reproductive organs were developed as follows:—two thin layers of the peritoneal membrane which surrounded the mesenteries were produced beyond their free edges to form the sac-like covering, within which the spermatozoa, or ova, when mature, burst through into the general cavity of the body. It was supposed that impregnation took place when both spermatozoa and ova were freely swimming in water, although occasionally the development of the young polype advanced considerably before it quitted its parent. The free-swimming germ was ciliated, and oblong-ovate in form, and at one extremity a depression, ultimately to form the mouth, was noticed; the tegumentary system became by degrees distinct, thread-cells, pigment spots, &c., presented themselves, as well as the muscular structure and the tentacles. Lastly, the cilia were thrown off, and the base underwent a change, according to the habits of the adult animal. Besides the reproductive apparatus, there was developed in the perigastric cavity a large quantity of a cord-like organ, called the "craspedum," which consisted almost wholly of cnidæ or thread-cells, and in addition to the craspeda, other organs of similar structure, termed "acontia," were occasionally met with. Only one observer had ever seen any nervous system in the Actinozoa, and by some its existence was altogether denied. The cnidæ, or thread-cells, diffused throughout the body, and collected in certain organs into large quantities, were then noticed. Each cnida consisted of a minute sac, formed of two walls, within which was coiled up a thread of extreme tenuity and great length, called an "ecthoræum," provided with barbs, which was capable of being darted forth; the interior of the sac was filled up with a fluid, probably poisonous. The paper was concluded by a very brief notice of the reparative powers of the Actiniæ, which were considerable.

The Vice-President thought that a very good future was in store for the Naturalists' Society, when junior members read such excellent papers, and enquired who were the chief writers on the subject.

Mr. Carpenter replied, Messrs. P. H. Gosse, G. H. K. Lewis, and Professors Huxley and J. R. Greene.

Mr. H. K. Jordan, F.G.S., remarked that the reproductive organs of the Actinozoa resembled those of certain Mollusca. The marine Gasteropoda were monœcious, but the land Gasteropoda were diœcious, though there was reason to believe that, as in the case of the Actiniæ, individuals occasionally changed their sex.

The lateness of the hour precluded any further discussion of this paper.

MEETINGS OF SECTIONS.

GEOLOGICAL SECTION.

THURSDAY, NOVEMBER 28th.—Mr. C. F. RAVIS in the chair. There was a good attendance, and two new members were proposed.

Mr. W. W. STODDART, F.G.S., read a Paper entitled "Notes on the Palæontology of the Bristol District." It was given in reply to enquiries addressed to the Author for a list of the strata and the localities within easy reach for the study of Geology, and its object was to describe a few such good localities from which typical fossils could be obtained, whence a tolerably good knowledge of the district might be obtained. After some preliminary remarks upon the advantages of the study of Geology, aud the best mode of pursuing it, the Author observed that the neighbourhood of Bristol was so good, combined with the facilities of access afforded by the railways, that two-thirds of the whole Geological scale was within the reach of a day's excursion, the district ranging from the lowest bed of the Upper Silurian to the highest bed of the Lower Oolite, passing through the Devonian Carboniferous, Millstone Grit, Coal-measures, Trias, and Lias.

The city itself lay in a hollow between two elevated table-lands, and was built on an alluvial soil now depositing, which extended from the mouth of the Avon to Bath, aud overlay mammaliferous gravels. The Lias approached very near the surface in many places. The Author then proceeded :—

"An examination of the accompanying Table will show the localities of all the strata before mentioned.

"The Silurians, you will observe, can be studied with great advantage at Tortworth, where they occur with the protrusion of Trap rock.

"The fossils at Damory Bridge are Upper Llandovery, of the same age as those of May Hill.

"In the Tortworth District the Ludlow and Wenlock beds are seldom opened, but when they are they yield very perfect Shells, Trilobites, &c.

"Near Longhope Station is an excellent quarry for Ludlow forms, and in the adjoining lands all the typical Wenlock fossils may be collected.

"The Devonian beds may be seen on the banks of the Avon, both in the railway cutting below Cook's Folly, and on the south bank of the river.

"In the description of these beds in the Geological Transactions is a mistake which has been copied in succeeding works, namely, that the Devonian beds reach to the wood under Cook's Folly. It also says they commence immediately below the Ichthyocopri bed. In reality the first decided Old Red bed does not appear for one hundred feet below that spot. Hardly any traces of fossils are as yet known.

"Above the Devonian is a complete and connected series of all the strata mentioned in the Table, to which the members are referred for details.

TABULAR VIEW OF THE FORMATIONS OF THE BRISTOL DISTRICT.

Period.	System.		Strata.	Localities for Observation.
Mesozoic or Secondary.	Jurassic.	Inferior Oolite	Freestone - -	Dundry, Saltford, Lansdown
			Ragstone - - -	Ditto ditto
			Conchifera Beds -	Ditto
			Cephalopoda Beds -	Ditto
			Mollusca Beds - -	Ditto
		Upper Lias	Upper Lias - -	Ditto, Upton Cheney
		Mid. Lias	Marlstone - -	Bitton, Upton Cheney, Dundry
		Lower Lias.	Turneri Zone - -	Horfield
			Bucklandi Zone -	Ditto, Montpelier, Bedminster
			Planorbis Zone - -	Ditto ditto
			Rhætic Zone - -	Almondsbury, Cotham, Aust, Bedminster, Pyle Hill
	Trias		Keuper Marls - -	New River, Cotham, Pyle Hill, Aust
			Keuper Sandstone	New River, Stapleton, &c.
			Conglomerate - -	Drawbridge, Clifton, Durdham, Westbury, Henbury
Palæozoic or Primary.	Carboniferous		Upper Coal Measures -	Coalpit Heath and Parkfield
			Pennant - - -	Hanham, Stapleton, Brislington
			Lower Coal Measures	Fishponds, Kingswood, Easton, and Bedminster
			Millstone Grit - -	Brandon Hill, Ashton, Tyndall's Park, &c.
			Upper Limestone Shale	South Buttress of Bridge
			Middle Limestone -	St. Vincent's Rocks, Great Quarry, Black Rock Quarry
			Lower Limestone Shale	Cook's Folly, Portishead, Clevedon
			Pilton Group - -	Cook's Folly
	Devonian		Conglomerate - -	Avon and Railway Cuttings
			Sandstone - -	Ditto ditto
	Silurian		Ludlow Beds - -	Longhope, Tortworth
			Wenlock Limestone -	Ditto ditto
			Wenlock Shales -	Ditto ditto
			Upper Llandovery -	Tortworth, May Hill
	Igneous		Trap - - -	Charfield, Uphill, Damory Bridge

SUMMARY OF AN ANALYSIS OF THE CATALOGUE OF THE BRISTOL FOSSILS, 1867.

	Genera.	Species.	Localities.
PLANTS :—			
Acrogens - - -	14	31	Devonian, Carboniferous, Lias
Gymnogens - -	9	19	Carboniferous, Lias
ANIMALS :—			
Foramenifera - -	15	15	Ditto ditto
Amorphospongidæ -	1	1	Oolite
Zoophyta (Corallaria)	21	42	Ditto, Carboniferous, Lias
Echinodermata - -	23	51	Ditto ditto ditto
Articulata - -	1	3	Ditto
Crustacea - -	9	14	Ditto ditto ditto
Insecta - - -	3	3	Lias
Mollusca - - -	106	429	Oolite, Carboniferous, Lias
Pisces - - -	26	65	Ditto ditto ditto
Reptilia - - -	5	14	Lias
Mammalia- - -	9	10	Post Pliocene
TOTALS :—			
Plants - - -	23	50	
Animals - - -	219	647	
	242	697	

The reading of this paper gave rise to a conversational discussion among the members. Several specimens were brought for exhibition, Mr. Browne showing specimens of granite and greenstone, Mr. Gillford specimens of Chemnitzia periniana from the Lias at Horfield, Mr. Pass a coal plant very perfectly carbonised, Mr. Praeger some slag from glass-works with a curious crystalline arrangement, and Mr. Stoddart a couple of fossil crustaceans from the Gault at Folkstone, named Palæocorystes Stokesii.

ENTOMOLOGICAL SECTION.

TUESDAY, DECEMBER 10TH.—The meeting of the Section was held this evening, by invitation, at the house of the President, Mr. S. Barton. The members met at half-past seven, and after tea had been partaken of, the evening was spent in examining the fine collections of British and Foreign Coleoptera, belonging to Mr. Barton. The foreign collection, including specimens captured by Dr. Livingstone and Du Chaillu was much admired.

The meeting separated at rather a late hour, the members first passing a vote of thanks to Mr. Barton, for his hospitality, and for the treat he had afforded them.

ZOOLOGICAL SECTION.

Thursday, December 12th.—As there was no quorum this evening, no meeting took place.

The Editor is given to understand by the Sectional Secretary that it will be proposed at the January meeting to suspend the meetings of this Section for the present. Communications on the subject are invited, addressed to Mr. S. H. Swayne, 8, Berkeley Square.

BOTANICAL SECTION.

Thursday, December 19th, 1867.—Mr. A. Leipner, President of the Section, in the chair.

On the motion of Mr. Derham, it was resolved,—"That Seemaun's Journal of Botany, British and Foreign, should be subscribed for from the funds of this Section on and after January next, and circulated among the members."

The evening was spent in mounting specimens of mosses for the Herbarium.

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PROCEEDINGS

OF THE

BRISTOL

NATURALISTS' SOCIETY,

(Established 1862,)

FOR THE YEAR 1868.

NEW SERIES.

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1868.

Table of Contents.

List of Errata.

PAGE	LINE FROM TOP	
5	24	*omit* ‘other’ *before* Pulmoni branchlata.
6	22	*for* ‘800·’ *read* 8000.
7	27	*for* ‘despatched’ *read* often despatched.
9	22	*for* ‘Brecles’ *read* Beccles.
11	21	*insert* ‘not’ *before* judge.
11	35	*for* ‘2 No^5,Ko)2 *read* 2(Ko,No^5·)
11	36	*for* ‘KS^2’ *read* KS.
19	14	*for* ‘Anthophagous’ *read* Onthophagous.
19	35	*omit* ‘foreign’ *before* Coleoptera.
21	21	*for* ‘Lencobryum’ *read* Leucobryum.
22	19	*for* ‘serpeus’ *read* serpens.
22	22	*for* ‘fluitaus’ *read* fluitans.
22	23	*for* ‘splendeus’ *read* splendens.
31	25	*for* ‘Perisodactyla’ *read* Perissodactyla.
47	27	*for* ‘Rhinosceros’ *read* Rhinoceros.
48	7	*for* ‘highbridge’ *read* Highbridge.
48	19	*for* ‘robertineum’ *read* robertidanum.
49	2	*for* ‘masculata’ *read* maculata.
49	11	*for* ‘Spirœa’ *read* Spiræa.
49	15	*for* ‘aiisina’ *read* alisima.
49	17	*for* ‘Ænanthe’ *read* Œnanthe.
49	25	*for* ‘Palicarea’ *read* Pulicaria.
49	26	*for* ‘Sanacetum’ *read* Tanacetum.
49	27	*for* ‘Hyphericnm quadraugulatum’ *read* Hypericum quadrangulatum.
50	17	*for* ‘kinper’ *read* kenper.
50	27	*for* ‘Hobodus’ *read* Hybodus.
50	28	*for* ‘Icthyosaurus’ *read* Ichthyosaurus.
55	31	*for* ‘Liepner’ *read* Leipner.
78	26	*for* ‘Corsus’ *read* Cornus.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

Vol. III. JANUARY, 1868. No. 1.

GENERAL MEETING.

Thursday, January 2nd, 1868.—Mr. S. H. Swayne, M.R.C.S., in the chair.

The Hon. Secretary, Mr. A. Leipner, read the minutes of the last meeting, which were agreed to.

Mr. Henry K. Jordan, F.G.S., then read the following paper on "The Whelk (*Buccinum undatum*); its development, habits, and distribution."

The whelk is a well-known and highly valuable mollusk. As an article of food and for its use to man, it must rank next to the oyster.

It abounds in all the British seas, and dead shells may be picked up on every strand at high-water mark, cast up by the storm.

It is caught in vast numbers in England, Scotland, Ireland, and Wales, and is either used for cod fishing (for which purpose it is the most valuable bait), or is sent to Billingsgate market to be sold for food.

The London poor are very fond of the whelk. Visitors to Billingsgate shell-fish market, in the morning, may see hundreds of hawkers carrying away their purchases; these they take home and boil, and in the evening they go out into the streets and display their luxuries on a stall, opposite a tavern or some favourite corner. The fish are extracted from the shell and placed in little saucers, and sold at the rate of four or five a penny. Who of us is there, that knows London, but has watched the stall-keeper retailing shell-fish to his numerous customers? Nowhere is the whelk eaten so extensively as in London. This place alone causes employment to many scores or hundreds of fishermen at Ramsgate, Harwich, Whitstable, Grimsby, and many other places, and these do little else but collect whelks, which are put in bags and sent by rail or water to the metropolis.

In by-gone ages the Romans used a large turbinated shell, which we now call *Triton nodiferus*, as a war trumpet, or to call together the people to a meeting. (I am informed that the West Indian natives still use a large shell for similar purposes.)

This shell the Romans called "*buccina*," and hence Linné took the name *Buccinum*, under which generic title he included a large number of mollusca.

I propose to divide this paper on the whelk into four heads.

1st.—Its development. A, Physiological. B, Geological.

2nd.—Its habits.

3rd.—Its distribution. A, Geographical. B, Bathymetrical.

4th.—General Remarks.

Firstly, then, A,—Its physiological development.

I do not propose giving an elaborately detailed account of its structure or constitution, because this has been admirably done by Cuvier and others, and it would be too dry and uninteresting a subject for this meeting. All that I shall attempt will be to give the principal facts connected with its embryology and economy.

The whelk is oviparous. Its eggs are membraneous pouches or capsules. The parent generally deposits these capsules beneath, and attaches them to, a stone or oyster: they are, as a rule, about 300 or 400 in number, but occasionally as many as 500 or 600 may be found. They are always piled on each other and agglutinated, forming a vescicular mass, specimens of which are on the table. Each egg or capsule contains several hundred yolks, but this number is afterward so greatly reduced that only 20 or 30 fry come to maturity. Taking 400 as the normal number of capsules, and 25 as the average number of fry which arrive at maturity out of each capsule, would give us 10,000 young shells as the result of the spawn mass, the offspring of one pair of whelks in one season! The mode by which the reduction of the embryos takes place is disputed. Some Scandinavian naturalists assert that they amalgamate with each other. On the other hand an English naturalist (Sir John Lubbock), in a very interesting paper which appears in the "Report of the British Association," for 1860, states that he has ascertained that the larger and more advanced embryos swallow the other yolks.

In another genus of the family, namely *Purpura*, the yolks divide into segments, and the more advanced embryos swallow these segments one at a time.

When the fry are matured the capsules burst and liberate the inmates, who then commence the duties of independent existence. After a heavy storm these masses of capsules may be found on the shore. Sailors often collect them and use them for washing their hands. The spawning takes place during the winter months, and about two months are required for the development of the embryos. When emancipated from the capsule the fry have a shell with two whirls and an operculum. At this stage they certainly possess very little beauty. The blunt mamimiform spire, and the unsymmetrical finish, or more correctly *commencement* of the suture, give the shell an awkward appearance. The whelk requires two or three seasons to attain maturity, and certainly lives six yeaɹs, probably more, for I have obtained, from the deep water outside the Dogger-bank off Scarborough, full-grown living specimens of the large variety "*pelagica*" with four-year-old oysters attached to the last or largest volution.

The arrangement of the sexes in the mollusca is very interesting. The terrestrial gasteropoda (such as the garden snail) are monœcious, each individual possessing both sexes, yet incapable of self-fertilization. Some of the fresh-water gasteropoda, as "*Valvata,*" change their sex, first being male and afterwards female, and are capable of self-fertilization; whilst the whelk, and probably all marine gasteropoda, are diœcious, each individual being of one distinct and unalterable sex. The male whelk has a longer and slenderer shell than the female; the sex, however, cannot be determined by the shell.

The proboscis of the whelk is singular and interesting. It is a long conical and retractile member, which can be protruded two or more inches beyond the snout, or retracted into a chamber which is situated on the upper part or back of the animal. The length of the chamber is not one-half that of the proboscis it receives. At its base the proboscis is attached to the anterior part of the chamber, from the sides and posterior part ot which a number of muscular fibres radiate, having the other extremities attached to the inside of the proboscis. The contraction of these fibres draws the anterior part of the proboscis within the posterior part, in very much the same manner that a stocking is doubled back upon itself. By means of this highly ingenious piece of mechanism the space required for the reception of the proboscis is reduced one-half. Within this muscular sheath or proboscis is the lingual ribbon or tongue, which has lately received the name of "*odontophore.*" Upon it, most beautifully and regularly arranged, are numerous hard and pointed teeth, and, like all the odontophores of the gasteropoda, it is a very interesting object for microscopical investigation. Some systematists assert that the odontophore affords sure evidence of, not only *specific* and *generic,* but also of *family* distinctions. Professor Stimpson has lately raised Nassa from being a genus in the Buccinidæ to the type of a distinct family, which he calls Nassidæ (which includes the genus Columbella), solely on odontologial grounds, namely, "the arched form and very numerous denticles of the rachidian tooth."

B.—Geological development. Buccinum undatum first made its appearance during the epoch of the Coralline Crag, and is therefore geologically speaking a creature of yesterday. Since that epoch down to the present time it has become more and more abundant, and is now one of our commonest shells, living in countless millions in all our seas.

2nd—Its Habits. The whelk is a carnivorous predatory creature. Crawling over the sea bottom in search of dead fish or mollusca, it performs the duties of a scavenger. Having found a living mollusk (it seems to prefer a bivalve) it seizes it with its ample foot and by a semi-rotatory motion of the proboscis, in which is the armed tongue previously described, it drills a hole through the shell, killing and afterwards devouring the inhabitant. The length of time occupied in doing this of course depends entirely on the thickness of the shell operated upon. A thin shell, like *Mactra stultorum,* would probably be perforated in four or five hours, a thick cockle or "*Venus*" would take several days. What a wonderful instinct is here displayed by this humble creature ! With very low visual power it finds, with unerring accuracy, a living bivalve, and spends days of labour to accomplish its object. It is sufficiently sentient to detect whether the bivalve is living or dead before it commences its task. I have examined very large quantities of dredgings from all parts of the British seas, in which perforated bivalves are very common, yet never saw a stone or any foreign substance perforated, and no naturalist has ever recorded having done so, with but one exception. It was, I believe, Dr. Battersby, who narrates having found a spine of an Echinus which had been perforated by a whelk or one of the Muricidœ. When we take into consideration the smallness and the rudimentary character of the eyes of the whelk it certainly is very wonderful how accurately it searches out the living mollusca to feed upon. At low water of spring tides the whelk may be found. It burrows beneath the sand or mud, exposing only the end of its syphon, by means of which it obtains water or air. This hiding place is revealed by a little hillock, here it hides till return of tide, when it again wanders about in search of food, or perhaps to fall a prey in its turn to a cod, haddock, or other fish. It does not hibernate like many other mollusks, cold water is its proper habitat. It is supposed to possess the faculty of smelling. On the coast of Cheshire the fishermen place a dead dog or other animal at low water mark, and cover it over with a large pile of stones. At the next recess of tide the spot is again visited, and whelks are found on the stones, apparently attracted by the smell of the covered carcase. This supposed faculty of smelling seems to be more probable from the fact that the greater quantity of whelks are caught in the traps when the bait is *stale,* and the odour consequently stronger. Like its congeners the whelk crawls into the crab and lobster pots, and there frequently falls a prey to these crustaceans, who crack the whelk shell with their powerful mandibles and eat the contents.

3rd,—Distribution. A,—Geographical.

The whelk has a very extensive distribution in northern latitudes ; it ranges throughout the Celtic Boreal and Arctic Seas, and from Boreal America to Greenland. Its southernmost limit appears to be Rochelle, a French seaport in the Bay of Biscay. It is stated to have been found in the Gulf of Lyons, in the stomach of a fish (*Trigla gurnardus*), and I should feel no surprise if such were the case, as I have long thought it probable that in the great depths of the Mediterranean, where there would necessarily be a low temperature, the whelk may still survive. I say still survive, because, during the newer Pleiocene epoch, it lived in the Mediterranean, and we can gather from the fact that the climate of the South of Europe was much colder than it now is. As a warmer temperature came on the whelk died or retired to colder districts.

As connected with this phenomenon, it may not be out of place here to remark that other Boreal and even Arctic species formerly lived in Celtic and South European areas. Natica clausa and Cyprina islandica are found fossilized in Sicily. The southernmost limits in which the latter is now found living are the Channel Islands and opposite coast of France, and the former lives in the cold region of the North Cape. Tellina calcarea (or proxima), Pecten islandica, Trophon scalariformis, Columbella, holbollii, and others, lived in that part of the Atlantic which covered what are now the British Isles. These species are only found living in Arctic seas. Two species, namely, Arca pectunculoides (raridentata) and Leda pygmoea, still survive, being found living in the Hebridean and Zetlandic seas; they are apparently dying out in our districts. It is just probable that two other Arctic species linger, for the "British Association Dredging Committee" dredged fresh specimens of Terebratula spitzbergensis and Rhynconella psittacea off the west coast of Shetland last summer. This migration of the whelk and other species to colder seas would be an excellent subject for some other member of our Society to work up and give us a paper upon. It would involve many important subjects and considerations, and be of very considerable interest.

B.—Bathymetrical range.

In a paper which I had the pleasure of communicating to this Society last session, entitled "A few Geological considerations suggested by the peculiar character of the Molluscan fauna found living in the littoral zone of the Channel Islands," I drew attention to the great bathymetrical range of some species of mollusca. My object was to show that the depth at which any fossiliferous stratum was deposited could not, with any approach to accuracy, be determined by the character of the molluscan fauna found fossilized in that stratum. I pointed out that several species, Buccinum undatum, amongst others which were considered as characteristic of a depth of thirty or sixty fathoms, lived in great abundance at *low-water mark,* and that, with the exception of strictly littoral species, such as Littorina, Purpura, Patella, and the other Pulmoni-branchiata, all species had a very extensive range, and that no rule could with safety be laid down defining the bathymetrical zone in which species lived, and of which they were characteristic; for when the number of exceptions to a rule is more numerous than the instances of conformity to it, then I think the rule is of little value.

The bathymetrical range of the whelk is not fully known. It is found on the shore at low-water mark, and obtained at all depths to which the dredge has reached. I think it quite possible that it lives in the greatest depths of the North Atlantic. Abysmal influences, such as pressure, darknsss, cold, &c., would but little affect the whelk, whose system is *vascular* or traversed by canals, which are filled with water; the pressure at great depths would therefore not be felt. As regards light, its eyes are very rudimentary, and therefore the diminution or absence of light would not be greatly felt. Some genera of mollusca, as Lepeta, Chiton, Propilidium, &c., have no eyes. As concerns the cold, this is the true habitat of the whelk. Being entirely zoophagus its distribution would of course depend upon the distribution of other animals. It is therefore necessary that we should consider briefly the distribution of animal life in great oceanic depths.

I well remember, when beginning to read the rudiments of Geology, being struck with the following passage in Page's "Advanced Text Book,"—"According to experiments, water at the depth of 1000 feet is compressed 1-340th part of its own bulk, and under this rate of compression we know that at all great depths animal and vegetable life, as known to us, cannot possibly exist; the extreme depressions of seas being thus, like the extreme elevations of land, barren and lifeless solitudes." The inaccuracy of this statement will shortly be made manifest. Dr. Wallich, from the soundings in the North Atlantic Ocean, in 1860, obtained mollusca from the extraordinary depth of 680 fathoms, which is about three-quarters of a mile. He also obtained living star-fish (ophiocoma) at a depth of 1300 fathoms, or one mile and a half. It is therefore quite probable that the whelk ranges from the shore to the greatest depths of the North Atlantic Ocean. It would be extremely interesting and useful to science if, in any similar expedition to that which Dr. Wallich accompanied, the first fifty fathoms of the sounding line were converted into a fishing line ; hooks could be fastened on at every fathom and baited, similarly to a cod fishing line. When the sounding was determined, fifty fathoms of slack could be paid out and allowed to remain for an hour or so. By this means fishes, mollusca, and other animals might be found which are at present unknown, and our knowledge of the geographical and bathymetrical range of species be increased. The Hydrographer General would no doubt smile if he heard these remarks; nevertheless I fully believe such a plan would give very valuable scientific results.

4th.—General remarks.

The whelk has for many centuries been known and esteemed as an article of food. The Romans apparently acquired a liking for it, as whelk and oyster shells have been found at Richborough and other Roman stations. Formerly it was held in higher esteem than it is now. Dr. Johnston narrates that when William Warham was consecrated Archbishop of Canterbury, 800 whelks at five shillings per 1000 were bought for the enthronization feast. This was on the 9th of March, 1504. The quality of whelks as an article of food varies considerably. In some districts they are rank and of unpleasant flavour. Those caught in the Sandwich Flats near Ramsgate, and at Grimsby, Harwich, and Whitstable are considered by connoiseurs to be the best. Last year evidence was given before a Committee of the House of Commons that £12,000 worth of whelks are yearly captured on a sandbank in Whitstable Bay.

Messrs. Baxter and Sons, of Billingsgate, very kindly gave me the following statistics, which formed a part of their evidence to the Royal Fishery Commissioners, in 1863 :—

Quantity of Mollusca yearly sent to the London Markets.

1843.		1863.	
Whelks -	- 37,000 Bushels.	Whelks -	- 37,000 Bushels.
Winkles -	- 46,000 ,,	Winkles -	- 40,000 ,,
Muscles -	- 26,000 Sacks.	Muscles -	- 20,000 Sacks.

A sack weighs 200 lbs. A bushel of whelks weighs 84 lbs., of winkles 100 lbs. The following table will also no doubt be interesting to the Society :—

Quantity of Dutch and English Shrimps yearly sent to the London Markets.

1843.		1863.	
Dutch -	- None.	Dutch -	- 144,000 Gallons.
English -	- 72,000 Gallons.	English -	- 144,000 ,,
		Chiefly from Leigh and Harwich.	

The London bushel is equal to ten gallons. The quantity of whelks is, therefore, 370,000 gallons. Assuming a gallon to hold 150, the total number would be 55,500,000.

The largest specimens are found in deep water outside the Dogger Bank. I have a specimen which measures nearly six inches in length, and my friend Mr. Leckenby, of Scarboro', has one six and a half inches—the largest example known. The giants belong to the variety *pelagica,* which has a larger spire and smaller mouth than the typical form, and is thinner.

Cod, ling, haddock, and other fishes devour enormous quantities of whelks, and were it not for its astonishing fecundity it would speedily become a rare shell. The empty shells are generally occupied by a soldier crab, such as Pagurus bernhardus and Pagurus prideauxii.

There are several ways in which whelks are caught. At Tenby, and many other places, a hoop is crossed each way with cord, on this is laid a piece of dead skate or other fish. Many of these which are called "traps" are taken to sea in a boat and lowered to the bottom. Every six or twelve hours at slack tide they are pulled up, and the whelks thrown into the bottom of the boat. Sometimes several hundreds are taken by one "trap," on which they are found piled one on the other, their probosces sticking into the bait. At other times and places they are caught by means of a dredge, which is towed by a boat over the oyster beds and sand banks. Considerable numbers are caught by the cod fishing lines; in sucking the bait they are caught by the hook, which they richly deserve for such cannibalism as eating their own kind.

It is interesting to consider the vast quantity of carbonate of lime which is secerned by mollusca for the formation of their shells (to say nothing of zoophytes). At Ferryside, a village at the mouth of the Carmarthen River, about 500 tons weight of cockles are yearly obtained. As many as forty tons are despatched by rail in a week. If the shell be half the entire weight this would give 250 tons as the quantity of carbonate of lime secreted by cockles in this small locality every year. Then there are whelks, oysters, muscles, periwinkles, and a host of other mollusca which have heavier shells, and live in wonderful profusion. To Billingsgate market alone 5000 tons of mollusca, such as winkles, whelks, cockles, and muscles, are yearly taken. This would give 2500 tons of carbonate of lime. I have not the slightest hesitation in saying that the mollusca in the British seas yearly secrete millions of tons of carbonate of lime for their shell structure. Professor Liebig has determined that carbonate of lime constitutes 1-12400th part of the weight of the ocean; a very small proportion truly, but when we consider that 350 feet cube of sea water would, if my calculations are correct, weigh in round numbers 12,500 tons, and contain over one ton of carbonate of lime, we can easily realize what an all bountiful store of *house making* material the mollusca and other lime secreting animals possess. Near the mouths of large rivers, and the shore, no doubt a much larger proportion of lime than 1-12400th part would be held in suspension in the marine water. A great deal of the lime is washed from our hills by heavy storms, and carried far out to sea by the rivers, and a great deal is doubtless derived from the waste of the cliffs.

The whelk, like other abundant and widely-distributed species, wanders considerably from its typical form. Varieties are numerous; the principal ones will be found in the drawers on the table. A study of the abnormal forms of living species is very instructive to the Geologist, and prepares his mind for the occurrence of similar phenomena in his Palœontological investigations. Doubtless many of the fossils now considered by palœontologists to be *distinct species* are nothing more than aberrant forms or varieties of other species. Time and further research will, however, correct this.

One form of whelk, namely, *acuminatum,* is called a variety of *Buccinum undatum* by Messrs, Forbes and Hanley ; and my friend, Mr. J. Gwyn Jefferys, in his fourth volume of "British Conchology," calls it a "monstrosity" of that species. I take the word monstrosity to mean an irregularity or deformity, not a divergence from the typical form by insensible gradations as in the case of varieties. This irregularity is generally, if not always, caused by an injury to the animal in its earlier stages, and its commencement can nearly always be detected, one part of the shell being normal and the other aberrant. I am inclined to regard the "*acuminatum*" as a distinct species, my reasons for thinking so being, first,—that its form is regular "*ab ovo*" and persistent. Secondly,—It lives in company with the typical form at Whitstable, Harwich, and other places, thus proving that differences of habitat and food are not the causes of dissimilarity. Thirdly,—That in the above districts no intermediate form or gradual merging of one form into the other has been discovered, though millions of *Buccinum undatum* and several of *acuminatum* are yearly taken, this proves it not to be a variety. Mr. Jeffreys, in the introduction to his valuable and, by me, highly-prized work, says at page 19,—"I believe it may now be considered a well-establisbed rule that all distinct groups of individuals living together, and having a common feeding ground, and which are not connected or blended with each other by insensible gradations, are prima facie entitled to the rank of *species*." With this rule I perfectly agree, and, in my humble opinion, it proves the *acuminatum* to be specific. Some whelks have two opercula, others are sinistral : specimens of both are on the table.

The whelk is a much more valuable animal than it has credit for ; thousands of fishermen are supported by capturing it ; great numbers of persons in the metropolis obtain a livelihood, as before noticed, by selling it as an article of food. The carriage of it from the shipping ports brings the Railway Companies no small amount of revenue. Wherever it abounds cod are numerous, and if it became extinct, which fortunately is very improbable, cod, haddock, and other fishes would desert our coasts, and our fishermen would have to relinquish their calling.

Thus much then for the whelk. My paper, though long, has, I candidly confess, treated the subject very superficially, and many points which might fairly have been noticed, as relevant to the subject, I have been obliged to omit. Still I hope my contribution to the Society will prove neither uninteresting nor useless.

The author amply illustrated his paper by specimens and diagrams.

The CHAIRMAN, while inviting discussion, observed that Mr. Jordan's paper was certainly not uninteresting, and would not be useless if it induced any member to bring forward the paper for which the author had asked.

Mr. A. LEIPNER thought that the calculation with regard to the quantity of carbonate of lime in water must be modified, as one fourth part would be lost in burning the residue to get rid of the animal matter, or some other plan must be devised affecting that object. He also considered that the amount of lime varied with the climate, and he thought that when absorbed it was rapidly replaced by the action of sea water on rocks, or by fresh supplies brought down by rivers.

Mr. GEORGE HARDING, junr., then read the following paper entitled "A Note on the occurrence of the European Bee-eater, Merops apiaster, near Bristol," which he illustrated by stuffed specimens:—

The European bee-eater, *Merops apiaster*, is a bird of very rare occurrence in England, its first recorded appearance in the kingdom being in 1794, when a flock of twenty was seen at Mattishall, in Norfolk, one being shot. It was not observed again till 1807, when four specimens occurred in Cornwall. The next record we have of it is in 1820, two specimens being obtained in Ireland. In May, 1827, one was shot at Kingsgate, in the Isle of Thanet. In 1828 a flock of twelve was seen at Helston, several being shot. A specimen was shot near Chichester, on May 6, 1829. One in the Mull of Galloway, in October, 1832, this being its only recorded appearance in Scotland. One was killed at Brecles in the spring of 1835; one in Hampshire in the autumn of 1839; one near Sheffield in the spring of 1849 (this bird was described as a beef-eater); and one at Kingsbridge, Devonshire, in May, 1858. Previous to 1866 the above are all, or nearly all, the records we have of the appearance of the bee-eater in the United Kingdom. On May 5th, 1866, my attention was drawn to a small flock of these birds at Stapleton, and I had the opportunity of observing them for some six or seven hours. Four of these birds were shot, three of which are in my possession, and are now upon the table. When I observed them first several were at rest on the dead branch of a fruit tree, and the rest were hawking round for food, several at a great height. I was much puzzled to account for the appearance of such beautiful visitors, and my first impression was that the birds I saw were escaped from either the Zoological Gardens or from some aviary, but a few moments' observation was sufficient to disclose the real character of the birds. After resting a minute or so the whole took to flight, and the flock were all busily engaged bee hunting. As there were some sixteen hives of bees within about sixty yards of where I first saw them, and in addition swarms of wild bees all busily engaged in gathering honey from a large quantity of fruit tress in full blossom, the birds had little trouble in making captures, and they appeared quite satisfied with the quarters they had fallen upon, and, although three specimens were shot during the day, the rest remained in the neighbourhood till night-fall. I do not wonder that in countries where the bee-eater is abundant it is considered a perfect pest by persons keeping bees, as I am quite sure that some hundreds of bees were captured and eaten by the birds while I was observing them. How bees and wasps can be continually devoured without any injury to the birds has never been made quite clear; my own impression is that the end of the abdomen containing the sting is bitten off by the bird before swallowing the remainder: my reason for thinking so is that when a bee was captured the bird would soar aloft, carrying the bee, often a large Bombus, at the point or near the point of the bill, the bird would then circle round with wings and tail extended, much in the same manner as may so often be observed with the kestrel, the bee would be carried there for a minute or more and then suddenly swallowed. Mr. Yarrel thinks this interval is used simply to crush the insect, and render it powerless to sting; but it is well known that if the sting of the wasp or bee be detached altogether from the insect it is still liable to wound quite as painfully as before, that is supposing the poison bags be not separated from it. If, therefore, the bird does not get rid altogether of the sting in the way I suppose, the only conclusion we can arrive at is that there must be some peculiarity in the structure of this and several other birds that render them indifferent to the poisonous influences of the sting, as they evidently possess perfect immunity of danger from this cause.

The occasional appearances of the bee-eater in England is caused doubtless by birds being driven by adverse winds from their usual course during their annual migration.

The home of the bee-eater, like the swallow and many other of our migratory birds, appears to be Africa, over which continent, it is probable they are pretty generally distributed, as specimens shot at the Cape of Good Hope appear quite identical with European ones. They are extremely abundant in those countries of Africa that border upon the Mediterranean. In April the annual migration takes place, and the birds distribute themselves in small flocks all over Southern Europe, being most abundant in Spain, Italy, Greece, and Turkey, whilst stragglers find their way often to France, Germany, and Switzerland, and occasionally, as we find, to the British Isles. With regard to the nesting of the bird nothing is known as far as our country is concerned, the stay here being generally limited to a day or so. Latham says that in the neighbourhood of Gibraltar they make a nest b y excavating a hole in soft sandy banks, penetrates 3 feet horizontally, then turning at right angles three feet further, the end is made larger to admit of the bird's turning easily; no nest is formed, but the eggs (which are pure white, and from five to seven in number), are laid on the bare ground. They are said to breed in immense numbers in the high sand banks of the Wolga and other great rivers in Southern Russia.

The flight of the bee-eater is, I think, more graceful and beautiful than any bird I have ever seen on the wing, the resplendency of its plumage, especially in the sunshine, adding greatly to the beauty of its appearance. It can turn in full flight with equal facility to any of the swallows. Lieutenant Blakiston, in his notes on the birds of the Crimea, says of this species,—"I had the long wished for satisfaction of riding to the Alma and back, on a hot day, at the end of May, and it chanced to be my last opportunity of observing several species of birds, among them was the bee-eater, and I only wish it was in my power to describe the graceful motions and beautiful appearance of the bird. I thought at the time that it was the nearest to perfection in flight and plumage combined, that I had ever seen. There were numbers about the rivers Belbec, Katcha, and Alma, which we crossed on the way, and at the second I observed some going in and out of holes in the high banks over the river, evidently their nests. At times they would hang upon the wing without any apparent motion." In the young birds the colours are said to be not nearly so brilliant as in the adult. A first year's bird, described by Mr. Yarrel, had the top of its head green, no reddish colour on the back, and no black round the neck, the tail feathers being all of the same length, whereas in the adult the central pair of feathers extend beyond the others. The female may be distinguished from the males by the paler hue of the reddish yellow on the throat.

I am aware that I have been able to bring forward very little that is new with respect to the natural history of this beautiful bird, my only reason for bringing it forward at all being Mr. Leipner's representation that the occurrence of such a splendid addition to our local fauna should not be passed over without some notice of it being brought before the society.

The CHAIRMAN observed that the Society would have been much obliged to Mr. Harding, for showing his beautiful stuffed specimens, even if he had not read his interesting notes.

Mr. HARDING, in reply to inquiries, remarked that the Bee-eater has a chirping note but no song. It eats on the wing, destroying wasps and even hornets, and swallowing bees entire.

Mr. LEIPNER observed with regard to the bee's sting, he should judge of it by its effects on ourselves, and he thought the true explanation of the immunity of the bird from injury would be found in the horny nature of its bill, tongue and mouth.

The CHAIRMAN thought Mr. Harding's suggestion the most probable.

Mr. W. L. CARPENTER thought that the poison would be innocuous, as it would not enter the blood without undergoing a change, and that as to the mechanical parts of the sting, such as the barb, they would inevitably be crushed by the powerful bill of the bird.

Mr. E. WILLOUGHBY then read a paper on Captain Schultze's White Gunpowder.

After describing the various ancient weapons of war and their gradual improvement, the author went on to speak of ordinary Gunpowder.

This is a chemical mixture of nitre, charcoal, and sulphur, in empirical and varying proportions, but usually approaching those represented by the formula, $2(No.^5, KO)^2 + 3C + SL$, or two atoms of nitrate of potassa to three of carbon and one of sulphur. On ignition these may be said to form $3(CO^2) + 2N + KS^3$, or three atoms of carbonic acid gas and two of nitrogen gas, leaving one atom of solid sulphide of potassium ; but in reality the decomposition is far too complex to be represented by an equation. To insure the desired decomposition the ingredients must be uniformly mixed into a properly homogeneous mass, and on the mechanical form of the resulting compound depends the rapidity with which the decomposition takes place. The denser the mass the slower will be the combustion.

Every step in the manufacture of this substance is attended with the greatest danger to human life, it is therefore desirable that some substitute should be found for it. Gun-cotton has been proposed for this purpose, but, on account of the difficulty in retarding its combustion, it has been almost entirely abandoned, and, from its being a definite chemical compound, it is also impossible to adapt it to all the requirements of industry and war. Nitro-glycerine has likewise been used in place of gunpowder for certain purposes, but this possesses all the disadvantages of gun-cotton to an exaggerated degree. If any new substance be found to replace the black powder it must possess the pliability of the time-honoured agent. It must be able to furnish varieties corresponding to the existing sporting, rifle, artillery, and blasting powders. These are essential; absence of smoke and residue are highly desirable.

All these requirements seem to be fulfilled by the powder of Captain Schultze. In the manufacture of this powder the wood is deprived, as far as possible, of its hydrogen, but the oxygen and carbon is retained. It is then mixed with certain substances which generate abundantly oxygen and nitrogen, but unincumbered by potash and sulphur. All the ordinary forms of powder can be produced by this process, smoke and residue are reduced to a minimum, and moreover the explosive power is greater than that of common gunpowder. The manufacture only occupies a few days, and is entirely free from danger until the "finishing" is performed by moistening the powder with a certain solution. This and the subsequent drying process can be performed at any time. Three millions of tons may be kept without the slightest risk, a small quantity only being "*finished*" at a time when wanted. Even when finished it does not explode except under pressure or in a close chamber, though when it does explode its effects are more powerful than those of ordinary powder.

Major T. Austin then burnt some of Schultze's powder in an éprouvette, but as it required much compression to show its force, it merely burnt out of the touchhole without exploding.

Mr. E. A. Præger thought that the system of preparing powder for use in time of war, was very absurd. He did not think that Schultze's powder would answer, from its requiring to be finally prepared so soon before using, and he considered it to be in that, and other particulars, decidedly inferior to Neumeyer's.

Mr. Willoughby, in reply, said that Shultze's powder need not be "finished" FIRST before being used, and that then it was on a par with Neumeyer's.

Mr. W. L. Carpenter inquired if either of these powders had been used for breech-loaders, as in them there would be no ramming. Mr. Præger and Mr. Willoughby did not know whether these powders had been so used. Mr. Præger thought that Neumeyer's had not been, and could not be used in breech loaders.

The Chairman observed that such questions could not be settled there, they must be decided by practical men.

MEETINGS OF SECTIONS.

ZOOLOGICAL SECTION.

January 9th, 1868.—Dr. Fripp, President of the Section, in the chair.

The audited cash account for 1867, was read and passed, showing receipts, £3 10s. 1d. (including a balance of £2 7s. 7d., from 1866), and expenditure, £2 5s. 2d. (including £1 6s. paid for Vol. 1 of "Gunther's Zoological Record," which was presented by the section to the Society's Library), thus leaving a balance in favour of the section of £1 4s. 11d.

It was unanimously decided to continue the meetings of the section, and several papers were promised for the current year.

Dr. Fripp was re-elected President, and Mr. S. H. Swayne, Secretary of the section.

It was determined to purchase Vol. 2, of "Gunther's Zoological Record," for the Society's Library.

ENTOMOLOGICAL SECTION.

January 14th, 1868.—Mr. S. Barton, President, in the chair.

After the minutes of the last meeting had been read, the Treasurer's account for the past year was audited and presented. This showed a small balance due to the Treasurer, but it was explained that one or two subscriptions were still out-standing, which, when collected, would nearly cover the adverse balance. The accounts having been agreed to, the members present proceeded to elect a President and Secretary for the ensuing year. The retiring officers were re-elected, with votes of thanks for past services. It was resolved that the two magazines for 1867, should be bound for presentation to the Society's Library.

Mr. J. B. Butler, then exhibited a drawer containing a number of rare species of Lepidoptera, among the most noticeable of which were the following :—

Argynnis lathonia.
Vanessa io, (fine variety).
Sesia chrysidiformis.
,, scolicœformis.
Heterogenea assella.
Chelonia caja (3 varieties).
Dicranura bicuspis.
Stauropus fagi.
Petasia nubeculosa.
Acronycta strigosa.
Xylomiges conspicularis.
Pachetra leucophœa.
Agrotis cinerea.
Noctua subrosea.
Dianthœcia cœsia (a new species recently captured in the Isle of Man).
Heliothis armigera.
,, peltigera.

We are pleased to announce that the number of members in this section has increased during the past year.

BOTANICAL SECTION.

JANUARY 17th, 1868.—The Members assembled at the residence of Mr. Lobb, Cotham Brow.

After tea, Mr. S. Derham was voted to the chair, and the accounts for the previous year having been read and audited, the consideration of them and the other business of the Annual Meeting was adjourned until February, and the present converted into an ordinary one.

The Honorary Secretary, Mr. YABBICOM, exhibited a living specimen of Asplenium Nigrum, from Devonshire, and explained the fructification by a portion mounted dry, as an opaque object for the microscope.

It was requested that all Members, when they had an opportunity, would contribute to the Meetings specimens or short communications.

Mr. LOBB showed some specimens of Mosses from this neighbourhood, and other localities, well in fruit.

The same gentleman also exhibited a collection of Marine Algæ, from Malaga, on the Mediterranean, collected between November and March, 1851-52, by Mrs. Lingford, named and arranged by Lady Tennyson. Among a large number of specimens, the following, Nitophyllum uncinatum and Callithamnion trocherii, have not been found in England, and many others but very rarely, as

Rytiplœa complanata
Haliseris polypodioides
Dudresnaia coccinea
Gigartina Teedii

while others commonly found with us have not been recorded previously so far south as Sphacelaria plumosa, and Lyngbia majescula. In many the normal form showed considerable modification, the change being probably as much due to the habitat as to the latitude.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

Vol. III. FEBRUARY, 1868. No. 2.

GENERAL MEETING.

THURSDAY, FEBRUARY 6th.—Mr. THOMAS PEASE, F.G.S., one of the Vice Presidents, in the chair.

The HON. SECRETARY, Mr. A. Leipner, read the minutes of the last meeting, which were confirmed. He then said he regretted to announce that the Society had lost one of its most valuable members, Mr. Alfred Noble, F.C.S., who had recently died in London, at the early age of thirty-four years. Most of them, he continued, knew the deceased gentleman as a very indefatigable member of the Society. For two years he had been Secretary of the Chemical Section, and had several times contributed valuable Papers both at the General and Sectional Meetings. It was also announced that at the last meeting of the Council the Rev. D. M. Claxton, M.A., had been elected an ordinary member of the Society, and that the Council recommended to the Society an alteration of Rules 2 and 9, whereby ladies might be admitted into the Society, under the style of Lady Associates.

The CHAIRMAN, in putting the motion for the proposed alteration in the rules to the meeting, observed that the subject of admitting lady associates had been a good deal discussed by the Council, and they were unanimously of opinion that such a class of members should be formed. It was true that ladies were now admitted to the meetings of the Society, but many ladies felt that they would rather join the Society, and thereby do something to promote its welfare, although it might be only in the shape of payment, than merely attend the meetings as invited guests.

In reply to a question it was stated that ladies would not be eligible as members of the Sections, but would be entitled only to attend all the General Meetings and to have a copy of the Proceedings.

The motion, having been put, was carried unanimously, but subject to being confirmed at the next meeting of the Society.

Dr. Henry Fripp then read a Paper on "The Anatomy of the Retina and the Physiology of Vision," which was illustrated by numerous drawings.

The report of this elaborate and interesting Paper is, at the request of the author, postponed to a future number of the Proceedings.

Owing to the lateness of the hour at which Dr. Fripp concluded his remarks, a communication from Dr. Beddoe, on "The Measurements of the Human Body for Ethnological purposes," was postponed until the next meeting.

MEETINGS OF SECTIONS.

GEOLOGICAL SECTION.

January 23rd, 1868.—Mr. W. W. Stoddart in the chair.

The Accounts for the year 1867 were read and passed, showing a balance in favour of the section of £1 3s. 4d.

The President, Mr. W. Sanders, F.G.S., was unanimously re-elected.

It was proposed by Mr. F. Ashmead, and seconded by Mr. C. F. Ravis, and carried unanimously "That Mr. A. C. Pass be Secretary for the present year."

Resolved that the sum of one guinea be presented to the funds of the Library of the Parent Society.

The Hon. Secretary reported the number of members of the section the same as last year, 23. The Secretary also read a list of papers contributed, and walks taken during the year, and stated that the *Geological Magazine* had been regularly circulated.

Mr. Gillford exhibited some fossils from the lias for naming.

There being only a few members present, Mr. C. F. Ravis's Paper on "Denudation in the Bristol District," was postponed to the next meeting of the Section.

FEBRUARY 27TH, 1868.—The minutes of the preceding meeting having been read and confirmed,

Mr. C. F. RAVIS read his Paper on "Denudation in the Bristol District," which had been postponed at the last meeting. After some preliminary remarks, the author went on to say—Two chief principles in the theory of denudation have been laid down. The first some years ago by Sir Charles Lyell,—namely, that the amount of waste of previously existing rocks is exactly equal to that of the deposition of new strata.

A good illustration of this principle in our own neighbourhood is presented by the condition of things at Aust Cliff. The beach there is strewn with large masses of stone which have fallen from time to time from the cliff. These masses are in process of formation into a bed of conglomerate, which will one day, unless the stones be removed by human agency, constitute a distinct stratum, extending as far into the bed of the Severn as the action of the waves is capable of conveying the stony fragments.

Such a conglomerate would be made up of red marle, blocks of the "Bone Bed," masses of the ostrea and other molluscan beds, fragments of gypsum, and the other substances now composing Aust Cliff. In the meantime the cliff is wasting away by the combined action of the sea at its base, and the atmosphere, with its various agencies, on the upper portions, so that the denudation of the old strata keeps pace with the deposition of the new.

The other principle of denudation is that which is so clearly and ably laid down by Professor Ramsay in his article on the subject, in "The Memoirs of the Geological Society," vol. I. The object of this principle is to determine the probable *amount* of waste to which the older strata have been subjected, by restoring in section the rocks as they formerly existed above the present surface.

After insisting on the necessity of having sections of the existing rocks constructed on a true scale, the Professor explains that the depth to which rocks descend below the surface may be determined by continuing the line of dip where strata disappear to the re-appearance of the same strata at a distance in conformity with the curves which are seen in the existing beds.

Thus, if strata be seen to dip at a certain angle, and to disappear below the surface, and strata of the same kinds are seen to re-appear in a distant part of the country with a dip in the opposite direction, the surface of the intervening tract being occupied by rocks of a more recent age, the inference is fair that the inclined strata are continuous under ground, and by connecting the beds at the two extremities by an imaginary line, we get a probable section of the strata below the surface. Presuming this inference to be legitimate, it may with propriety be applied to explain the phenomena connected with contorted strata, the upturned edges of which are frequently far apart.

Applying this principle to the rocks in our own neighbourhood, I cannot do better than avail myself of one of Professor Ramsay's sections. The section is marked by a line drawn through Dundry Hill, crossing the River Avon, and passing by Durdham Down to Blaize Castle, and terminating the flats near the Severn.

In this section, the old red sandstone, the carboniferous limestone, and the coal measures are seen to be conformable, and if lines are drawn in accordance with the dips and curves exhibited at the surface, it will be seen that the strata now denuded must have attained a height of nearly 8000 feet above the existing sea level.

The carboniferous strata through which this section passes, is continuous on the surface, by Westbury and Henbury; although interrupted on the line of section by patches of old red sandstone and magnesian conglomerate, the former showing that the whole of the carboniferous limestone has been removed, laying bare the inferior rock, and the latter exhibiting a superficial deposit of new conformable strata, which must have been laid down after the older strata had been removed, the deposit of magnesian conglomerate lying between the two arms of the range of limestone, being probably newer than the carboniferous limestone, (since it is largely made up of the debris of that rock), rests immediately upon the old red sandstone. The new red marl, overlain by the lias and the inferior Oolite, at Dundry, also occupies a similar position with reference to the carboniferous limestone. It is therefore clear that in the one case the carboniferous limestone with the superincumbent coal measures, and in the other the coal measures themselves have been removed by denudation, prior to the deposition of the overlying secondary rocks.

Our own City and Suburbs present a most instructive illustration of the effects of denudation in modifying the contour of the ground. The old city stands on low flat land, consisting mainly of new red sandstone; the range of hills on the west and north-west, on which are built the suburbs of Clifton, Redland, Montpelier, Cotham, Kingsdown, &c., consists partly of the older carboniferous strata and partly of lias, which has escaped the denudation to which the foundation of the old city has been subjected. This exemption of the lias from the fate of its once continuous beds, seems to be greatly owing to its being backed by the harder and less yielding rocks of the carboniferous series, and partly to causes dependant upon the direction and comparative violence of currents in the seas, which affected the removal of so much solid matter from our neighbourhood. The great line of the denudation of the lias extends in a north-easterly direction from the city, and has an average breadth of about a mile. Skirting the lias at Ashley, and Montpelier, it forms an extensive bay sweeping round by Horfield, Redland, and White-ladies, to Cotham, there pursues its course in a wider channel, by the east side of the city, and curving round towards the south-west by Bedminster, expands into the great valley running by Ashton and Nailsea, to the moors, bordering the Bristol Channel. In the midst of this line of denudation are numerous masses of lias which have escaped the denuding influences, but which bear on their surface marks of the violent aqueous action to which they have been subjected.

The Author concluded a long and interesting paper by a short reference to the topics of the Sequence of Geological Phenomena, and the Marks and Agencies of Denudation.

ENTOMOLOGICAL SECTION.

FEBRUARY 11TH, 1868.—The President of the Section, Mr. S. BARTON, in the chair.

Mr. A. E. HUDD, exhibited a bred specimen of *Cuculia gnaphii*, an insect of extreme rarity in England. This specimen was bred from a larva taken at Tilgate, in 1866, by Mr. E. G. Meek; Mr. Hudd also showed a specimen of *Acidulia rubricata*, a rare species, a few examples of which have occurred from time to time on the South and South-eastern coasts.

The PRESIDENT exhibited several splendid species of *Anthophagus*, a genus of foreign Coleoptera.

Mr. J. W. CLARKE (in the absence of the Hon. Secretary on account of indisposition), read a note on *Vanessa levana*, illustrated by specimens, showing the differences between vernal and autumnal broods of this insect, Linnæus described them as distinct species, naming them *V. levana* and *V. prorsa*. Since his time they have always been regarded as distinct, until last year, when their specific identity was placed beyond all doubt, by rearing several individuals from the egg.

ZOOLOGICAL SECTION.

February 13th, 1868.—The President, Dr. Henry Fripp, in the Chair.

Mr. A. Leipner occupied the evening with a Discussion on the Classification of the Mammalia, with special reference to the several systems proposed by Cuvier, Owen, Huxley, and Dana. After pointing out the great advance made by Cuvier's system on those which preceded it, he went on to explain the characteristics of the above four systems, pointing out the advantages and short comings of each.

BOTANICAL SECTION.

Thursday, February 20th.—On this occasion the members were entertained by Mr. W. Sanders, F.R.S., F.G.S., President of the Parent Society, at his residence, Richmond Terrace.

Subsequently the adjourned Annual Meeting was held, at which Mr. Sanders presided. The Honorary Secretary presented the audited Accounts for 1867, showing a small balance in hand, and made a statement relative to the probable expenses for the current year. On the motion of Mr. Halsall, seconded by Mr. Derham, the usual subscription of One guinea was voted to the library fund. Mr. J. W. Clarke proposed, and Mr. Derham seconded, "That Mr. Leipner, as President of the Section, and Mr. Yabbicom, as Honorary Secretary, be requested to continue their services for the present year," which was carried unanimously.

Mr. Leipner mentioned a communication from a gentleman relative to a specimen of Wellingtonia, nine years old, which, being transplanted, died. Upon a transverse section being made of the stem it was found that nine concentric rings had been formed in the year, contrary to the theory of only one being formed annually. Mr. Leipner entered into an explanation of the cause of these appearances in the stem, but said that without further information it would be premature to come to a result which would be antagonistic to preconceived theory.

Mr. LEIPNER made a verbal communication on "The Mosses of the Bristol District." He said the locality seemed, as far as it had been worked, to be a very productive one for the study of Muscology, and he had been led to the investigation of it two or three years ago in consequence of having it in contemplation to publish a work on this branch of Botanical science. On one day in January he discovered, in Leigh Woods, thirty-nine species and two varieties, and altogether the district yielded about one hundred species, most of which he had discovered himself, and the remainder had been found by Miss Attwood. There still remained several portions not yet thoroughly investigated, and, as some mosses are extremely local in character, it was thought that more might yet be discovered. The narrow limits of the habitat of Grimmia orbicularis and of some other rare species was noticed. Mr. Leipner accompanied his remarks with a specimen of every species hitherto found in the neighbourhood, of which the following is a list:—

Phascum cuspidatum
Pleuridium subulatum
Wessia viridula
„ mucronata
„ cirrhata
Dicranella varia
„ heteromalla
Dicranum fuscesceus
„ scoparium
Lencobryum glaucum
Fissidens bryoides
„ pusilluo
„ incurvus
„ adiantoides
„ taxifolius
Pottia truncata
Didymodon rubellus
Ceratodon purpureus
Leptotrichum flexicaule
Trichostomum rigidulum
„ crispulum

Barbula cavifolia
„ aloides
„ unguiculata
„ fallax
„ vinealis
„ convoluta
„ tortuosa
„ muralis
„ d. rupestris
„ b. incana
„ subulata
„ latifolia
„ ruralis
Cinclidotus riparius
„ b. terrestris
„ fontinaloides
Grimmia apocarpa
„ orbicularis
„ pulvinata
Racomitrum lanuginosum
Zygodon viridissimus

Orthotrichum anomalum
,, saxatile
,, affine
,, diaphanum
Tetraphis pellucida
Encalypta vulgaris
Funaria hygrometrica
Leptobryum pyriforme
Bryum carneum
,, atropurpureum
,, cœspiticium
,, argenteum
,, capillare
Mnium undulatum
,, rostratum
,, hornum
Atrichum undulatum
Pogonatum aloides
Polytrichum formosum
,, juniperinum
,, commune
Fontinalis antipyretica
Neckera crispa
,, complanata
Homalia trichomanoides
Leskea polycarpa
Anomodon viticulosus
Thuidium tamariscinum
Isothecium myurum
Homalothecium sericeum
Brachythecium glareosum
Brachythecium rutabulum
,, populeum
Eurhynchium myosuroides
,, circinnatum
,, striatum
,, striatulum
,, piliferum
,, prælongum
,, Stokesii
,, Swartzii
,, pumilum
Rhynchostegium tenellum
,, confertum
,, murale
,, rusciforme
Thamnium alopecurum
Plagiothecium denticulatum
,, sylvaticum
Amblystegium serpeus
,, riparium
Hypnum stellatum
,, fluitaus
,, cupressiforme
,, b. filiforme
,, molluscum
,, cuspidatum
,, purum
Hylocomium splendeus
,, squarrosum
,, triquetrum

In consequence of the lateness of the hour, Mr. Yabbicomb's paper was postponed.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

Vol. III. MARCH, 1868. No. 3.

GENERAL MEETING.

THURSDAY EVENING, MARCH 5th, 1868.—Mr. S. H. SWAYNE, M.R.C.S., occupied the chair.

The minutes of the previous meeting having been read and confirmed, the resolution passed at the last meeting for an alteration in the rules, by which ladies will be eligible for election as members of the Society, was unanimously agreed to by the members present.

DR. BEDDOE made some remarks on the methods of measuring the Human Body for ethnological and other purposes. The general drift of his discourse was to show the difficulties that lie in the way of establishing satisfactory and uniform systems of measurement, and the nugatory results of much laborious and conscientious work that has been done in this department, owing chiefly to the want of definition and agreement in the systems employed—For example, the measurements of the girth of the chest obtained at British recruiting stations are almost useless for scientific purposes, although the directions given by the Department appear all that could be wished: in this case the variations depend chiefly on the different degrees of tightness with which the measuring tape is applied. The existence of the variations, and their approximate magnitude, is demonstrated by such facts as the following,—equal numbers of men, born in the same province, and yielding the same average height and weight, gave an inch or even two inches more of girth at one recruiting station than at another.

He proceeded to discuss certain points respecting the measurement of the living head. Measurements from the prepared skull are of course vastly more valuable than those from the head, by reason chiefly of the absence of integuments and the visibility of the sutures; but skulls from races dwelling in remote regions are difficult to procure, and in civilized countries like our own, the respect felt for the dead body hinders the attainment of skulls fairly representing the average national type, those in our public and private collections having mostly belonged to convicts or paupers. We are therefore driven to the inferior but easily obtained material derivable from the living population.

Dr. Bush's instrument, and his process for obtaining with it radial measures from the meatus auditorius taken as a fixed point, were shewn to involve certain practical difficulties when applied to the head—The author employed only index callipers and a measuring tape. He always registered from several measurements of length, partly in order to render his own results comparable with those of other observers, partly because it was possible in this way to obtain some idea of the convexity of the forehead and the hindhead. He also took the breadth at several points, choosing those which are most certainly recognizable, so that one head might be fairly compared with another. Such points are, for length, the occipital tuberosity and the glabella, which latter he took to be the elevation between the superciliary ridges; and for breadth that of the greatest width, (the position of which relatively to the meatus appeared to be of value as a race-distinction) the greatest expanse of the zygoma ; the point of least width about the junction of the frontal and malar bones, and a point above the root of the zygoma and close to the anterior termination of the helix : this last he believed to be hitherto his own peculiar property, but it was a very convenient substitute for the meatus, the insertion of callipers or other instruments into which was not generally relished by the person operated on. He attempted to acquire some idea of the vertical development of the skull by means of two curvilinear measures, one from the nasal root to the occipital tuberosity, the other from the meatus to the other across the summit of the head. The circumference he took at several points, corresponding with those from which he obtained measures of length.

He concluded by exhibiting a remarkable publication by Professor Fitzinger, of Vienna, containing drawings of the so-called Avar Skulls found near Baden, in Austria.

The Chairman, in inviting discussion, said that the difficulties attending the subject were very great. He did not think that the shape of the skull by any means indicated the capacity of the brain case, and that skulls of diverse shapes might contain the same amount of brain.

Mr. E. A. PRÆGER inquired if Dr. Beddoe had used a tape in taking the measurements he had described? If so, he thought they would be very liable to error, on account of the stretching of the tape and other causes.

Mr. W. L. CARPENTER asked if the measurements of the external form of the head had been compared with those of the cubical contents?

Dr. HUDSON inquired what amount of error the stretching of the measuring tape would cause? Also, if there was as great a difference observable in measurements of the skull in individuals of the same race, as in those of different races?

Mr. H. K. JORDAN asked if the size of the head and the weight of the brain gave any index of intellectual capacity?

Dr. BEDDOE, in reply, said that he had used tape in making his measurements, but he had found that the errors arising from its stretching were very small indeed, and that the other sources of error he had pointed out were much more important. With respect to the differences in size of the head in individuals of the same race he had found them to be quite as great as between individuals of different races. With regard to the size of the head and weight of brain being indications of intellectual capacity, he believed it to be the rule, but there were many exceptions.

Mr. ADOLPH LEIPNER, the Hon. Secretary, then made the following communication on "Proteus anguinus:"—

Proteus anguinus, two specimens of which have been kindly lent to me by the Rev. W. W. Spicer, is a Batrachian belonging to the Division Batrachia Gradientia, or walking batrachians, of which the common newt is a familar example. It is found in various parts of the Austrian dominions. The specimens on the table were obtained in the Grotto di Madelina, at Adelsberg, near Trieste.

They are usually observed either in the water of, or crawling on the margin of, a small pond in the centre of the cave. This, however, is evidently not their true habitat as they are only found there after heavy rains. It is supposed that their natural abode is a large subterranean lake, lying between Adelsberg and Laybach, and that they are forced by the rains through the crevices of the rocks, until they find an exit in the small pond already mentioned, and in a similar one in a cave at Laybach.

The Proteus differs from nearly all other batrachians in not undergoing a metamorphosis, thus retaining its external gills through life in conjunction with internal pulmonary sacs.

For this reason it was long considered a larval form, but its osteology proves the contrary.

The head is flat, and somewhat anguiform; the eyes are covered by the skin, being only marked externally by small dark spots; the gill tufts are two in number, one on each side, as in fishes; the heart in this and other batracia with persistent gills, has only two cavities differing in this respect from that of all other reptiles, which has three.

When the animal is kept in its normal condition—of almost total darkness—the gills are of a beautiful bright red, and when placed under the microscope, the circulation of the blood in them can be well seen. If the creature be exposed to day-light, however, the gills become nearly white on account of the contraction of the vessels not permitting the passage of the blood, its corpuscles being exceedingly large. The corpuscles of the blood in man are the $\frac{1}{4000}$ of an inch in diameter, those of the Proteus are about fifteen times larger, being the $\frac{1}{340}$ of an inch. Several unfounded statements have been promulgated with respect to this creature. One is that it is viviparous. Its mode of reproduction is, it is true, quite unknown, but it is most unlikely that it brings forth its young alive. Another is that it feeds upon mollusca. The real truth of the matter is that no one has ever seen the Proteus eat.

Dr. Lionel Beale, who kept several for five years, could never during that period get them to eat anything, and yet they apparently flourished. My own observations confirm those of Dr. Beale on this point. Two specimens which were kindly lent to me by Mr. Joshua Saunders, and which I kept for some months, would never eat, and yet when I returned them they were in just as good condition as when first received.

A vote of thanks to the Rev. W. W. Spicer, for his kindness in lending his specimens of Proteus, concluded the proceedings.

The following additions have been made to the Society's Library:—

The Zoological Record, vol. II., from the Zoological Section.

The Proceedings of the Quekett Microscopical Club, from the Club.

The Naturalists' Note Book for March, 1868, from the Publishers.

MEETINGS OF SECTIONS.

ENTOMOLOGICAL SECTION.

TUESDAY, MARCH 8TH.—The President, Mr. STEPHEN BARTON, in the chair.

The President exhibited a box containing a large number of species of Phytophagus collected by himself in Australia. There were several hundred specimens, and they caused much interest among the members of the Section.

The Hon. Secretary exhibited specimens of about forty species of Eupithecia, including all the species occurring in the Bristol district.

It was determined that the next monthly meeting should be held at the Institution on April 7th, the first Tuesday in the month, the usual evening for meeting falling upon Easter Tuesday.

A conversation then took place with respect to the summer excursions, but ultimately the matter was deferred to the next meeting of the Section.

ZOOLOGICAL SECTION.

MARCH 10TH.—In consequence of the limited attendance, the meeting was postponed until next month.

GEOLOGICAL SECTION.

MARCH 11TH.—Mr. E. HALSALL in the chair.

Two new members were elected, and it was decided to arrange the programme for the Summer Walks at the next meeting.

Mr. Stoddart showed a remarkably fine slab from the lower limestone shales of Cook's Folly, covered with small fossils, viz.:—*Ceriopora rhombifera, Retzia radialis, Retepora prisca,* and several undetermined species.

Mr. Blackmore exhibited specimens of two corals, Cyathophyllum regium and Lonsdalia floriformis, and Mr. Prangley showed a fine specimen of *Coralloides amplexus.*

BOTANICAL SECTION.

March 19th.—Mr. A. Leipner, President, in the chair.

The evening was occupied in preparing specimens for the Herbarium.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

Vol. III. APRIL, 1868. No. 4.

GENERAL MEETING.

Thursday Evening, April 2nd, 1868.—Mr. S. H. Swayne M.R.C.S., in the chair.

The minutes of the preceding meeting having been read and confirmed,

The Hon. Secretary, Mr. Adolph Leipner, announced that at the next meeting of the Society a new rule would be proposed for the consideration of the members, which it was hoped would prevent the occurrence in future of the difficulty now experienced in collecting the subscriptions. He then stated that the members would be no doubt interested in learning that one of the vultures at the Zoological Gardens had laid an egg, it being an exceedingly rare thing for birds of prey to breed in confinement. He also exhibited a remarkably large specimen of the house spider "*Tegenaria domestica*," which had been captured near Henbury.

The Hon. Reporting Secretary, Mr. T. Graham Ponton, then exhibited two specimens of some very beautiful photographs of natural flowers which have been recently brought into this country from Germany. The photographs are coloured by hand, and are executed by Friedrich of Prague.

Mr. Adolph Leipner then read a Paper, of which the following is an abstract, on the Mammalian skulls and other specimens collected in Burmah by Mr. W. Theobald, jun., of the Geological Survey of British India, and recently presented by him to the museum of the Institution, with notes by the donor.

MAMMALIA.

The order Bimana was represented by two skulls of Burmese.

Of the order Quadrumana there was but one example, a head of the Entellus monkey, (*Presbytes entellus*) which is an exceedingly common animal in India, the specimen exhibited was obtained in Bengal.

The next order the Carnivora was well represented by—

Canis aureus, the jackal, from the Punjaub, two skulls of which were shown. These, Mr. Leipner remarked, exhibited the typical dentition of the family exceedingly well.

Helarctos malayanus, the Sun-bear, and *Helarctos tibetanus,* of both of which skulls were exhibited. The first of these is the only species of bear found in Burmah, where it is very common, and commits great ravages among the fields of Indian corn. It is arboreal in its habits, and often tears open trees with its teeth for the sake of the honey contained inside. This bear is easily tamed, and Sir Stamford Raffles kept one for a long time, which used to run about his nursery and was so docile that it never required to be punished.

The second species, *Helarctos tibetanus,* is the Hill-bear of the Anglo-Indians. It is plentiful in the Himalayas, but does not range into Burmah. Its habits are similar to those of the last-mentioned.

The Non-ruminant section of the order Artiodactyla was represented by—*Sus bengalensis,* of which there were two skulls. Mr. Leipner remarked that the dentition of this animal was peculiar, the upper cannines being twisted round and reflected upwards.

The Ruminant section was reprented by skulls of—

Bos sondaicus, "The Tsain" of the Burmese. This species of wild ox is far from rare in Pegu, whence it extends through the Malay Peninsula and Islands. The colour is light red and the horns differ in shape in the sexes. This is a timid and retiring animal, and is much less dreaded than the next species. It does not extend into India.

Bos cavifrons, "The Pioung" of the Burmese. This magnificent taurine occurs throughout India in appropriate spots; such places are however being encroached on every year, and the number of these animals is consequently being gradually diminished. It also ranges through Burmah and the Malay Peninsula: though more widely spread it is not so common in Burmah as the last species. The shape of the horns does not materially differ in the sexes, those of the cow being merely a little more slender than those of the bull. The bulls are much dreaded when irritated, and from their strength and agility are excessively dangerous animals. The colour of the bull is a very dark blackish brown.

Hyelaphus porcarius, "The Darai" of the Burmese. This stag is somewhat rare and local in India, but is very abundant in Burmah, delighting in the low half-cultivated lands and marshy forests. It is the "Hog-deer" of Europeans.

Panolia eldi, "The Sungnai" of the Burmese. This curious deer is not found in India, but is common on the grassy plains and in the shady forests of Pegu, and is frequently found in large herds. The Burmese distinguish a variety with small horns as "The Flying Sungnai," but the difference is only I think the result of locality or less suitable food.

Rusa aristotelis, "The Sath" of the Burmese, "The Samba" of India. This stag is pretty common in Pegu, India, and the Malay countries. Indian animals have the largest horns, and fine horns are rarely seen east of the Bay, though the conditions of life are apparently equally favourable.

Styloceras vaginalis, "The Ghee" of the Burmese. Perhaps ironically so called from its size, as "ghee" means large. This pretty little deer is widely diffused over India, where it is called "Kaka" or the Barking Deer in Bengal, and the "Jungle Sheep" in Madras. The latter, a most inappropriate name, is also occasionally applied, very absurdly, to the four-horned antelope. The ghee is extremely common in Burmah, and is of a very fearless disposition, frequenting the close proximity of villages in preference to the deeper forest. A doe of this species is frequently swallowed whole by pythons, which need not be longer than twelve or fourteen feet to accomplish such a meal. The natives assert that a python of about thirty feet in length will swallow a full grown doe Samba Deer. This I think improbable, but there is no doubt that a half-grown one could be easily swallowed by a python of that size.

The Pachydermatous section of the Order Perisodactyla was represented by a fine skull of

Rhinoceros sumatranus, the two-horned Indian Rhinoceros. This animal is not rare in Pegu, though, from its retiring habits, it is not often seen. It is usually of inoffensive habits, but will attack the hunter if wounded. The skin is quite devoid of the thick impenetrable armature of *Rhinoceros indicus.* The horns are greatly valued by the Chinese, and fetch their weight in silver. The blood too is collected and dried, and fetches a good price among the Chinese as a medicine.

Mr. Leipner remarked that the horns of the rhinoceros had nothing to do with the skeleton of the animal. They are simply epidermic appendages, and are similar in structure to whalebone, or rather to the compound hairs of elephants. The dentition also, he said, is remarkable. There being no canines, the number of molars are from ten to fourteen in each jaw.

Skulls of the following species were also exhibited: *Hircus ægagrus,* the Shawl goat of Cashmir. *Hystrix indicus* the porcupine, and the Pegu hare.

REPTILIA.

Specimens of the following species of reptiles were exhibited :—

Crocodilus biporcatus. This is the common crocodile of Pegu, and is very numerous in all the salt water creeks of the Traivadi delta. Accidents from these animals are not rare, but less frequent than might be anticipated from their numbers. They are most dangerous during the rainy season, when they breed. The female lays her eggs on some grassy sand bank, and watches them jealously. The Burmese and Karees are very fond of the flesh of the Crocodile, and both shoot and harpoon it whenever they can.

Crocodilus palustris. This crocodile occasionally occurs inland. When old ones are killed near a large river, it is usually found that their stomachs contain several pounds weight of metal, brass, and silver rings, derived from the limbs of corpses which have been thrown into the River and devoured by the animal.

Crocodilus porosus.

Tryonix gangetica.

Testudo elongata (Blyth). This is the most widely diffused and abundant tortoise in the Province, ranging throughout Pegu and the Tanasserin. It is unknown in India.

Testudo platynotus (Blyth). This species is very closely allied to *T. elegans*, but differs from it in its uniformly larger size, flatter back, and other trifling details. It is pretty common in the valley of the Tranadi above the British frontier, but does not range down to lower Pegu.

Cyclemys oldhami (Gray). This box tortoise is remarkable from possessing a marginal cartilaginous sature, but instead of the transverse sternal cartilaginous hinge, it has a pseudo hinge formed by the permanent non-anchyloses of the pectoral and abdominal bony plates, thereby permitting a small extent of motion though less so than that produced in Testudo by a cartilaginous or true joint.

Geomyda grandis.

Batagur trivittata.

Batagur berdinosei. This species is quite distinct from B. ocellata with which Günther confounds it. The locality also is different, the one being confined to Bengal, the other to Burmah.

Tetraonyx lessonii.

Chitra indica.

The Hon. Treasurer, Mr. W. W. Stoddart, F.G.S., then exhibited a curious specimen from a Cornish mine. This consisted of a mass of a marine and land shells, amongst which were oysters, pectens, helices, and bulimi, mixed with sea sand and agglutinated together by the action of carbonate of copper. The remarkable part of the matter is that this specimen had been obtained a mile and a half in the mine, in a newly opened working, where as far as could be ascertained, the sea had never had any access; so how the shells and sand got there is a mystery. Mr. Stoddart said he had at first thought the sand and shells might have been taken into the mine for building, but had found on inquiry that this could not be the case. The specimen he observed was a very interesting one, especially to Geologists, for very often such odd facts throw light on other more important matters.

MEETINGS OF SECTIONS.

ENTOMOLOGICAL SECTION.

April 7th, 1868.—The President, Mr. S. Barton, in the chair.

Mr. J. W. Clarke brought the following species for exhibition, all of which had been captured during the past month in the neighbourhood:—Amphydasis prodromaria, Eupithecia abbreviata, Tœniocampa munda, T. rubricosa, and T. stabilis (var) Dasycampa rubiginea, and Xylina petrificata (hybernated specimens) Xylocampa lithoriza, and several other species.

Mr. A. E. Hudd also exhibited a number of species captured this season, including, besides several of those brought by Mr. Clarke:—Tœniocampa miniosa, Tephrosia crepuscularia, Lobophora lobulata, Diurnea fagella (varieties) and Epigraphia avellanella.

It was then determined that the first excursion should take place on April 28th, to Avonmouth.

Evening meetings for collecting to Leigh, April 16th, the members to meet at the Suspension Bridge, at 7 p.m., and to Durdham Down, April 23rd, the members to meet at the top of the Gully, at 7 p.m., were also decided on.

GEOLOGICAL SECTION.

Wednesday, April 8th.—Mr. W. W. Stoddart in the Chair.

It was decided that the following walks should take place during the coming months, namely :—First to Paulton, second to Dundry, third to Willsbridge, fourth to Dundas.

Mr. W. R. Browne then read a paper on certain organic remains found in excavating the new lock-gate at Cumberland Basin. The paper was illustrated by drawings of the sections, and by several specimens, amongst the most noticeable of which latter was a fine skull of Cerus elaphus, the red deer.

A short discussion as to the probable causes of the alteration in the river bed ensued.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

Vol. III. MAY, 1868. No. 5.

ANNUAL MEETING.

THURSDAY, MAY 7TH, 1868.—Mr. THOMAS PEASE, F.G.S., Vice-President, in the chair.

The Hon. Secretary, Mr. ADOLPH LEIPNER, having read the minutes of the preceding Meeting, which were confirmed, announced that Mr. Oliver Giles and Mr. R. V. Sherring had been elected ordinary members of the Society.

He then proposed the following new Rule, which was seconded by the Hon. Treasurer, Mr. W. W. STODDART, F.G.S., and carried unanimously:—

"That any member wishing to resign, is to notify his intention of doing so, in writing, to the Honorary Secretary; and that the Honorary Secretary shall be authorized to withhold the Proceedings from any member from whom *two* subscriptions are due, and that the Council shall be empowered to remove the name of such defaulter from the list of members."

The minutes of the last Annual Meeting having been read,

The Hon. Reporting Secretary Mr. T. GRAHAM PONTON, F.Z.S., presented the following report of the Council.

THE REPORT OF THE COUNCIL.

IT is once more the duty of the Council to lay before you their report of the progress of the Society during the past year.

The Council have again to congratulate the Society on the large amount of good work it has accomplished, and on its bright prospects of greater and more extended usefulness in the future.

Many important communications have been made at the general and sectional meetings, while the members have shown, by the frequent discussions which have taken place, a growing interest in the Society's welfare, and an increasing sympathy with its aims and objects.

Your Council have also to congratulate you upon the recent alteration in the Rules, by which ladies will in future be admitted into the Society as Associates—an alteration which it is believed has given general satisfaction to the Society, as tending to increase its popularity with the public at large.

But while there is much cause for rejoicing, there are not wanting subjects of regret.

Within the past year the Society has sustained a great loss by the resignation of the Hon. Reporting Secretary, Mr. W. Lant Carpenter, whose business engagements would not permit of his longer continuing in that office, the duties of which have, since Mr. Carpenter's resignation, been discharged by Mr. T. Graham Ponton.

Another cause of regret is the suspension of the Meetings of the Chemical Section, which arose from various unforeseen and unavoidable circumstances.

A considerable number of new members have been elected during the year, but, on the other hand, many of the old members have died or have resigned in consequence of leaving Bristol; the total number of members, therefore, now amounts only to about two hundred and fifteen, showing a decrease on that of last year.

The state of the Library Fund has, your Council are glad to say, enabled the Society to make some important additions to the number of their books by purchase; several have also been made by the kindness of private individuals; and the Sections have, as in former years, devoted a portion of their funds to the purchase of books for the Society's Library.

The Council again regret that but little progress has been made towards the publication of the proposed work of the Society on the Natural History of the Neighbourhood, and they fear that the Scheme will have to remain in abeyance so long as the funds of the Society continue in their present unsatisfactory state.

Although the financial position of the Society has improved since last year, it is still far from what your Council could wish; and they are sorry to learn that the Honorary Treasurer has again experienced considerable difficulty in collecting the subscriptions. It is to meet this difficulty, and to endeavour to place the financial position of the Society on a more solid basis, that your Council have felt themselves obliged to frame the new rule which they submit to your consideration to-night.

In conclusion, your Council cannot refrain from expressing a hope that the promise of the past may be amply fulfilled in the future, and that the acknowledged position which the Society has already attained as a scientific body, may not only induce its members to endeavour to preserve that reputation, but incite them to make more strenuous exertions than before.

The Hon. Treasurer, Mr. W. W. Stoddart, F.G.S., then read the audited accounts for the year, *(see page 39.)* He said that the balance against the Society last year was £23 13s, this year it was only £9 8s. 6d.; and he hoped that by another year he would have as large a balanee in its favour. The arrears of subscriptions amounted to £23 17s. 6d., and he considered that when these were collected the Society would be out of debt.

Mr. C. Blackmore then moved the first resolution: "That the Report now read, together with the Treasurer's Account, be approved and printed under the direction of the Council, and that a list of the Officers and Members, and the Rules of the Society, be added thereto."

Mr. R. V. Sherring seconded the resolution, which was carried unanimously.

Mr. Pearce moved the second resolution: "That a contribution of £5 5s. from the funds of the Society be presented to the Institution, and that the Hon. Secretary be requested at the same time to convey the best thanks of the Naturalists' Society, for the kindness with which they have been met by the Committee of the Institution."

Mr. F. Martin having seconded the resolution, it was carried *nem. con.*

Mr. Stephen Barton then moved the third resolution, as follows: "That the Hon. Secretary, the Hon. Reporting Secretary, and the Hon. Treasurer, be requested to continue in their respective offices during the ensuing year."

Mr. C. F. Ravis seconded the resolution.

The resolution having been carried unanimously,

The ballot was then taken for the office of President, Mr. A. Leipner and Mr. Graham Ponton being the scrutineers, the result of which was the unanimous re-election of Mr. William Sanders, F.R.S., F.G.S.

The ballot for two Vice-Presidents was then taken, when it was announced that the Rev. Canon Moseley, M.A., F.R.S., Instit. Sc. Paris Corresp. and Mr. Thomas Pease, F.G.S. had been re-elected.

Another was then taken to elect four Members of Council, three in place of the three Members who had retired, as usual, by rotation, and were ineligible for re-election, and one in place of Mr. C. O. Groom-Napier, F.G.S., who has left Bristol. Dr. Henry Fripp, Mr. P. J. Worsley, B.A., F.C.S., and Mr. W. L. Carpenter, B.A., B.Sc., were elected in place of the retiring Members, and the Rev. W. W. Spicer, M.A., F.M.S. in place of Mr. Groom-Napier.

Mr. F. V. Jacques then moved the fourth resolution: "That the thanks of the Society are due to its Officers, and the Members of the Council, for their management of the Society's affairs."

Mr. Henry Johnson seconded the resolution, and it was carried unanimously.

Mr. Stoddart having briefly acknowledged the compliment, in his own name and in that of his colleagues, the business of the evening terminated.

The following additions have been recently made to the Society's Library.

Quarterly Journal of Science, January to April, 1868—Purchased.

Bivalve Entomostraca, Recent and Fossil, by Professor T. Rupert Jones, F.G.S., Re-printed from the Quarterly Journal of Microscopical Science for April, 1868.—From the Author.

The Journal of the Quekett Microscopic Club.—From the Club.

The Naturalists' Note Book for April, 1868.—From the Editor.

MEETINGS OF SECTIONS.

ZOOLOGICAL SECTION.

TUESDAY, MAY 14th.—Mr. W. SANDERS, F.R S., F.G.S., in the Chair.

The minutes of the meeting of February 13th having been approved,

Mr. S. H. SWAYNE, M.R.C.S., Secretary of the Section, read a paper "On the comparative measurements of the Skeleton of Man and the Gorilla," taking as the basis of his remarks the fine Skeleton of the Gorilla in the Museum of the Bristol Institution. The following is a list of some of the more remarkable measurements :—

Man.	Inches.	*Gorilla.*	Inches.
Entire length of skeleton ...	67·7	Entire length of skeleton ...	58·2
Breadth of skeleton across the acromions	15·0	Breadth of skeleton across the acromions	15·0
From the occipital protuberance to the chin	9·1	From the occipital protruberance to the chin	12·5
Width across the orbits ...	4·0	Width across the orbits ...	5·5
Width across the malars ...	3·8	Width across the malars ...	6·5
Width of skull at zygoma ...	5.4	Width of skull at zygoma ...	5·4
Length of ramus of lower jaw from the angle to the coranoid	2·4	Length of ramus of lower jaw from the angle to the coranoid	4·5
Breadth of ramus of lower jaw	1·6	Breadth of ramus of lower jaw	3·2
Length of upper canines outside the socket	0·4	Length of upper canines outside the socket	1·5
Length of vertebral column along the curve anteriorly	30·4	Length of vertebral column along the curve anteriorly	29·2
Length of longest cervical spine	1·0	Length of longest cervical spine	3·0
Length of sacrum	5·7	Length of sacrum	5·5
Length of coccyx...	1·4	Length of coccyx...	2·0

Man.	Inches.	*Gorilla.*	Inches.
Length of sternum to ensiform cartilage	8·5	Length of sternum to ensiform cartilage	10·2
Length of arm and hand	30·5	Length of arm and hand	39·5
Length of the dorsal border of the scapula	6·5	Length of the dorsal border of the scapula	10·0
Breadth of the dorsal border of the scapula	3·9	Breadth of the dorsal border of the scapula	7·0
Length of the axillary border of the scapula	5·2	Length of the axillary border of the scapula	8·7
Length of the clavicle	6·2	Length of the clavicle	5·7
Length of humerus	13·4	Length of humerus	16·7
Circumference of humerus at the middle of the shaft	2·5	Circumference of humerus at the middle of the shaft	4·0
Width of the humerus across the condyles	2·6	Width of the humerus across the condyles	4·0
Length of radius	9·9	Length of radius	13·0
Circumference of radius at the middle of the shaft	0·8	Circumference of radius at the middle of the shaft	2·7
Length of Ulna	10·7	Length of Ulna	14.5
Circumference of Ulna at the middle of the shaft	2·1	Circumference of Ulna at the middle of the shaft	3·0
Length of hand and carpus	7·2	Length of hand and carpus	9·6
Length of phalanges and metacarpus of the middle finger	6·0	Length of phalanges and metacarpus of the middle finger	8·5
Length of the three phalanges	3.5	Length of the three phalanges	5·0
Extreme length of leg exclusive of the pelvis	36.2	Extreme length of leg exclusive of the pelvis	28.5
Length of the pelvis from the labrum ilii to the tuberosity of the ischium	9·0	Length of the pelvis from the labrum ilii to the tuberosity of the ischium	14.2
Breadth of the pelvis across the ilii	8.7	Breadth of the Pelvis across the ilii	15.6
Cavity of the pelvis across from the second bone of the sacrum to the pubis, conjugate diameter	5.2	Cavity of the pelvis across from the second bone of the sacrum to the pubis, conjugate diameter	6.7
Circumference of the pelvis round the crista ilii	8.1	Circumference of the pelvis round the crista ilii	11.5

Man.

	Inches.
Width across the outlet ...	5.5
Length of the femur	30.2
Circumference of femur at the middle of the shaft	3.2
Breadth of the patella	2·0
Length of the tibia	15.2
Length of the fibula	14.6
Circumference of the fibula at the middle of the shaft	0.7
Length of the foot along the sole	9.7

Gorilla.

	Inches.
Width across the outlet ...	7.9
Length of the femur	26.2
Circumference of femur at the middle of the shaft ...	4.2
Breadth of the patella ...	1.4
Length of the tibia	10·6
Length of the fibula	10.2
Circumference of the fibula at the middle of the shaft	1.6
Length of the foot along the sole	10.2

DR. *W. W. Stoddart, Treasurer, in Account with the Bristol Naturalists' Society.* CR.

1868.	£	s.	d.
To Subscriptions received to April 30, 1868 ...	67	13	0
Sale of Extra Copies of Proceedings ...	1	13	0
Donation from Chemical Section	1	5	0
Balance due to Treasurer	9	8	6
	£79	19	6

	£	s.	d.
Arrears yet unpaid, 1865 ...	£1	15	0
,, ,, 1866 ...	7	2	6
,, ,, 1867 ...	15	0	0
	£23	17	6

1868.	£	s.	d.
By Balance due to Treasurer	23	13	0
Cash paid—Morris	30	2	0
,, Morgan	0	11	0
,, Sturge	0	9	3
,, Mardon & Co.	1	4	9
,, Gratuities, Notices, and other Expenses, per Secretary and Treasurer	23	19	6
	£79	19	6

	£	s.	d.
To Balance due to Treasurer ...	£9	8	6

LIBRARY FUND.

	£	s.	d.
To Balance in hand	15	6	0
Subscriptions and donations to April 30, 1868.	6	11	6
Donation from Botanical Section	1	1	0
,, Geological Section	1	1	0
	23	19	6
To Balance in hand	£17	2	6

	£	s.	d.
By Cash Paid—Mardon & Co.	0	15	0
,, Williams	0	3	0
,, Kerslake & Co.	5	19	0
Balance in hand	17	2	6
	23	19	6

4th May, 1868. Audited the foregoing Accounts, and found same correct,

STEPHEN BARTON.

FREDERICK VICE JAQUES.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

Vol. III. JULY, 1868. No. 6

GENERAL EXCURSION.

Friday, July 10th.—The first Excursion of the Society for this season took place on this day; it was attended by about thirty members and visitors. The party left Bristol by the 10.40 train for Highbridge, *en route* to Brent and Burnham. On the arrival at Highbridge the party separated, some of the members being conveyed in the vehicles, which were in waiting, to South Brent—the remainder, who preferred walking, proceeded on foot across the fields to the same place. On arriving at South Brent the members were met by Mr. Gabriel Poole, of the Manor House, who kindly showed them over the ancient village church, directing their attention to the various points of antiquarian interest in the building.

After the church had been visited, Mr. Poole hospitably entertained the party at luncheon in his house, which was close at hand.

Ample justice having been done to the entertainment so generously provided, their courteous host again took upon himself the part of cicerone, and led the party to Brent Knoll. The climb up the hill proved somewhat fatiguing, especially to the ladies; but all were repaid for the toilsomeness of the ascent by the magnificence of the view obtained from the top.

The prospect, although a little obscured by the heat of the weather, was very extensive, embracing as it did the range of the Mendips from Crook's Peak to Glastonbury Tor, and still more distant, the Quantocks were to be seen towering up dimly through the haze.

After the view had been duly admired, the party sat down in a circle round the President, who proceeded to explain the geological features of the Knoll, and the surrounding country.

He said—"After the deposition of strata, to the extent of perhaps ten miles in thickness, including the Lauarentian, the Cambrian, and the Silurian, the old red sandstone followed, and upon this were accumulated the strata of the limestone and coal measures. The southern boundary of the Bristol Coal Basin, formed by the range of the Mendip Hills, is composed of these last-named formations. The central parts of this range present the outcrop of the old red sandstone, uplifted, and bearing on both its northern and southern slopes the limestone beds, with corresponding dips to the north and south. The new red sandstone follows next, and then the lias. Brent Knoll is composed of lias strata, surrounded by an alluvial plain. But as the upper beds of the new red sandstone have descended many feet, probably at least fifty, below the base of the Knoll, so only the middle and upper divisions of the lias are present in this remarkable hill. Further, as other strata were evidently continuous, originally, with the corresponding strata at Mark, and Wedmore, and Puriton, a striking example is here presented of the enormous amount of denudation which has been effected by marine action during the depression and elevation of the land. Brent Knoll is capped by the first-formed beds of the inferior oolite. The alluvial tract of country surrounding the Knoll is the result of marine deposits during post-tertiary times. A layer of peat at the depth of twenty-eight feet is evidence of depression, not only to this extent, but from a height sufficient to escape the action of the highest spring tides. Other accumulations of vegetable matter at less depths indicate similar changes of level. At Stolford, situate in the estuary of the Parrett, a large number of trunks of trees are visible at low water of spring tides, indicating that the gronnd supporting them has sunk probably as much as fifty feet."

Mr. Sanders concluded his remarks by requesting Mr. Poole to afford the members some information with respect to the ancient historical reminiscences connected with the Knoll, and the part of Somersetshire in its immediate neighbourhood.

Mr. Poole then rose, and said :—

"The top of this hill is, I believe, an ancient British fortress or the central keep of one. It was certainly occupied by the Romans, as Roman remains have been found here, but it is not of Roman construction. In the times prior to the Roman invasion, and before the marsh lands of Somerset were reclaimed from the sea, it must have been impregnable. From the summit of the Knoll you look over (wholly or partially) the three great alluvial basins of Somerset. The one to the north of the Mendip Hills is drained by the River Yeo, and is called the North Marsh. The second lies between the Mendip Hills on the north and the line of Polden Hills on the south, and is drained by the Rivers Axe and Brue. The third is the Bridgwater level, and comprises the vast tract of marsh and peat lands, drained by the River Parrett, which lie south of the Polden Hills. The Brue and Parrett fall into Bridgwater Bay very near to each other. There is no record, that I am aware of, when these vast plains (all under the level of high water mark) were reclaimed from the sea. It must have been done at one and the same time, and the work was of too great magnitude for any of the ancient British chieftains to have accomplished—the embankments on the two sides of the River Parrett being forty miles in length, those on the Axe more than twenty, and the mouth of the Brue being dammed up by a clyze ; sea walls also must have been erected at Huntspill, Burnham, and Brean. The Romans are known to have erected similar works on the north-eastern shores of Britain, for the purpose of dislodging the Britons from the shelter which the swamps afforded them, and I have no doubt that they were the engineers who planned and executed the reclamation of the marsh lands of Somerset. Prior to that the whole of those lands must have been vast swamps, covered with gigantic reeds, and a fortress like Brent Knoll situate in the middle of such a swamp must have been almost unassailable, for no army could encamp in the swamp, nor could a military road be made across it to any purpose, so long as every high tide covered it. As a Roman road, and Roman coins and other remains have been found in the district, the reclamation of these tracts from the sea must have been as old as the Roman occupation, and I can scarcely conceive that any other people can have affected so great a work. Here, however, the history of the district does not stop, for various discoveries have been made in different parts of it, tending to shew that in recent times (geologically speaking) several changes in the relative levels of land and sea have taken place. The Ordnance Map shews that on the coast opposite to Burnham, at two places, viz.—Stolford and Porlock—there are submarine forests, the stumps of the trees being found erect as when they grew, and the roots buried in the mud. The wood of these trees is of the colour of ebony. Miles away from this forest, and as far inland as the upper parts of King's Sedgmoor, the borders of the sand banks at Burtle and Westbury, the trunks of trees are found of the same dark colour, and some of them without their roots, and without their smaller limbs, shewing that they had probably rotted off between wind and water, and been drifted by water to the places where they are now found, their heads probably having been destroyed before the butt of the tree rotted off. As you go down the River Parrett at low water you see a line in the mud, which appears to project from the slimy bank, and if you ask the sailors what it is, they will tell you it is the half-tide lynch." Again, in the Brue, when the water is low, you can trace for miles, just at the water line, a band of black peat. These are the croppings out of a former surface of land buried beneath the alluvial. I have for several years interested myself in collecting information as to the changes that have taken place in this alluvial district, and I have satisfied myself that there are at least three surfaces, that from some cause or causes have been buried by the alluvial deposit of the Bristol Channel. When the basin for the Taunton Canal was excavated a little above Bridgwater, a careful section was taken by the late Mr. Austin and Mr. Baker. At the depth of sixteen feet from the existing surface, which is below the level of high water mark in the River Parrett, was found a stratum of peat varying from one to two feet in thickness, which must have once grown on the surface, and in this were found fresh water shells of the same kinds as those now found in the present peat moors of Somerset. At twenty-eight feet below the existing surface there was found a stratum of pebbles. In this Mr. Austin found bones of the Ox, Horse, Deer, Dog or Fox, and Porpoise, in high preservation but very black, also Stag's horns, and with them a femoral bone, an ilium, a radius, and a humerus, all human, and a piece of coarse pottery; shells also, like those inhabiting our present shores were found there. In the stratum under this were found the roots and fibres of plants penetrating the red marl about twenty-nine feet below the water. Another section was made near the same spot when the Bristol and Exeter Railway Bridge over the Parrett was being built. This section varied but little from the other, except that the red marl was a little nearer the surface than at the canal basin. In the brick yards at Bridgwater the peat stratum sixtaen feet below the surface is nearly always found, and about seven or eight feet below the surface is frequently found another thin bed of peat, or other indications of another surface. In one of the brick yards below Bridgwater (Messrs. Colthurst and Symons's) an unfinished ship on the stocks was found, deep in the alluvial deposit. I did not see her, but I am informed that she was nearly sixty feet long; and back in the peat moors adjoining the Somerset and Dorset Railway, between Highbridge and Glastonbury, there is similar evidence of buried surfaces. On my own estate at Westbury, I have discovered a timber road, about four feet in width, made of split poles, and leading across the peat land from the sand bank of Burtle to the sand bank of

Westbury. This road is about seven feet below the existing surface of the peat, and as birch and alder poles, of which it is constructed, will rot, if exposed to the weather, in three or four years, it is evident that from some cause or other this road must have been covered with peat or water soon after its construction. At the same depth are found hazel bushes with leaves, and the fruit more than half ripe on them, and the roots and stumps of birch and alder bushes standing as they grew. The peat here, too, is from fifteen to twenty-five feet deep, and I have seen clay brought up from about fifteen feet deep, which was perforated in different directions by the fibres of plants. The upper beds of peat are cut out for fuel, to seven or eight feet deep, but below that the peat bed are not used for fuel. They seem to consist of beds of undecayed reeds, and are evidently formed of a different sort of vegetation from the upper beds. The human bones and pottery found at the canal basin shew that the subsidences of surface, of which the foregoing facts afford evidence, have taken place since this part of England was inhabited by man. There is reason to believe, nevertheless, that some of them at least must have taken place before the Mammoth and other great extinct mammalia had disappeared from this district, for in the year 1835 the skull ot a Mammoth was found projecting from the gravel on the beach at St. Audries, and some of the teeth were then secured, but Mr. Webb, who found it, did not secure the skull or search for the other parts of the body; and Sir Alexander Hood, a few years since, found the tusks of the animal projecting from the shingle. This part of the coast is formed of lias reefs, and these remains were found in the shingle and mud deposited between the edges of two of them. The skull had disappeared when Sir A. Hood found the tusks. In other parts of the district bones of the Mammoth and Rhinosceros have been found. When the excavations for the Gaol at Taunton were being made, the bones of a Rhinosceros were found there. These evidences of subsidence do not exhaust the evidence of change which this district affords. There are indications of a time when the line of beach against the sea was some twenty or thirty feet higher than it is now; but I will not enter into that question now, except to say that these subsidences and elevations are not limited to this comparatively small district, but I have traced both unmistakeably at Northam Burrows and Cornborough, in Barnstaple Bay, and the latter (I believe) also at Falmouth, on the opposite side of the Peninsula of Devon and Cornwall. It would be very interesting if some public society would invite information from all parts of the West of England, to throw light on these curious changes, and, if possible, to fix approximately the dates of them."

At the conclusion of Mr. Poole's remarks, which were listened to with great interest, the members proceeded down the hill to East Brent, where, after returning him their hearty thanks for his kindness, they bade farewell to their hospitable entertainer.

The party having taken a cursory look at East Brent Church, entered the carriages which were in readiness to convey them to Burnham. On their arrival at Burnham the members sat down to dinner, fully prepared to enjoy it after the fatigues of the day. Dinner over, the members again entered the carriages and returned to highbridge in time for the 6.55 p.m. train to Bristol, all being well pleased with the success of the day's excursion.

MEETINGS OF SECTIONS.

BOTANICAL SECTION.

TUESDAY, MAY 12th.—The members of the Section assembled at the Suspension Bridge and walked to Leigh Woods. A few plants of Orchis mascula and Arabis hirsuta were found, and a single specimen of Helleborus fœtidus, not however in flower. Myosotis versicolor exhibited the remarkable changes situation makes in its growth, varying from about an inch to eight or nine inches in height. Oxalis acetosella was very abundant, and in several situations Lamium galeobdolon was found. The wild raspberry displayed its flowers above the more humble plants of Euphrasia officinalis, Geranium robertineum, G. rotundifolium, and G. dissectum. The mosses were dried up in many situations, but various specimens were found including species of Bryum, Hypnum, Funaria, Tortula, and others.

TUESDAY, June 9th.—Brockley Combe was the spot selected for investigation on this occasion, the members proceeded by the Bristol and Exeter Railway to Nailsea, and walked through the fields to the down, above the Combe, where the ground was very dry, and but few plants in addition to those observed at the last excursion to this neighbournood were found. A few spikes of Orchis mascula were picked, and O. masculata was abundant. Lapsana communis and Linum catharticum were present in several places, and around the hedges the climbing stems of Bryonia dioica, and Tamus communis threw their graceful garlands in company with the rough Rubia peregrina. Verbascum thapsus and Salvia verbenaca with the last year's fruit still adherant were found on the edge of the Combe.

Tuesday, July 14.—The members on this occasion proceeded by rail to Portbury, and from that station on foot to the neighbouring marshes. In the hedges by the road side, specimens of Eupatorium cannabinum were observed also Spirœa ulmaria and Salvia verbenaca. In some parts of the marsh the ditches were dried up in consequence of the continued dry weather, but in the greater number there was a good supply of water, so that the excursion proved more successful than was anticipated. Among the plants found were Epilobium hirsutum and E. parvifolium, Alisina plantago was abundant, as also Sparganium ramosum, but S. simplex was less frequently found. Suim augustifolium was moderately plentiful as well as Ænanthe crocata. A few plants of Butomus umbellatus raised their beautiful heads of flowers from the water, while half submerged, half floating, were Ranunculus aquaticus Veronica anagallis, Galium palustre and Helosciadium nodiflorum ; in a few places were specimens of H. inundatum, and here and there covering the banks the bright flowers of Myosotis palustris. Scutellaria galericulata was picked as also Agrimonia eupatoria and Lysimachia nummularia. Polygonum persicaria was found in one part in company with a species of Potamogeton On the dryer parts were found specimens of Verbena officinalis and Palicaria, Dysenterica and Sanacetum vulgare were very abundant, less so Geranium dissectum and Hyphericum quadraugnlatum. The members worked towards Portishead, from whence after taking tea they returned to Bristol.

ENTOMOLOGICAL SECTION.

Tuesday, May 12th.—An excursion took place to Leigh Woods, a large number of species were observed and captured by members of the section, but none of sufficient importance to need special reference.

Tuesday, June 9th.—The members of the Section met at the Bristol and Exeter Station and proceeded by the 1-15 train to Nailsea, walking thence to Brockley Combe, and across the Warren to Goblin Combe, and returned to Bristol by the 8-17 train by way of Yatton. A very pleasant afternoon was spent, and a large number of captures made but principally of species recorded as having been met with during former visits of the Section to Brockley.

GEOLOGICAL SECTION.

Thursday, May 22nd.—The first walk of the season took place to Paulton. Eleven members and four visitors were present; the party left Bristol in a break at 2-30 and although it rained nearly the whole distance, yet the weather cleared up on reaching Paulton. Four quarries were examined. The middle lias beds were found resting on the white lias, and some good fossils were obtained. The party reached Bristol at 10-15.

Tuesday, June 2nd.—The second walk of this Section was taken to Gorden Cliff (on Severn) on this day, eleven members and one visitor attended. The party left Bristol by train at 8-45, *via.* Gloucester. Mr. Stoddart explained the section of the cliff, comprising Kinper marls overlaid by the rhœtic beds, which here attain a thickness of nearly forty feet, and are full of the characteristic fossils, of which a large number were obtained including the following species:—

Mollusca.

Myacites musculoides
Modiola minima
Monotis decussata
Cardium rhœticum
Ostrea liassica
Pecten valonicnsis
Axinus
Pleurophorus
Avicula contorta, &c., &c.

Hobodus
Gyrolepis
Pholidophorus
Acrodus
Many bones of Icthyosaurus, &c., &c.

Tuesday, June 24th.—Owing probably to the unpromising state of the weather and other causes, only a few of the members accompanied the walk of the Section to Upton. The members were met at Saltford Station by Mr. Parker, Jun., who very kindly acted as guide to the several places which would give the best illustration of the middle and upper lias. On alighting at the Saltford Station the party at once proceeded to examine the capital section of the beds of the lower lias, afforded by the Mangotsfield Railway. The fossils here were numerous and a good collection made. Among others were the following genera:—Modiola, Axinus, Cardium, Lima, Myacites, &c. comprising many species. After spending some time here, the members walking through the little villiage of Swinford, reached the narrow lanes leading to the edge of Lansdown. Some of these are noticeable for their Roman origin, having been originally made for military purposes. After a search among the nettle-grown banks of the marlstone and beds of the middle lias eeming with fossils, the height of the marlstone was taken in a a lane south-west of North-stoke, by Mr. Stoddart's barometer and was determined to be one hundred and sixty-one feet above the mean sea level; about fifty feet higher was the base of the upper lias sands. Owing to the surface of the ground being so covered up, it could not be ascertained whether these beds were in their original position or the effects of a landslip which so often occurs on the Lansdown slopes. More observations on other parts of the hill must be made before this point can be considered as settled. The following fossils were noticed:—

Ammonites	bifrons	Pecten
,,	annulatus	Rhynchonella (2 specimens)
,,	variabilis	Terebratula
,,	moorei, &c.	

So numerous were the fossils that some of the beds were entirely composed of of them such as the pecten and ammonite beds. Between Upton and North-stoke was a quarry noted for its crustacians, but time did not permit of its examination. From thence the members proceeded to Mr. Parker's charming residence where they were most hospitably received and entertained to tea, which after the hot walk was especially grateful. Mr. Parker shewed his collection of fossils and Roman and ancient British remains which were very good and of great interest. After thanking and parting from their kind host the members proceeded through Bitton, and stopped at the lower lias quarry at Keynsham, where the usual fossils as Ammonites semicostata, sangeanus and bucklandi with many gasteropods and bivalves were collected. The return to Bristol was then made after a very enjoyable and profitable excursion. As a hint to the Botanical Section, their Geological confreres would observe that the ground walked over was exceedingly rich in plants, many of them being rare, and the number of species very great.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

Vol. III. SEPTEMBER, 1868. No. 7.

GENERAL MEETING.

THURSDAY, SEPTEMBER 4th, 1868.—Mr. W. SANDERS, F.R.S., F.G.S., &c. President, in the Chair.

The Minutes of the last Meeting of the Society having been read and approved;

Mr. ADOLPH LEIPNER, the Hon. Secretary, made a communication, "On some Mammalia and Birds, from Newfoundland, recently presented to the Institution by the Government of that Colony, through Charles F. Bennett, Esq., of St. John's."

He commenced by saying that, all his friends having deserted him, he had been compelled to come forward himself. He regretted this should have been the case, and hoped that the Members would make an effort to provide subjects for discussion at the coming Evening Meetings of the Society; as yet, however, he was sorry to say, he had had no promises of papers.

He then proceeded to describe the various Mammals and Birds in detail, dwelling upon the distinguishing peculiarities of each.

The specimens of the Mammalia comprised :—

Vulpes decussatus, Geoff, (The American Cross, or Tawny Fox.) With respect to this animal, Mr. Leipner remarked :

This Fox is very variable in the colour and markings of its fur, some specimens are of a pale yellow, some are blackish in the general tinting, while others are of a reddish fawn, and others again, like the one before us, are remarkable for the manner in which the black, the white, the yellow, and the fawn are dispersed over the body and limbs. In almost all specimens there is a darkish transverse stripe over the shoulders, hence the name of the Cross Fox.

As the Fox belongs to the same family of Carnivora as the Dog, the formula representing the normal dentition of that animal will hold good also with regard to the Fox. It is as follows :—In. $\frac{3-3}{3-3}$ Can. $\frac{1-1}{1-1}$ P.M. $\frac{4-4}{4-4}$ M. $\frac{2-2}{3-3} = 42$.

Martes Americana. (The American Sable.) With regard to this animal Mr. Leipner remarked :—

This species seems to resemble greatly the Asiatic Sable ; Dr. J. E. Gray, mentions that the great point of difference is that the upper tubercular grinder is smaller in this species than in the Asiatic. The fur is not so valuable as in the Eastern species; it is however much sought after, and bears a high price.

Putorius fœtidus. (The Polecat.) White variety.

This animal, Mr. Leipner said, I have with some doubt called a white variety of the Polecat, better known as the Ferret; for Dr. Gray observes that the Ferret is strictly an African form, being an albino caused by the heat. It is therefore quite clear, if my determination is right, and I am at a loss to what other species I can refer the specimen, that there must be an American albino variety also.

The dental formula of the genus Putorius is, according to Professor Owen, In. $\frac{3-3}{3-3}$ Can. $\frac{1-1}{1-1}$ P. M. $\frac{3-3}{3-3}$ M. $\frac{1-1}{2-2}$; Dr. Gray gives—In. $\frac{3-3}{3-3}$ Can. $\frac{1-1}{1-1}$ P. M. $\frac{2-2}{3-3}$ M. $\frac{2-2}{2-2}$ The number is, of course, the same in both cases, thirty four, the difference in the formula being caused by the view taken by the respective authors as to the character of certain of the teeth.

The Polecats, and consequently the Ferrets, may, with the Stoats and Weasels, be called the most predacious and bloodthirsty of all Carnivora.

The havoc they make is far greater than one would think possible from their small size.

The Polecat slays Rabbits and Hares in great number, and ever and anon depopulates the farmer's hen-roosts; but its life is not all one of unmixed evil, for it frequently confers a great benefit on the country population by devouring rats; in fact ferrets are often specially trained to hunt those animals.

The fur of the Polecat is of but little value, being chiefly used for making paint brushes.

Mustela erminea, var Americana. (The Stoat, or Ermine Weasel.) In speaking of this animal, the author remarked:—

The distinctive feature of this variety of the common Stoat is the comparatively great length of the tail, which is from one-third to one-half that of the body; whereas in the African and European Stoat, the tail is only about a fifth or sixth of the whole length of the creature.

This Stoat is considerably smaller than our British one, approaching more nearly in size to the Weasel; but although so diminutive in comparison with ours, I find on inquiry that it is of the full average size of American Ermines.

The colour of this animal varies, as of course you are aware, from a deep rich brown in summer to a pure creamy white in winter. This change is not caused by a dropping off or moulting of the summer coat, but is an actual change in the colour of each individual hair.

The object of this extraordinary change is doubtless twofold, as a means of protection against its enemies, by assimilating it to the colour of the snow-covered ground, and as a means of protecting it from the intense cold.

The author then exhibited four specimens of Seals, evidently belonging, he said, to three distinct species; but as he had not had time accurately to determine their specific identity, he would reserve an account of them for a future occasion.

Trichechus rosmarus. (The Walrus.) A single canine tooth of this animal was shown. Mr. Liepner said:—

The dental formula of this animal is very peculiar. In the young we find three incisors in each inter-maxillary bone, and two on each side of the fore-part of the lower jaw. These, however, soon disappear, except the outer pair above, which remains close to the inter-maxillary suture, and on the inner side of the canines. In the adult, behind the permanent incisors, and much resembling them, are three simple molars, and there are four similar teeth on each side of the lower jaw. The canine tusks, of which the specimen on the table is one, are from fourteen to twenty inches and more in length, and are frequently seven in width across the base. They assist the animal in clambering over the rocks, and perhaps also in dragging up algæ, which, together with small shell fish and crustacea, form its chief diet.

The ivory of the tusks is of fine quality, and is much used by dentists.

Fiber zibethicus. (The Musquash, or Musk-rat.) Mr. Leipner remarked :—

This animal is only found in North America, frequently in places above 20° of north latitude. It is dark brown on the upper portions of its body; the neck, sides, and legs, are of a reddish hue, and below it is of an ashy grey. Its length is about two feet, the tail being nearly half. The incisors are peculiar from their bright yellow hue. The dentition of the Musquash is very typical of the order Rodentia, to which it belongs. The incisors are four in number, two in each jaw; the canines are wanting; and the molars are peculiarly plaited, and have no fangs. The incisors never fall out, but when the edge is rubbed off it is renewed by a constant upward growth of the tooth.

Lepus variabilis. (The Arctic Hare.)

The genus Lepus, the author said, might always easily be distinguished in other rodents by the presence of two accessory incisors in the upper jaw.

This species of Hare differs from our common Hare *Lepus timidus*, from the shortness of its ears, and generally larger size of the body. It is very similar to the Irish Hare *Lepus hibernicus*, which species many authors regard as a mere variety of the Arctic form.

Amongst the most remarkable of the birds exhibited by the author, were a fine specimen of the Raven, now becoming so scarce in England, a series of the Ptarmigan, showing the gradation from the summer to the winter plumage, an American Robin, a Golden-winged Woodpecker in magnificent plumage, and a fine pair of Pine Grosbeaks, or Hawfinches.

The President, in inviting discussion, remarked that the author had raised some curious points in the course of his very interesting paper, more especially those in reference to the change of colour in hair and feathers on the approach of winter.

A considerable discussion on this point ensued, in which Mr. S. H. Swayne, M.R.C.S., Mr. W. L. Carpenter, B.A., B.Sc., Mr. Leipner, and other Members took part. It was closed by some remarks from Dr. HENRY FRIPP, of which we are enabled, by the kindness of that gentleman, to give a somewhat amplified statement. He said:—

Lightness or darkness of hair, irrespective of the *colour* due to pigment, is the result of the optical properties of the structural elements concerned, and of the morphological arrangement of the tissues composing the hair or fur. Change from light to dark or dark to light may be adequately explained by considering the altered optical effects due to structural differentiation of the organic particles; as for example, increased or diminished opacity, density, aggregation, fluidity, permeability by air, water, or liquid fats; and certain changes of external and internal physical condition, such as dryness or moisture of the surface on which the light impinges, (hair being notoriously hygrometric) as also smoothness or roughness of the cell walls, the plane or angular form of the interior particles, &c.

When we speak of white or black hair, our estimate of the relative whiteness is founded on the amount of light *reflected* from the hair viewed as a more or less opaque object, and not on the existence of any white pigment.

Light falling on a hair is partly reflected from the surface, and partly transmitted to the interior, again to be reflected outwards, and to undergo a greater or less amount of dispersion. The specific properties of reflection, refraction, and absorption of light, possessed by the several constituent elements of hair structure, form important items in our estimate of the cause of change in appearance of the hair. The "*lustre*" of hair is not the same as that of glass or metal, (dyed hair has no lustre.) It is not a *surface* effect, but rather due to the various refractions of light and shadow going on in the organic matter or substance of the hair, and requires a certain thickness of substance as well as differentiation of the elements. Lustre also depends on the brilliancy of the positive colour (pigment). Reflection from the surface of a hair is affected by the nature of that surface, its smoothness or roughness—its flattened or cylindrical form—its depressed facets, or elevated ridges—its reticulated markings, (iridescence) &c. Thus a scaly or imbricate surface affects the reflection and transmission of light, according to the fineness, coarseness, irregularity, &c. of the surface marks. The epidermic scales of the cuticle are, for the most part however, sufficiently translucent to allow of a large amount of light passing to and from the interior, as pigment is not found collected in the cuticle.

The further transmission of light into the interior depends, in the next place, on the nature of the surface of the cortical substance. The maximum *reflection* of light will take place when the *outer* surface of the cortex is most opaque. In mammalian hair the cortex is usually fibrous and of horny texture, the fibres being built up by the apposition of elongated fusiform cells, containing dark nuclei and pigment granules. The elongated striation and dotted appearance of the shaft of a hair is not solely due to the cell arrangement and pigment deposit, but arises in part also from the unequal refraction of light through the clear and opaque portions. The normal, fibrous, horny cortex does not reflect so much light as would be thrown back by a dense granular mass, possessing slight transmitting but strong reflecting property. But when oil drops or fat granules accumulate in the cortical substance opacity is produced. For reflection of a white tint the fatty change is highly favourable. In every tissue, accumulation of fatty molecules occasions reflection of light which is white and not coloured, because an aggregation of dense refractive particles with interspaces of pigment and horny substance is equivalent to an irregular surface which interrupts and breaks the direct reflection of light, whereas a smooth surface reflects, as from a mirror, every coloured ray falling on it. Thus a cortical mass composed of numerous differently refracting parts breaks up the reflection of colour, and uniformity of tint results. *Surface* reflection producing either a white tint or a true mirrored reflection of the outlines and colour of objects may be illustrated by comparing the reflection from ground and polished glass (or metal) respectively. Refraction through and reflection from the particles or *substance* of organic structures may be illustrated by artificial mixtures of pigments (vegetable, animal, or mineral) with water, gums, oils, &c. In the instance of white paint, made of partly crystalline or transparent lead particles and oil, a certain "body" of white tint results which is not found in mixtures of other white metallic or earth oxides. A similar "body" or solidity of white reflection is produced by finely granular protein and finely molecular fat mixed, as is seen in tissues which have undergone "fatty degeneration." Such tissues are very opaque, when examined by transmitted light; that is to say dispersion of light by various refraction in and around the particles increases as their transmitting power is diminished.

On the relative transparency and homogeneity of the cortical substance, therefore, depends the amount of light reflected or absorbed into the interior of a hair. If the exterior surface of the cortex be simply horny, and not dark, pigmented, or rendered strongly reflective or refractive by molecular fat deposit, light will penetrate to the inner core of the hair, *i. e.* the medulla (pith,) &c. On the optical properties of the organic elements of this core and their particular arrangement in the several types of construction, will depend the modifications that occur in the further passage of light. If this core or medulla be composed of cells, further reflection and refraction will occur, according as the cell wall and contents are more or less translucent or opaque. In the youth of a hair, the medullary substance towards the root contains cells of rapid growth, and filled with semifluid matter, in which lies a nucleus with a few granules of fat. The medullary cells are continuous with the mass of soft cells forming constantly around the papilla at the base of the hair bulb. All these cells of the bulb growing older, differentiate either into the fibre cells of the cortex, or into the medullary cells. They gradually lose their nutritive matter, the cortical fibres retaining pigment, and elongated nuclei, but becoming horny. The cells forming the central core, at first rounded and full, become dry, angular, and shrivelled, their former juicy contents being replaced by fine bubbles of air. The young hair is consequently more translucent, and has greater lustre than old or white hair—for its cortex and medulla are composed of cells more homogeneous in composition, and less coloured by pigment, also more evenly moistened by nutritive juices, and having a less amount of air included in its medullary cells. As the vigour of the cell-growth at the papilla declines, alterations occur, the whole shaft becomes drier, the pigments dissolved in fatty media become more granular, the fat more molecular, the membranes of the cells thicker, more shrivelled, and less translucent. All such changes are accompanied by corresponding changes of optical effect. In particular, the reflection of light from the central core of cells is so complete when these cells contain air, and their membrane has lost its smoothness, that the medulla appears, when examined by transmitted light, as dark as if the cells were filled with black pigment. The effect due to air bubbles in a fluid, or crystal, or between laminæ of glass, horn, and generally all translucent substances, is, as is well known, obstruction to the direct passage of light. Thus, light penetrating the surface of a hair, is refracted in its passage to the centre, or core, and then sent back again through the cortex if the central core be perfectly opaque. Consequently, as the substance of the cortex is composed of fibres which are arranged in plates, forming a concentric lamination through the whole thickness of cortex, a series of broken refractions occur, the proportion of light refracted or reflected at each surface varying with the consistence and homogeneity of the laminæ, and with the state of moisture or dryness of the cell-membranes of which the cortical fibres and plates are composed. The reflection consequent on the presence of fat or oil molecules, is less than that caused by cells full of air, but fatty or oily *pigment* molecules would cause total reflection, and in proportion to the amount of pigment, would the positive colour of the hair predominate. Thus the same hair may appear white at one time, and show its natural colour at another, according as pigment granules lie in sufficient mass together in unaltered parts of the shaft, or as the cortical substance is altered by pathological causes. In a hair then, composed of cells arranged in the three forms of cuticle, cortex, and medulla, the anatomical disposition of each part mainly determines the nature of changes (and consequently of optical effects) which the hair may undergo. The question of positive colour is not here discussed, as there can be no doubt that colour is due to the pigment deposited in the cortex. Changes of *colour* are mainly dependant on functional activity of the papilla, that is to say, on the rapid growth of cells containing more or less pigment material, which can be deposited as the cell is metamorphosed into cortex-fibre ; in short, on the substitution of a new shaft for an old one by continuous growth. The removal of pigment from an adult hair shaft, either by absorption or circulation of any bleaching fluid is not the mode (as some suppose) in which the hair becomes white. The usual and natural permanence of colour, implies of itself a passive condition of the once formed hair shaft And the hair in this passive state is not liable to any resumption of activity. The rare and very exceptional instances of sudden whitening of the hair, by no means prove a sudden absorption or actual removal of the pigment. In accounting for the supposed sudden absence of colour it must be borne in mind, that the causes which usually produce it, are such as occasion not only excessive depression of mind, (horror, grief, &c.) but also powerfully influence all organic function, and annihilate for the moment, absorption and secretory action. This is not a state favourable to the assumption of such theories as the removal of the pigment or the influence of an imaginary bleaching process, such as the pouring forth of a fluid capable of acting chemically on colouring matter. On the contrary, the adult hair consists of dead matter, incapable of being permeated by a circulating fluid, and inaccessible to any but the constantly accompanying sweat or fatty secretion When a person perspires after the sudden shock of mental distress or bodily danger, the effect is one of reaction, but even in this case the hair does not turn white. It is rather when reaction does *not* occur that the hair whitens.

Accepting the stories of hair suddenly rendered white as facts, our first step towards explanation is obviously to ascertain by dissection and micro-chemical treatment whether any changes of texture, disposition, or physical condition of the affected hair have occurred, the causes of which could be traced to the psychical and corporeal malady. Whether this has been done satisfactorily by a competent anatomist or not (the opportunity is rare) I know not. But it may be, *a priori*, fairly conjectured that dryness and shrivelling of the hair bulb and shaft would be the first result of interrupted functional activity of the papilla and its accompanying sudoriferous and sebaceous glands. The shaft would be further exposed to the ordinary drying influences of the atmosphere, whilst the natural lubrication from the gland secretions was in abeyance.

The raising of the cuticle scales by drying and the admission of air beneath them, would naturally follow a state of dryness of the surface, and the absence of protecting grease. Then the separation of the horny plates of the cortex, and the entrance of fine air bubbles between the cells or concentric laminæ might be considered possible, and quite adequate to prevent the colour of the pigment from being seen so well as before; as also to produce strong reflection of light. Lastly, the medullary cells, by suddenly filling with air, would develope an equally sudden whiteness by refraction of light, supposing the horny substance of the cortex to be moderately translucent.

Thus whiteness, having a certain body to it, would be more noticeable in a hair dried and split, or cloven into fissures and planes, into which air had insinuated itself, than in a hair from which pigment had been removed, and which would simply be colourless and more or less transparent. It is not improbable that the few instances in which sudden whiteness of hair has been recorded as the effect of mental disquiet, are due, in reality, to previous unsuspected changes of texture and organic deposits, rendering the hair liable to a rapid alteration of its structure and optical properties. Extreme fright and other depressing mental emotions afflict countless millions without affecting their hair. Moreover, the probability that only rapidly decaying hair is subject to such changes, is rendered almost a certainty when we consider that the adult well-pigmented hair withstands all outward influences in a remarkable manner, and is amongst the most indestructible parts of the body. The gradual process of change, from lustrous coloured dark to dull white, is well known as being due to disintegration of the molecular pigment and fatty deposit. Clear grey and translucent white gradations are due to the partial preservation of the translucent character of the cortex and medulla with relatively small proportion of pigment. With alteration of the physical properties of the cell membranes and contents, a corresponding change of optical effect must result. The dark colour of the skin in negroes depends on pigment deposit in the epidermis (homologous with hair cortex.) The pigmented skin of the negro never turns white from fright.

The occurrence of pathological whitening of the human hair, here touched upon in answer to some observations made during the discussion, is altogether beside the question of the normal growth of white hair in animals inhabiting mountainous and polar regions. A moment's consideration will show that the whitening of human hair, whether by a natural process of degradation of organic particles, or by a sudden derangement of texture, can have little relation to the formation of the winter fur of an animal—a process governed by laws of growth and differentiation of tissues. The optical effects, however, resulting from structural disposition of elements, possessing (singly and in certain combinations) characteristic physical properties, are the same whether studied from one or other point of view, and justify, so far, this digression.

None of the processes above mentioned are comparable with changes of *colour* in the particles of a circulating fluid ; e. g. in the petals of a flower. The colouring matter of flowers, is not in the cellulose wall of the plant-cell, but in the fluid contents. Such colour may come and go rapidly, be intense or delicate, or disappear in an equally short time, but there is no question of white or black here, or of altered reflection or refraction ; it is simply of gradations of colour, whether single or mixed tints.

Respecting the white furs and hair of animals, the microscope yields us a full explanation of the facts. The difference between colourless and coloured hair is one of pigment or its absence. The appearance of *whiteness* or *darkness* of an object is an optical phenomenon, explicable by material conditions such as are exhibited by the elegant hair and wool structures of mammals when placed under a microscope. In viewing such textures by transmitted light, solid parts which strongly reflect or refract light, will be seen as more or less opaque objects ; fluids which are colourless, and transmit light, will be scarcely noticeable; and coloured fluids absorbing all portions of the spectrum but those corresponding to their own colour, reflect and transmit their colour equally whether viewed by reflected or transmitted light. But a colourless part is not *necessarily* transparent, as it may appear with a white tint, which has more or less "body," giving the idea of substance. Thus if we examine a dark coloured hair by transmitted light, it will appear black in proportion to the density and closeness of the pigment—being opaque, it obstructs the passage of light. The same hair seen in reflected light, will exhibit its own proper colour if the cuticle under which the pigmented cortex lies is transparent ; but the surface markings of the cuticle will be distinguishable as fine lines projected over the subjacent pigment. Again, if the pigment disappear and be replaced by fatty molecules, the hair will appear, by reflected light, of a dull white colour, with a considerable body, and by transmitted light, instead of being transparent, it will appear as opaque, and therefore as dark as the pigmented hair, care being taken to exclude all reflected light.

If, again, a large sized central core of air-filled cells exist, the hair will shew white by reflected and dark by transmitted light, though there be little or no colour. Lastly, in a hair having considerable thickness, and containing tissues which at different planes of its thickness are composed of transparent horny matter, molecular pigment, fatty granules and air-filled cells, the appearances by reflected light will be due to an infinite variety of internal refractions and reflections, and will shew various shades of dark when the substance absorbs, or partially transmits light ; but various whiteness of tint where the substance is opaque. And these appearances will be *reversed* when the hair is viewed by transmitted light, if the hair be partially transparent.

The structure of the hair of the mammalia varies greatly in respect to the arrangement of the cuticle, cortex and medulla. Wool hairs generally have a more or less developed cuticle, but are deficient in medulla, while in some ruminants (deer) the medullary portion almost replaces the cortex. In rodents the cortical and medullary portion are very distinct, as is well known, in the common examples (mouse, rat, rabbit). In the specimens of hair, or rather fur, of the mountain hare of the European Alps, and the Canadian hare on the table, the construction is as follows ;—the whole hair is an elongated spindle shaped flattened tube, running to a fine point at its outer end. No imbrication of cuticle scales exists in the shaft of the larger hair, the cuticle being a very thin transparent membrane. The cortical substance is a simple cylinder, almost colourless. Within it and constituting the chief thickness of the hair, lies a medulla composed of rectangular cells so disposed as to form a series of longitudinal and cross rows. The walls of these cells are separated by an interspace equal in width to about half their own diameter. Viewing this structure by transmitted light we see, with proper focussing, a clear exterior border or edge, which represents the cortical substance of the enclosing cylinder (this is best seen when the hair is split up). Within this border the whole interior is occupied by what looks like a rectangular framework of longitudinal and transverse bars, having a dark outline; the spaces between these bars being clear and transparent. The clear large spaces between the bars correspond to the cells, which when full of colourless fluid are perfectly transparent—the network of bars, on nearer examination, proves to be the optical expression of the contiguous cell walls with air-filled *narrow* insterspaces. The cell wall is composed of horny substance continuous with the internal layer of the cortex. With a power of about 220 ($\frac{1}{4}$ or $\frac{1}{5}$th) the shaded "bar" distinctly shews a double outline of shade with a middle line of clear light—corresponding to the cell walls of contiguous cells, and an interspace which will appear transparent or not according as it contains fluid or gaseous matter. As the hair is widest in its middle portion, and tapers both ways, but especially towards its outer extremity, a change in the uniform arrangement of the longitudinal bars takes place at different points, as the calibre of the cortical tube narrows—instead of running parallel, two bars incline towards each other, and uniting at an angle fuse into one. That is to say (interpreting the optical expression) a row of cells gradually fines off, and the row on either side of it comes into apposition as the middle row disappears. In the widest portion of a large hair the transverse row of medullary cells numbers 4 to 6, in the tapering ends it is only a double or finally a single row. And as the hair is a *flattened* cylinder, the greatest thickness, where the width is greatest, corresponds only to two, or at most three cells.

The hair is therefore a tube of horny substance, within the hollow interior of which, rows of cells are arranged with a tolerably regular rectangular outline—the walls of the cells are partitions of horny substances of a soft consistence ; the substance of the walls of the outermost cells being continuous with the inner layer of the cortex. In consequence of the absence of pigment, the dark shaded outline of this network of cells, which gives the appearance of a window mapped out by bars, is due to the refraction and opacity of the cell walls, or septa seen edgewise.

The whole of this structure of the shaft of the hair being therefore nothing more, in an optical point of view, than a series of air-filled cells, with separating and enclosing cortical substance which is clear and homogeneous, the result is, *almost total refraction of light from the pith-like mass of cell membrane—but this light being broken up without separation into colour, a white tint like snow is produced*—such as, produced optically, in the same way, characterizes the furry coat of these animals. Ermine fur is similar, and the varieties of coloured fur differ only in gloss and in the presence of different coloured pigments.

The reflection of a white tint is illustrated by mica—when a plate of transparent mica is split into very thin laminæ each is in itself transparent and colourless. If now the laminæ are piled one over the other, a white tint results from the continuous reflection from the separate surfaces having a thin stratum of air interposed between them.

But, in addition to this, a certain lustre is observed which is due to the repeated reflection, as well as refraction, going on in the alternate strata of air and mica. The hair has a lustre due to the horn substance, which lustre is of the kind peculiar to semi-transparent matter (vitreous lustre being the type, in contra-distinction to the metallic lustre due to opaque bodies).

To simplify the question of colour, I have treated it as a quality of the pigment. The usual explanation of a coloured substance is, that all the colours of decomposed white light are absorbed by the colouring substance, except that which the substance itself transmits or reflects. But absorption does not mean annihilation ; the absorbed colours have escaped the eye, have become invisible, but the undulations have disappeared to the sense of vision only because they have been translated into some other correlation of movement. Again, many organic structures cause the sensation of colour when the structure itself shews only those physical conditions by which the number of undulations, corresponding to the colour seen, is produced. Thus in the iris no coloured pigment is found, and similarly the colour of a hair, as seen by reflected light, varies often considerably from that observed in the pigments diffused in its substance.

The Hon. Reporting Secretary, Mr. T. GRAHAM PONTON, F. Z. S., then exhibited a kitten with a curious malformation of the feet. This was at first supposed to be simply an accessory toe on each foot, but on examination it was found to be, in reality, an accessory foot composed of three minute toes united together. A remarkable circumstance connected with the case is, that the kitten's mother has the same malformation, and every kitten to which she gives birth, possesses it.

Mr. S. H. SWAYNE, M.R.C.S., then showed an unusually large specimen of the common puff-ball fungus, which he had gathered recently in Herefordshire. He also mentioned that when there, he had seen a specimen of the common edible mushroom, which was the largest he had ever met with. It measured about two feet in circumference.

The usual time for closing the meeting having arrived, the proceedings terminated.

SATURDAY, 26TH SEPT. 1868. — Mr. W. SANDERS, F.R.S., F.G.S. &c. President, in the Chair.

The Minutes of the last Meeting having been read and confirmed, the President said that the Members had been convened for that evening in place of the usual one, for the purpose of meeting Dr. W. B. CARPENTER, of London, who had kindly offered to give the Society an account of a recent voyage he had made to the Faröe Islands in conjunction with Professor WYVILLE THOMPSON.

Dr. W. CARPENTER, V.P.R.S., then addressed the Meeting, and gave a most interesting description of his expedition.

At the conclusion of Dr. CARPENTER'S remarks, a long and interesting discussion took place, in which the PRESIDENT, Mr. H. K. JORDAN, F.G.S., and other Members took part.

A full report of this Meeting will appear in a future number of the proceedings.

MEETINGS OF SECTIONS.

ENTOMOLOGICAL SECTION.

SEPT. 8TH, 1868.—Mr. S. BARTON, M.E.S., President, in the Chair.

Mr. EDWYN C. REED, formerly Hon. Secretary of the Section, who has recently returned from Bahia, was present, and gave an interesting account of the Entomology of the Brazils.

Mr. REED stated that he had been very unfortunate in selecting Bahia as a collecting ground, but he was induced to do so for several reasons; chiefly, however, because it was equi-distant from Para on the one hand and Rio de Janeiro on the other, from which places most of the principal Brazilian collections had been obtained.

In choosing an intermediate station, he hoped to find numerous examples of many genera sparingly represented at those places; for instance of the genus Agra, belonging to the Geodephaga, many species of which occur on the Amazon and several at Rio. Such proved not to be the case, however, for he had found but six species at Bahia during three years' collecting.

Again, Mr. BATES records the capture of many species of Papilio in a day on the Amazon; he, Mr. REED, found only five during his stay at Bahia. The genus Haliconia, so strongly represented on the Amazon, likewise yielded only some six species at Bahia. Ants, however, he found to be very numerous, so much so as to entail a serious loss on the coffee and cocoa planters. One species, called in Portuguese "Formiga da mandioc," strips small trees of their leaves in a few minutes. This ant, he observed, was no where more abundant than in the City of Bahia, in many of the suburbs of which it is impossible to cultivate even a small garden, as a midnight visit from this fierce marauder will reduce a pretty garden to a mass of leafless stumps and twigs. It was, said Mr. REED, an interesting sight to see these ants at work, some cutting off the leaves and letting them fall to the ground, where hundreds are ready to cut them up and carry them off; hundreds more running up and down the trunk, those passing down always carrying bits of leaf in their mouths. Wherever they travel regularly, a road about six inches wide, and worn quite smooth, is to be seen.

A good sized nest of this species will cover a piece of ground from fifty to a hundred yards in diameter. Among the ants are found many stinging, or rather biting species, the bites from which are very painful. One, the fire-ant, (formiga de fogo) has a very painful bite, but it passes away immediately, without leaving any swelling or other effect.

Mr. Reed concluded his remarks by saying that he regretted he was unable to exhibit specimens of most of the insects he had mentioned, his entomological collection being still in the hands of his London agent.

GEOLOGICAL SECTION.

July 15th, 1868.—The fourth walk of the Section took place on this day, to Dundry. For the following account of it, we are indebted to Mr. W. W. Stoddart, F.G.S., under whose guidance the party was placed.

The party passed first through Bedminster Down, where the relative positions of the Trias and lowest beds of the Lias were pointed out. The ascent of the Hill was made by the western road. The first halt was for the purpose of finding out the Marlstone bed, and of ascertaining its height above the sea level; this was calculated to be four hundred and eighty-one feet. The Knoll and Cross-road Quarries were next examined, but owing to their being unworked the collecting bags were not well filled. Numerous and very good examples of corals were obtained, some of the more common Mollusca, and the carapace of a *Glyphea rostrata*.

Before leaving the Hill, the Members obtained an unusually advantageous view of a thunderstorm. It was well observed from the top of Dundry Hill, which has an altitude of more than seven hundred and sixty feet above the sea level. The storm was seen to come from the direction of Yatton and Ashton, thence (missing the Hotwells end of Bristol) it passed over Durdham Down, Cotham, and away towards Bath. The flashes were very beautiful and characteristic, exhibiting very distinctly the difference between those from the positive and negative ends of the cloud. In the one case they were of the usual zig-zag form, and in the other straight and threadlike. During the whole time heavy rain was seen to fall, at the various spots over which the storm passed, while the summit of the Hill where the party stood was dry and dusty.

One of the Members collected a specimen of the coral bed containing a colony of Lithodomi in all its stages of growth; and snugly preserved in their stony homes.

SEPTEMBER 9TH, 1868.—The fifth walk of the Section, the destination of which was Dundas, took place on this day. About seventeen members and visitors were present. The party left Bristol by rail for Limpley-Stoke, from whence they walked to Dundas. The quarry was found to be quite overgrown with vegetation, but a little searching revealed the bed of Upper Lias, which is only about one foot in thickness, and immediately underlies the Inferior Oolite.

Amongst the Fossils obtained from the Upper Lias bed were the following *Lingula Beanii*, *Avicula inœquivalvis*, *Ammonites serpentinus*, *Ammonites bifrons or Walcotti* and *Ammonites crassus.*

The Rev. H. H. WINWOOD acted as guide, and supplied the names of the fossils obtained, and also explained the peculiarity of the beds. This consists in the absence of the Liassic (or Oolite) sands, which are in some localities of enormous thickness, but here entirely wanting.

SEPT. 23RD.—The sixth walk of the season was taken on this day. Sixteen Members and Visitors attended.

The party left Bristol by rail for Bathampton, whence they walked, via Bathford, to the quarries on Farleigh Down. There some fossils were obtained from the Oolite and Bradford clay.

Attention was directed to a curious recent conglomerate containing flints, &c. The cementing portion of this substance being carbonate of lime, evidently deposited by infiltration.

Although late in the season, the weather proved very fine, and a very enjoyable afternoon was spent.

The party returned to Bristol by an early train.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

Vol. III. NOVEMBER, 1868. No. 8.

GENERAL MEETING.

THURSDAY, 5TH NOVEMBER, 1868—Mr. WILLIAM SANDERS, F.R.S., F.G.S., President, in the Chair.

The Minutes of the last Meeting having been read and confirmed, the Hon. Secretary announced that Mr. J. N. Burt, the Rev. J. Perrin, Mr. Board, Dr. Debus, F.R.S., and Mr. N. Andrews, had been elected Ordinary Members; Mr. Gabriel Poole, Mr. F. Fedden, Mr. W. Theobald, Jun., and Mr. E. C. Reed, Corresponding Members; and Mrs. A. Brittan, Mrs. W. L. Carpenter, Mrs. Leipner, Miss May, Mrs. Stoddart, and Mrs. Yabbicom, Lady Associates of the Society. Mr. Adolph Leipner, Hon. Secretary, then read a Paper by Mr. E. C. Reed, entitled "Stray Notes from the Brazils," of which the following is an abstract:—

February, 1865, found me on the Mersey on board the fine steamer "Herschel," and in due course I arrived at Bahia. The City of Bahia, which is about half the size of Bristol, is built on the side of a hill about two hundred and fifty feet in height. From a distance it looks extremely beautiful, but on landing the illusion is soon dispelled by the very dirty condition of the streets. All the principal trade of Bahia, indeed I may say of Brazil, is carried on by Europeans. An immense number of varieties of the human race are to be seen in this city; slaves were formerly brought from all parts of Africa, and also from Madagascar, these crossing and recrossing with the Portuguese race have produced all possible tints and gradations of colour. The Brazilians are generally a weak race, but some of the blacks of Bahia are the strongest men I have ever seen.

On the evening of my arrival I captured my first Brazilian insect, a beautiful green *Blatta*. As we were dining it flew in through the open window, and pitched on the cloth.

Next day I went out collecting, and entering a small wood I found numbers of splendid insects entirely new to me. Suddenly I heard a shrill whistle, which I concluded came from some railway near, but upon closer inspection I found it proceeded from a Cicadæ, perched on the trunk of a tree,—this I soon transferred to my collecting bottle, and endeavoured to find the female, but without success. It must be remembered that only the male Cicadæ produce sound, and this proceeds from a complex arrangement of plates at the base of the posterior coccæ.

On this day also I saw for the first time the *Tiu*, a large edible lizard, the flesh of which is extremely white and better than that of any capon; I felt some little repugnance to it at first, but found it so good that I never afterwards missed an opportunity of shooting and eating it. After a residence of about two months in Bahia, I went to Valencia, a sandy district, where I took many good species of Coleoptera. After a fortnight's stay there I went to Ilheos, one of the oldest towns in Brazil, situated about two hundred miles south of Bahia. At Ilheos I remained nearly two years, during which time I sent home several collections of insects, and I believe upwards of fifty species of Orchids, and other plants. Of about two thousand plants which I obtained, five hundred did well, and are now in the Gardens at Kew, those of the Royal Horticultural Society, and the collection of Mr. Wilson Saunders.

During my stay at Ilheos, I explored a part of the river Itahype, in a canoe. At nearly every mile we had to drag the canoe up a rapid, above which we generally found a beautiful still basin, sometimes of great width, surrounded by magnificent trees covered with innumerable species of Parasites, or rather Epiphytes. Amongst the most distinctive features of the Brazilian forests are the Araceæ, a family, of which "Arum maculatum" is the British representative. But how different are the tropical forms. Growing up to a height of fifty or sixty feet, they branch out on all sides, and send off roots in all directions. These roots are used by the natives for making baskets and cords; they are very tough and elastic, and are sometimes found forty feet in length.

Besides these, I noticed numerous species of *Bromeliaciæ*, an occasional Screw-palm, Cedar, Rosewood, and Logwood Trees, and an immense number of Orchids. In the wet moss at the rapids and on the river bank I obtained insects of the genera *Stenus* and *Elnus.* We shot abundance of Wild Pigs, three species of Monkeys, a fine Otter, two Tapirs, some Capibara, many Gallinaceous Birds, and some Parrots. Fish also were abundant, and we salted large quantities. I should have stayed here some time had not insects been difficult to obtain, and had I not suffered from a severe attack of that tropical scourge, intermittent fever; I therefore returned to Ilheos. On the 29th July, 1867, I again left Ilheos with a troop of three men who were returning, with their mules, to their home in the interior. In twenty days we arrived at a miserable village of tame (I cannot say civilized) Indians, the Catolé.

The men go nearly naked, the women have a short skirt only; the village consisted of about eight huts, in a very dilapidated state; their language is very gutteral; with difficulty I learned a few words. As our animals were very much exhausted, not having found any grass for the last twenty days, we were obliged to remain here nearly a week, which I spent in making some Ethnological researches. I found another village inhabited by a tribe totally different in features, language, and habits. These were Botocudos.

The Indians of the Catolé are Camacans. They are a comparatively settled people, planting large quantities of roots for food, and cotton, which they spin into very good cloth; they use no tattooing, but like a little paint on festive occasions. This is generally put on in streaks about half an inch wide, over the face, arms, and breast; the women use ordinary earrings, but do not pierce the nose or lips. The Botocudos plant little, and generally live by hunting—they tattoo a little. I never saw one painted. They make incisions in the lower lip and ears, in which round pieces of flat wood are inserted. Their especial ambition appears to consist in forcing the largest piece of wood possible into this incision. I saw an old man with a piece fully four inches in diameter; the earpieces are necessarily smaller, rarely exceeding two inches in diameter. The remnants of two other tribes are to be found in the neighbourhood, but I did not see them.

Two days after leaving the Catolé we arrived at Cachimbo, a town on the River Pardo, consisting of some twenty houses and huts, and a church large enough to contain 200 persons. There the deciduous woods commence, mixed with patches of the great forest. Four more days' journey brought us to the Campinos, situate between the Rivers Pardo and Icquitironhia, where I found large droves of half-wild cattle and horses, and many houses scattered about. Perhaps the inhabitants are about four to the square mile. I remained here some time, and collected many insects and plants, but found great difficulty in obtaining the necessaries of life. The land is very productive, and by two months' industry sufficient food may be obtained to maintain a family for a year, but such is the idleness of the people that they barely have sufficient for home consumption, and I could scarcely buy anything. Again, a small mud hut does not afford sufficient facility for preserving such delicate things as insects from the attack of ants and cockroaches, so after several trials and disasters I gave it up in despair. I found the temperature here very different from that on the Coast. I never saw the thermometer at the latter place below 57° Fahrt., here it is down to 52°. At Ilheos 90° is high, but here I frequently found it 104°. As I could not return to the Coast until February, it being considered unsafe to enter the forest during the rainy season, I went to the River Verde, a tributary of the San Francisco, but saw nothing worthy of remark, so I availed myself of the first opportunity of returning to Ilheos. On my return journey I was more struck than on my first by the variable nature of the forest trees. Sometimes five or ten miles altered the entire nature of the growth. For instance, in some places we found little except Palms and Bromeliacæ in a sandy soil, at others we could not find a Palm to thatch our rancho, clay and loam replacing the sand. I noticed a curious family of large soft-wooded trees, here called Barigudas, of which I saw more than a dozen species. These trees are never found on the sea coast, but commence about fifty miles in the interior.

A bird allied to the Whip-poor-will is very common in the forest on the Coast, and I heard its plaintive cry just before meeting with the first Bariguda,—here, however it abruptly terminates—*and they are never found together.* This is a curious fact well known to the woodmen. The blossom of one species of Barigudas is very destructive to cattle; they eat it greedily, and a large number die. It is said that even deer are sometimes found dead beneath the trees.

I will now give a list of the principal animals I met with, commencing with the Quadrumana. Four genera occur—*Mycetes*, *Callithrix*, *Cebus*, and *Jacchus*—but I found some difficulty in determining the species. *Mycetes fuscus* is by far the most common howling monkey, and well it deserves its name; its decidedly unmelodious voice may be heard for nearly a mile, and as these monkeys commonly assemble in large bands, their combined noise is beyond description. They frequently imitate the Jaguar, though not very closely. In my opinion their flesh is by far the best flavoured meat obtainable in the Brazils.

The Marmoset *Jacchus vulgaris* is very common round the plantations; its chief food being bananas. The blacks catch them in great numbers, in large baskets constructed on the same principle as the lobster pot, baited with bananas. A larger species of Jacchus occurs in the interior.

Bats are very numerous, and some of them are very large. One species of Vampire Bat measures thirty inches across the wings. Cattle and horses suffer much from their attacks, sometimes even men are wounded during their sleep, but this is rare.

The Jaguar, *Leopardus onca*, is now somewhat rare on the coast, though rather common in the great forest, where its footprints are very frequently seen, but the animal, from its stealthy habits, is seldom to be met with. A Jaguar hunt is attended with little danger to man if many dogs are present, for while fighting with the dogs, to whom the Jaguar has a great antipathy, it may be approached with impunity.

The Puma, *Leopardus concolor*, called in Portuguese the Susúerana, is more frequently met with than the Jaguar, and is supposed to be a much less courageous animal. Various Ocelots also occur. They vary much in colour and are very destructive to poultry. Two species of Otters are also found, but are rare.

A Racoon, called by the natives Maspellida, is sometimes met with, but from its cunning and nocturnal habits is seldom killed. It is extremely variable in colour. The specimen I shot was blackish brown, with irregular yellowish bands on the body ; the tail had alternate black and yellow rings. The species may perhaps be *Procyon cancrivorus*.

The Coaiti, *Nasua rufa*, is a lively little animal, frequently met with in small companies. It is easily domesticated, but from its destructive habits is not a pleasant companion. This species varies much in colour.

Two Marsupials are common in the Brazils, skulls of which are now before you ; they may, I think, be referred to *Didelphis azara* and *Didelphis guica*. They are generally found about houses and in plantations. Whales of various kinds are frequently found on the coast.

I certainly expected to find a large number of Rodents in Brazil, but I am acquainted with some dozen species only. The ordinary brown Rat is common everywhere, but the Mouse, here called Rata calanga, is confined to the towns. I twice met with a species of Porcupine, that appears to me decidedly different from *Cercolabes prehensilis*. It is smaller and the spines are yellow tipped with black, but it has the prehensile tail. It is met with chiefly in sandy places.

The Agouti, *Dasyprocta agouti*, called in Brazil the Coteia, is perhaps the most common animal in the country. Its flesh is good but rather dry. When chased by dogs it generally runs in a circle, and endeavours to take shelter in fallen trees or amongst stones. If it takes shelter in a hollow tree its extrication is attended with difficulty and some danger, as snakes may be driven out with the Agouti.

The "Paca," *Cœlogenys paca*, is nearly as common as the preceding species. It burrows in the earth, but I never heard of its living in hollow trees. It is very fond of the water, and when chased always takes shelter there. This animal has been accused of doing injury to the sugar canes—an accusation I think unfounded, as during nearly three years I was intimately acquainted with all the principal planters of Ilheos and must have heard of it if such had been the case. I believe the harm is really done by the Racoon before mentioned. The Paca does, however, eat cocoa. Its flesh is delicious.

The Capybara, *Hydrochœrus capybara*, is certainly the most curious of the Brazilian animals. Its bristly hair and great size are quite exceptional features in the Rodent family. It is a water loving animal, and is never found at any distance from a river. It not only swims well, but is a good diver, and can remain under water more than five minutes. It does great damage to the rice plantations.

Several species of Aperea occur, but I know little about them.

In the interior I found two species of the Tapeti. These much resemble the English rabbit, but are smaller. The Tapir, called in Portuguese the Anta, is not uncommon. It lives in the woods, but is most frequent near rivers. It is usually captured in deep pits slightly covered over with palm leaves and vegetable debris. It is easily tamed, and is a quiet inoffensive animal, although it will occasionally inflict severe wounds on the dogs. Its flesh is not particularly good, and is not unlike ordinary beef.

At least two species of wild Pigs are found in Brazil. The smaller one, *Dycotyles tajasu*, is most commonly met with near plantations, where it plays sad havoc with the mandioc. The white lipped Peccary, *Dycotyles labiatus*, is chiefly met with in the woods, rarely entering the plantations. In my opinion it is the most dangerous antagonist met with in the country, and I would certainly rather fight a Jaguar than a brave band of white lipped Peccaries. More than once I have been obliged to climb a tree in order to get out of their reach. When angry they clash their teeth smartly together, producing a sound audible at some distance.

Three or four species of Armadillos are not uncommon. The largest, *Priodonta gigas*, called the Tetuasû, is frequently found in the cemetery of Ilheos. A smaller species, which I believe to be the *Dasypus peba*, called the Taturabe molle, or soft tail, is the commonest of all. It burrows with incredible rapidity.

Several species of Ant-eaters occur, the largest, *Myrmecophaga jubata*, is not uncommon. I was once compelled by hunger to eat its flesh, and found it abominable.

The Tamanduà, *Myrmecophaga tamandua*, is the most common species. It is so variable, that I do not think I ever saw two exactly alike. It is said to eat honey.

A Sloth, which I refer to Bradipus tridactylus, is common on the sea coast, but is never found in the interior. Cyclotherus didactylus also occurs.

I must now notice a few of the Birds of Ilheos.

Commencing with the Urabûs, the first on the list is the *Sarcorumpus papa*, which is very rare on the coast, but more frequent on the inland plains.

Two species of Cathartes are common everywhere, viz. *Cathartes fœtidus* and *Cathartes aura.* I fancy there are indeed more species than these, but I avoided shooting those nasty yet useful birds. I once shot a specimen of *Cathartes fœtidus*, and can most positively affirm that it well deserves its name. It measured seven feet across the wings. It is rather a singular fact, that these carrion birds should eat any vegetable food, but they are especially fond of the nuts of the species of palm, from which the true palm oil is extracted.

Passing to the Falcons, the next bird I can take note of is the Caracará. The Ilheos species scarcely appears to me to be the *Polyboras Braziliensis*, but if not the same, it is very closely allied to that species.

Hawks are generally abundant. I know more than twenty species, some large, others scarcely larger than a thrush.

Owls occur, but are not abundant. Three or four species only are common.

Passing to the Parrot family. The Ararauna is by no means rare, but is never seen in numbers—I think I have seen a dozen together, but never more—in this respect differing from its congeners, especially the Maracanà.

About six species of Maracanàs occur. Though found throughout the whole year, they are most abundant during the rainy season. They are, I believe, untameable.

About the members of the Parrot family, I can give but very little information. Upwards of sixty species occur, chiefly during the rainy season. They are caught for the purpose of food in large numbers, chiefly by means of bird lime and a decoy bird. Many species are very local even in their migrations, different species being found at stations only twenty miles apart. For example : at Rio-das-contas a large green Parrot with a yellow head, occurs more or less frequently every year, but I believe it has never been taken at Itahype, eighteen miles off, probably because its favourite food does not occur there.

A large number of beautiful Woodpeckers are to be found, and some of them are as tame as the Robins in England. I have frequently taken down epithetical plants from a tree while the Woodpeckers were busy overhead.

I found two species of Crotophaga on the coast, and a third on the plains of the interior. The coast species are blue black, the other is black and white. One species, which lives in flocks of from twelve to twenty birds, is very common. They build a large nest common to the flock, in which I have sometimes found nearly thirty eggs. The eggs are about an inch long, scarcely longer than wide, and at first sight appear very rough and white, but they are really blue, but with a white crust which easily rubs off. This bird feeds upon insects, chiefly Lepidopterous larvæ. It is found only in cultivated districts and old plantations, never in the primæval forest.

Land Tortoises are common in Brazil. They are generally found about ten inches long, but I once saw one that weighed fifty pounds, and measured nearly eighteen inches in length. An odd little mud tortoise, closely allied if not belonging to the genus Rhinosternum, is also common in most of the rivers.

Two species of Alligators occur. The commonest is called by the Portuguese Jacarà, and I have always considered its scientific name to be *Caiman palpybrosus*, though it would appear that it is the species Wood describes under the name of *Jacaré sclerops.* Large specimens are about nine or ten feet long. I have frequently encountered them on the banks of rivers, and have shot many.

The Amphisbœnidæ are represented by different species. The commonest, *Amphisbœna alba*, is frequently found in the nests of the Termites. It is known as the two headed snake, and is supposed to be very venomous. I scarcely need say this is not the case.

Lizards of many species are abundant. The largest, known as the Tiu, *Teius teguexin*, as I before stated, is excellent eating. The Tiu is very fond of eggs, and will sometimes enter hen houses in search of them. I supposed its food to consist principally of insects, but I once saw a Tiu catch and eat a poisonous snake. Five venomous serpents are common at Ilheos, but their noxious qualites are, I think, much over rated.

Amongst the chief are the Rattle-snake, *Crotalus horridus*, which is confined to sandy places, and the Surucucú, *Lachesis mutus*, found only in damp places in the forests. The keeled scales of this latter species are very curious, and the skin is handsome when the animal is alive ; but from its great size and activity, it is by no means a pleasant neighbour.

Several other snakes occur, but I have no space now to mention them.

Mr. W. W. Stoddart, F.G.S., then read a paper entitled "Geological Notes from Norwich."

After speaking of the nature of the Norfolk and Suffolk beds, and showing, by means of diagrams, the probable mode in which they had been deposited, and their relative position in point of time, he proceeded to describe the various beds in detail. He said—

The whole of the strata with which we have to do are based upon the London clay.

First is the red crag. This is the oldest deposit of the Pliocene beds. It is composed of quartzose sand, and both it and its fossils are distinguished by their peculiar red colour. It is only about forty feet in thickness, but has been subjected to great denudation.

As a warning to Geologists not always to consider the fossils found in a deposit as having existed during its formation, I would state that at Bramerton I picked up numbers of the little Potamides so well known in the Isle of Wight. My first impression was, that the bed was Miocene, until a further consideration brought me to the conclusion that the sand banks would naturally be the receptacles of dead shells. Besides this, in many parts of the red crag, phosphatic nodules, occur, which contain crustaceans and fishes washed out of the London clay beneath.

Between the red crag and the next, or Norwich crag, are found two clay beds, one at Bridlington, in Yorkshire, and the other at Chillisford, in Norfolk. Although so far apart, they are of the same age.

The Norwich mammaliferous crag comes next. It is a fluviomarine deposit of shelly sand and gravel. It is very rich in organic remains, especially mammalian. Near Cromer the Norwich crag lies directly on the chalk, and is well seen between that place and Weybourne. The list of its fossil mollusca contains as many as eighty-nine per cent. of existing forms.

A very fine section of the beds was made at Bramerton, for the use of the British Association. About three feet of the red crag was at the base, and the Norwich crag immediately above it, containing two thick beds of shell, each six or seven feet thick.

Above the Norwich crag lay the forest bed of Cromer. This ancient forest bed is now buried and covered up by the Norfolk drift. To this formation the names boulder clay or glacial deposit have been given, because it is now believed to be the result of glacial or ice action. It is composed of sand, sometimes stratified and sometimes contorted. Amongst this are boulders of all sizes, some polished or scratched by rubbing on the rocks. The drift is, in fact, an accumulated mass of gravelly sand, containing fragments of all sorts of rocks, with boulders of all sizes, mixed without the slightest regularity.

The short discussion which followed Mr. Stoddart's paper concluded the proceedings.

MEETINGS OF SECTIONS.

ENTOMOLOGICAL SECTION.

OCTOBER 15TH, 1868.—Mr. S. BARTON, President, in the Chair,

Mr. E. C. REED exhibited a quantity of small Coleoptera, taken by him in Brazil. Many of them were closely allied to some of the British Genera. In the course of his remarks Mr. Reed stated, that it was a mistake to suppose that all tropical insects were large, as upwards of ninety per cent. were as small as those now shown.

The President then exhibited a fine specimen of *Monohammus dentator.* It had not long left the pupa. It was brought to him alive, having been taken in the neighbourhood. Its antennæ measured eight inches from tip to tip. He also showed four species of Coleoptera, which had been found alive in a small packing case from Barbadoes; there were, he said, many examples of one species, but not having been able as yet to compare them, he could not say what they were.

The Hon. Secretary then exhibited the result of a day's collecting in South Wales, near Swansea. His box contained about five hundred specimens, and nearly sixty species, amongst which were large numbers of Nebria complanata and Broscus cephalotus, which he distributed amongst the members of the Section.

BOTANICAL SECTION.

OCTOBER 15TH.—The first Meeting of the Session was held at the residence of Mr. S. Derham. After that gentleman had entertained the Members at tea, Mr. LEIPNER, President, occupying the Chair:—

A conversation took place on the effects of the late weather on vegetation, and instances were mentioned of the Corsus sanguinea being now in flower, and of a second crop of apples being formed on the trees.

The Rev. W. W. SPICER, presented to the Section the plants he had been collecting for the Society's Herbarium during the past summer, numbering 456 species and varieties, admirably dried and mounted, and arranged according to the London Botanical Catalogue, and the Index Fungorum

Britannicorum. Of these, 411 were Phœnogamous plants, and 45 Cryptogamous plants, or 325 Exogens, 86 Endogens, 14 Acrogens, and 31 Thallogens. Mr. Spicer said it gave him much pleasure to ask the acceptance by the Section of the specimens which were the result of his rambles during the leisure he had lately enjoyed; he had named them carefully, and to the best of his ability, and should any errors have crept in it was not for want of watchfulness on his part.

The Chairman said a vote of thanks would be a very inadequate mode of expressing their gratitude to Mr. Spicer for this handsome addition to their Herbarium, but he was sure the members would concur with him in looking back with pleasure to the short period of their friend's sojourn among them, and in hoping that when he returned to his parishioners he would still assist them with his advice and counsel.

Mr. Derham exhibited a basket of Fungi, collected in the neighbourhood of Wrington. Besides a number of other species, were the following:—

Agaricus imbricatus.
,, squamosus.
,, sulfureus.
,, galopus.
,, Fæniseeii.
,, semiglobatus.
Lycoperdon geminatum.

GEOLOGICAL SECTION.

October 14th, 1868.—Mr. W. Sanders, F.R.S., F.G.S., President of the Society, in the Chair.

Mr. Adolph Leipner gave an account of the "Carboniferous Corals in the Museum Collection of the Bristol Philosophical Institution."

The author at the outset wished it to be understood that any remarks containing views differing from those of the Authors of the "Monograph of the British Fossil Corals," were offered with the greatest diffidence; that in reviewing the collection, now by him named and arranged according to the Monograph, he would follow the latter closely, and even mention Genera and Species not yet represented in the Museum, in the hope that a list of desiderata would stimulate the energies of local collectors, and perhaps also bring presents or offers of exchange even from a distance. *The desiderata are printed in Italics.*

At the request of the author, we omit the description of the Families, Genera, and Species, as these can be found by referring to the Monograph, and only give his special remarks on some of the species and specimens. The author proceeded as follows :—

Family I. MILLEPORIDÆ. 1, Genus FISTULIPORA. *F. minor*, Mc.C.; *F. major*, Mc.C. 2, Genus, PROPORA. *P. cyclostoma*, Phill. Family II. FAVOSITIDÆ. 1, Genus FAVOSITES. *F. parasitica*, Phill. 2, Genus MICHELINIA. M. favosa, Goldf. Of this species the collection possesses eight specimens, from Masbury, Mendips, the Black Rock, Bristol, and from Knowle Quarry, near Brentry—it also occurs at Combe Hill, near Henbury. The specimen No. 1 has been in the hands of the authors of the Monograph, and I believe it to be the specimen figured in the Monograph, Pl. 44, fig. 2. Of the second species of this Genus, viz., M. tenuisepta, Phill., the Museum possesses but one specimen, which is the one figured in the Monograph Pl. 44. fig. 1, and is from Masbury, Mendips. M. megastoma Phill. is represented by three specimens, of which one—unfortunately without locality mentioned—is figured in the Monograph, Pl. 44, fig. 3. The other two specimens are from Masbury, Mendips, and Black Rock, Bristol. *M. antiqua*, Mc.C. 3, Genus ALVEOLITES. A septosa Flem. is represented by seven very fine specimens, six of which are from our own Rocks. No. 19, a Bristol specimen, exhibiting the external surface, is the original of Monograph, Pl. 45, fig. 5. No. 22 also has been in the hands of the authors of the Monograph. A depressa, Flem. Three of the six specimens of this species (Nos. 26, 27, 28,) have been thus named by the authors of the Monograph themselves, who have had them for examination, when preparing that publication; on comparing, however, all our Museum specimens of Alveolites, (which, without exception, are from our own district) and availing myself of the frequent opportunities of examining specimens of this genus, I cannot help thinking that "A depressa, Flem.—A capillaris, Phill." is only an extremely small form of "A septosa, Flem."—a view which apparently McCoy is also inclined to adopt—See McCoy Brit. Pal. Foss. p. 82." This, I think, is certain, that large specimens will sometimes exhibit a great diversity in the diameter of the calices, and that we possess almost all possible forms between the typical "septosa," and the equally typical "depressa." There is, however, one form of Alveolites occurring in our Rocks, of which we have two specimens in the collection, (Nos. 32, 33,) probably from Knowle Quarry, near Brentry, which I must certainly regard as a new and most distinct species, presenting a peculiar gyrate or labyrinthine outline in a cross-section; I therefore have not given them a specific name in the catalogue.

(In the course of conversation, which arose here among the Members of the Section, Mr. W. W. Stoddart, F.G.S., stated, that though he could not quite agree with Mr. Leipner's remarks on "A septosa and A depressa," yet he fully concurred in the opinion that Nos. 32 and 33 were a distinct and as yet undescribed species.)

4, Genus CHÆTETES. *Ch. radians*, Fischer. *Ch. tumidus*, Phill. 5, Genus BEAUMONTIA. *B. Egertoni*, M. Edw., *B. laxa*, McC. 6, Genus SYRINGOPORA. For the thorough examination of this genus, we possess abundant material, there being no less than 26 specimens in the collection; and some parts of our Rocks abounding in them, they furnish still greater opportunity for study. But I must acknowledge that as yet I have not been as successful with this Genus as I could wish, and that the dubious frame of mind of Mr. Stutchbury, when working among these corals, seems also to have descended upon me. Several specimens Mr. Stutchbury had entered in the Old Catalogue as "allied to S. ramulosa,"—"allied to S. geniculata,"—and one specimen (No. 53) was named by him "S. reticulata,"—whilst another (now No. 54), which I have no doubt is but the lower part, and thus younger growth of the same, was named "S. geniculata." Some specimens are typical—at least, in my opinion—of S. ramulosa, Goldf., as, for example, No. 34, from the Mendips, No. 37, from Cleeve, and Nos. 40 to 43, from Bristol. Others would furnish types of "S. reticulata Goldf.," as Nos. 51, 52, from Bristol; and others again, of "S. Geniculata, Phill." viz. Nos. 53, 54, from Bristol (?); but what is to be done with all the intermediate forms—intermediate as to size of corallites, distance of corallites from each other, distance of connecting tubes, &c., I do not know as yet. The whole genus requires a careful revision.

Fam. III. SERIATOPORDÆ. 1, Genus RHABDOPORA. *Rh. megastoma*, Mc.C. Fam. IV. AULOPORIDÆ. 1, Genus PYRGIA. P. Labechii, M. Edw., No. 61. I have thus named in the Catalogue, but feel by no means certain as to the correctness of the name. The description of this species is to me too vague, and I have had no opportunity of obtaining a view of the work to which our authors refer. Fam. V. CYATHAXONIDÆ. 1, Genus CYATHAXONIA. *C. cornu*, Michelin. Fam. VI. CYATHOPHYLLIADÆ. 1 Genus ZAPHRENTIS. *Z. cornucopia*, Michelin. *Z. Phillipsi*, M.Edw. Z. Griffithii, M.Edw. No. 62, I have ventured to name thus, but do not feel quite sure. It is from our own Rocks, and I am informed by Mr. Spencer Percival that the same form also occurs at Combe Hill, near Henbury. If this specimen should really be "Z. Griffithii," it would certainly be interesting, as the authors of the Monograph state that they had only seen one specimen, belonging to the collection of Mr. Stoke, which had been found at Clifton.

(Mr. W. W. Stoddart here stated that he had met with several specimens of this form, and always regarded them as belonging to this species.) Z. Enniskilini, M.Edw. The specimen (No. 63), which I have named thus, agrees in every thing with the description of this species given in the Monograph, except that the septal fossula in the specimen is on the *convex* and not on the concave side. *Z. Bowerbanki*, M.Edw., *Z. patula*, Michelin, Z. cylindrica, Scouler. Of this species we possess seven well marked specimens from our Black Rock, the Mumbles, near Swansea, and from Limerick. One of the specimens is remarkable for the great number of septa, viz.—about 90 *R. subibicina*, McC. 2, Genus AMPLEXUS. A coralloides, Sow. All our specimens (from No. 71 to No. 82) are Irish, from Limerick, and Killarney. No. 80 may possibly prove a distinct and new species, as also No. 83. *A. cornu-bovis*, Michelin, *A. nodulosus*, Phill., *A. spinosus*, De Koninck. *A. Henslowi*, M.Edw. 3, Genus LOPHOPHYLLUM. *L eruca*, Mc.C. 4, Genus CYATHOPHYLLUM. C. Murchisoni, M.Edw. The specimens of this species in the collection, six in number, are from our own Rocks, and are very typical forms, except Nos. 88 and 89, which were named by Mr. Lonsdale, and where I must acknowledge that I can see no difference between these and transverse sections of "C. Stutchburyi," except that No. 88 has perhaps the septa somewhat thinner than is usual in that species. *C. Wrighti*, M.Edw. C. Stutchburyi, M.Edw. Of this coral we have certainly a magnificent series, from Nos. 90 to 125, and these, with the exception of one from Limerick, are all from our own district, viz.—from Long Ashton, Clifton, and Knowle Quarry, near Brentry. The number of septa in our specimens I find to vary from 132 to 160. Several specimens (No. 91, 95, 98, 99,) are typical of "Turbinolia expansa, McC." (McCoy Syn. Carb. Foss. of Ireland). C. regium, Phill. The authors of the Monograph must surely have made a mistake in saying "C. crenulere, Phill." appears not to differ specifically from C. regium, and to be only a variety with smaller calices. My opinion is, that C. crenulare, Pill. is a form of "Lonsdaleia floriformis,"—a form most abundant in our Rocks, and that it ought to be included amongst the synonymes of this species. Of C. Regium, Phill. we again have a most beautiful series, as it occurs in our rocks. No. 127 is the original of Pl. 32, fig. 4, but in my opinion answers more to "C. turbinatum, Goldf." than to any other species; but as the locality of this specimen is not known, it ought never to have been figured by our authors. Again, our authors state "septa numerous, 120 to 130." Now the number of septa (always a most treacherous guide) varies in this species from 60 to double that number. For example—No. 138 has 60, 64, 68, the younger marginal corralites having of course the smaller number of septa. No. 131 has 62, 64, 68, 78, 72 septa; No. 137 has 68, 80, 72, 76, 78, septa; No. 126 has 72, 78, 85(?), 101(?), 106, septa; and in No. 145 I count 104 and 106. The external character of the calices is also very variable,—now concave, now flat, now again convex, nay almost towering up in the centre.

But this C. regium, is it really a distinct species from the preceeding, viz. C. Stutchburyi? I think not. The latter in my opinion is but the simple, and the former the compound, massive form of one and the same coral. C. Stutchburyi has not had time to produce germinations, has probably grown up in stations, which became rapidly silted up (and this the marley beds, in which we find them, prove,) has had to throw all energies into the maintainance of its own individual life. C. regium on the contrary could grow massive, reef-like, could develope latterally by germinations, no such call being made upon the vital powers to rapidly develope in height to overcome adverse circumstances. For I can see no difference between the two species in their internal structure. Moreover in No. 142 we possess a specimen, composed of *two corallites*, not as in No. 127, (the one figured in the Monograph) each calyx perfectly indepedent of the other, but united by vesicular structure; the numbers of septa in these two corallites is 104 and 116, and the height of the specimen intermediate between the typical C. Stutchburyi and the massive C. regium. No. 102 then presents us with a specimen, in which *three calices* are united, having 120, 124, 126 septa, the height of corallum intermediate. And these are by no means solitary instances of so few as 2, 3, 4, &c, corallites united, but I may safely say that I have met with more than a dozen of such specimens from our rocks, and that without searching for them. I am more doubtful however, whether it be right to regard "Turbinolia expansa, Mc. C.," as specifically identical with C. Stutchburyi, though it certainly would be difficult to separate them by a good and sharp definition. The remaining species *parracida*, Mc. C., *C. psendo-vermiculare*, Mc. C., *C. dianthoides*, Mc. C., *C. Archiacis*, M. Ew., are I am sorry to say, not represented in the collection.

(Want of time did not permit the author to complete his review of the collection; but he has promised to do so at some future meeting of the Geological Section.)

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

Vol. III. DECEMBER, 1868. No. 9.

GENERAL MEETING.

THURSDAY, DECEMBER 3rd, 1868.—Mr. THOMAS PEASE, F.G.S., one of the Vice-Presidents in the Chair.

The HON. SECRETARY having read the minutes of the last Meeting, which were confirmed, announced that Captain A. Jones, the Rev. T. C. Browne, M.A. and Mr. Prangley, Jun. had been elected Members, and Mrs. Herbert Thomas, a Lady-Associate of the Society.

He then said that the Council had recommended that a resolution should be put to the Meeting with reference to the forthcoming work of the Society on the Natural History of the Neighbourhood; it was as follows—"That it is desirable that a Guarantee Fund of from thirty to forty pounds be raised by subscription for the Society's Publication, and that any of the Fund advanced be repaid by the proceeds arising from the sale of the first part of the work, or from the Society's exchequer if it permit of it." Mr. Leipner then said he would say a few words in explanation of this resolution. It might be, he continued, in the recollection of the members that a resolution in respect to the publication of this work had been passed by the members some considerable time ago. The first part was now nearly complete, and if funds were forthcoming it might be in the hands of the public in six months. The Society was unhappily, as they all knew, by no means wealthy; the Council had therefore determined to raise the fund mentioned in the resolution in order to meet the expense of publishing the first part of the work. He might say, however, that only a small portion of the sum mentioned would in all probability be required, and he therefore trusted that the members would come forward and subscribe liberally towards it. The money could not possibly be lost, for the book would be certain to sell well, and the guarantors would be paid out of the profits of the sale. Failing that even, there were the funds of the Society, which, although not at present very flourishing, would undoubtedly shortly greatly improve, and would ere long be amply sufficient to repay any amounts drawn from the Guarantee Fund, and also to pay for the publication of the book.

The resolution was then proposed by Mr. S. Derham, seconded by Mr. Blackmore, and carried unanimously.

Mr. Leipner then said, he had also to announce that the Council had, at their last meeting, passed a resolution which it would be for the members present to confirm, it was—"That the Council consider it advisable that the Proceedings of the Society should be published quarterly, instead of monthly as heretofore.

This new arrangement was, he said, advisable for two reasons. I.—That at present the officers were much pressed for time, and consequently that in the hurry of going to press, errors crept into the publication which would be avoided by the new scheme, and: II.—That there would be a considerable saving of expense, which, in the present state of the Society's funds, would be very important. These reasons were, he thought, quite sufficient to induce the Society to endorse the opinion of the Council.

The resolution was then put from the Chair, and unanimously confirmed.

Dr. C. T. Hudson then made a communication to the Society on "A winter gathering of Rotifers." He said:—

"I had long been under the impression that during the winter months of the year it was of little use to search for Rotifers ; solitary specimens might indeed be captured, but for purposes of study solitary specimens are of very little service, as so many mishaps are sure to occur while attempting to isolate one and prepare it for microscopic investigation, that the first condition for success in this study is to have at hand several scores of the same creature.

This will be readily understood when it is remembered that to study the internal structure of a Rotifer, it is necessary first to isolate an animal often less than 1-100 part of an inch, next to place it on a compressorium in a drop of water whose diameter shall not much exceed twice its own length, and then to hold the Rotifer without crushing it between two plates of glass, which for this purpose must be brought together within 1-600th of an inch without touching each other. Should the plates of glass in the compressorium be not accurately parallel, the drop of water is certain to run away from the Rotifer along the space where the plates more nearly approach one another, such space acting as a capillary tube, and thus the creature is killed, and all the time and trouble taken in isolating it, is lost.

For these and other like reasons I had ceased to look for Rotifers in winter, but the accidental capture of a multitude of Synchœta tremula, in a pond near Exmouth, in January, made me aware that I had come to a wrong conclusion ; no doubt Rotifers are scarce in the winter months, bnt they may be met with in sufficient numbers to make them available for study.

I have thought therefore that it might be of service to others to mention what Rotifers I have met with at this time of the year, as well as the means I adopt for catching them. So far as my experience goes, all the winter Rotifers are free swimming ones ; it is true that I have met with Melicerta ringens late in November, and have then kept it eight or ten days more in captivity, but I never met with more than one at a time. As I have already said, I have taken Synchœta (S. pectinata, as well as S. tremula) in hundreds in mid-winter, and not only at Exmouth, but also at Guildford and at Bristol. Triarthra longiseta swarmed in a pond at Portbury, up to the first week of December, at which time I paid it my last visit ; it is gone now, (22nd Jan.) but I fancy that its disappearance is more owing to an alteration in the pond than to the time of year. Triarthra thrives in water dyed by manure to a decided brown colour, and when I diluted this water with rain water I found that I speedily lost all my specimens. Still there is no doubt a point at which the draining of manure into the pond kills Triarthra, and as the pond was very foul when I visited it last, and swarming with Paramecium (a sure sign of the abundant presence of decaying matter, and of the absence of almost all Rotifers except Hydatina,) I was not surprised to find my search unsuccessful.

In Garraway's pond (in quite clear water) I took, this December, Polyarthra in great numbers, a few Synchœta pectinata, a solitary Triarthra, (of what species I do not know as I lost it), and a perfect swarm of Rhinops vitrea; the latter, which is I believe a new Rotifer, I have described in the January number of the Annals and Magazine of Natural History.

My method of detecting these free swimming Rotifers is to pour some of the water into a small trough (about two inches by four), the copper framework of which holds two plate glass sides parallel to one another at a distance of a quarter of an inch, then by holding the trough opposite some dark surface, as a shady wall, tree, mould, &c. the Rotifers are readily seen as white moving specks, even by the naked eye.

I do not mean to say that it is an easy art to capture, isolate, and gently hold down one of the smaller free swimming Rotifers; but patience and perseverance will enable any one who has tolerable sight to acquire it, and when acquired there will be employment for the microscope in the winter as well as in the summer for years to come, as well as the pleasure of pursuing a subject of which little is known, and in which there is ample scope for fresh discoveries.

Mr. W. L. CARPENTER, B.A., B.Sc., then rose and said:—

"That he wished to call the attention of the members to a wonderful discovery recently made in spectrum analysis, a subject on which some of them might remember he had lectured at the Institution some time ago; the history of the discovery was this:—For about two years a well-known English astronomer, Dr. Lockyer, has entertained the idea that by fishing, as it were, round the border of the sun with a spectroscope attached to his telescope he might in course of time catch sight of one of those wonderful red prominences which form so prominent a feature in an eclipse, and might thus obtain a more accurate knowledge of their nature without having to wait for the rare opportunities afforded by the sun's obstruction. This object he at last effected on the 20th of October last, by the aid of a powerful spectroscope provided for him at the expense of the Royal Society (and which was exhibited in an incomplete state at the last meeting of the British Association in Norwich). He has, after many failures, observed carefully the spectrum of a solar prominence, which he has described in a note to the Secretary of the Royal Society. By a remarkable coincidence, the same idea of observing the red prominences by the aid of a spectroscope without the intervention of an eclipse occurred to M. Janssen, a French astronomer, when engaged in observing the late eclipse in India. This object he also succeeded in effecting, on the 19th of last August. Here then is a repetition of the case of Adams and Le Verrier. Lockyer's claim to priority of idea is unquestionable, although to Janssen belongs the honour of first practically proving the truth of the theory.

The news of the English discovery reached the great astronomer Delauney, of Paris, and was announced by him to a meeting of the Academy just five minutes before a letter from M. Janssen to that learned body was read, containing an account of his investigations.

The fact that the observations of the two savans do not exactly correspond in minor details is of little moment. The great thing is the discovery of the possibility of observing and investigating the composition of the sun and the prominences without the necessity of waiting for an eclipse.

Mr. F. C. RAVIS then read a Paper entitled "Supplementary Notes on some of the late movements on the Somersetshire Coast." He said :—

"About three years ago I read a paper before the Society on the movements of the coast of Somersetshire in geologic times, chiefly with reference to two raised beaches, one at Woodspring Hill and the other in Birnbeck Cove, both in the neighbourhood of Weston-super-mare. I observed in this communication that the land in these localities had risen some twenty or thirty feet above the sea-level since the period began, during which the present marine fauna had been in existance, and I hinted at the probability that this movement would be found to have extended over a much more considerable range of coast than that included between these two points. I propose now to bring before you a few particulars supplementary to that paper: the result of further research in the same direction.

My first note has reference to *the relative ages of the mountain limestone, and the trap at Woodspring Hill.*—That at least some of the beds of limestone which rest upon the trap were deposited before the injection of the latter is pretty evident, for some of the limestone is greatly altered by contact with the trap, and many of the limestone beds which appear from their position to be superior to the trap, though out of the line of any visible portion of it, are traversed in all directions by veins of the igneous matter. At the same time there can be I think as little doubt that the injection of the trap was prior to the movement that caused the inclination of the beds, for in general outline it appears to conform itself to that inclination, and the superincumbent strata though somewhat shattered do not seem to be thrown out of the normal dip of the entire group of rocks. In short the trap was injected probably during the deposition but before the elevation of the limestone. It is further evident that it was intruded under the water of a sea highly charged with carbonate of lime, from its being permeated by veins of that mineral. As it flowed over the surface of the sea-bottom it must have included within its surface, quantities of the water into which it was discharged from below, and on the cooling of the mass the carbonate of lime would crystalize in veins ramifying through the intruded rock.

Encroachment of the sea.—Notwithstanding the evidences of upheaval of the land displayed in this section, I cannot help thinking that the present state of things is one of encroachment of the sea on this coast. The usual marks of retirement of the sea from the shore, namely, the formation of inland cliffs, with a gradual slope of the intervening land, are here wanting. As the land rose and the beach emerged from the sea-level, the natural and inevitable tendency would be to lengthen the distance between the cliffs and the water. Twenty feet rise of the land with a shelving beach such as this, would be equivalent to a very considerable horizontal distance, yet the waves dash against the rocks immediately under the old beach. Not a single foot does the sea appear to have really retired. In the case of a precipitous cliff with deep water, of course perpendicular elevation would effect no amount of horizontal distance. But the old shore was evidently like the modern one, a sandy and shelly beach with a ridge of pebbles at the highest part. It therefore seems to me, that after retirement to such a distance as would be equivalent to a perpendicular rise of twenty feet or more, a pause has taken of sufficient duration to allow the sea to eat its way back through the foundations of the ancient beach, which it has swept away, the superincumbent deposit falling into ruin, and carried out with the tide; and still at high spring tides I doubt not it continues to assail the lower deposits which remain and thus to bring down portions of the upper by the force of gravitation, for I find that the end of the wall overhangs the cliff to the extent of some inches, and ere long unless attended to, its component stones will come down upon the shore and mingle with the natural detritus of the rocks from whence they were quarried.

Contents of the ancient beach at Woodspring.—In the paper above referred to I enumerated three or four species of mollusca found in this beach. To these I have since added several others, and by the kindness of Mr. Henry Woodward and Mr. Gwyn Jeffreys, who have taken the trouble to look over the specimens and name them, I am now able to give the following list:—

Tellina	Baltica v. solidula
Littorina	littorea
,,	obtorsata
,,	rudis
Nassa	incrassata
,,	reticulata
Cardium	edule
Murex	erinaceus
Pupa	
Helix	virgata
,,	campestris
Ostrea	edulis

It will be observed that a few of these are land shells ; whether they were washed from the land to the beach in ancient times. or have only inhabited the spot since it became a portion of the dry land, I must leave undetermined.

With these were found fragments of bone, the jaw of a small Rodent, probably Arvicola agrestis, limestone pebbles, comminuted shells, and small pieces of flint ; a few words respecting these last.

Flints.—Mr. Day mentions the same as occurring in the raised beach of Birnbeck Cove, and remarks on it as a singular fact, since there is no rock in the neighbourhood at the present day yielding flints. In the geological chapter at the end of Rutter's History of Somersetshire, it is stated that in the shingle of a small bay on the North-East side of the Flat Holmes, there are pebbles of chalk flints, sandstone, quartz, flinty slate, and porphyry. The flints at these three localities had most likely a common origrin whatever that origin may have been. May they not have been deposited at the bottom of the sea during the glacial period, and on the emergence of the sea-bottom have been redistributed by the waves, and mixed with the shells and other matters of the contiguous shore? Or having been distributed over the surface of the neighbouring heights, during the period alluded to, they may have been at a later period washed by rains and torrents from the higher to the level, and mixed with the shells and sand of the beach, just as the Tertiary shells of the Isle of Wight are washed from the cliffs and may be seen on the shore mingled with the testacea of the present age.

Supposed beach on the South side of Woodspring Hill.—I have not yet succeeded in verifying my supposition that there exists the remains of an ancient beach on the south side of Woodspring Hill. The block of pebbles and shells discovered on this side was dug out of the scarp of the footpath, which ascending the hill side at an angle with the horizontal line which the old beach would naturally keep, can of course cross that line at one point only, thus making the rediscovery of the spot very difficult.

Ancient Dunes.—The beaches referred to from their position at the foot of a precipitous cliff or steep hill, appear to have been accompanied by the sand hills or *Dunes*, so common in the rear of our modern sea shores especially when skirting a flat country; at any rate there are no signs of them on this hill so far as I have observed. But remains of the ancient Dunes of Sand bay closely adjoining Woodspring Hill on the South, which must have been contemporary with these beaches, as well as some which from their greater elevation must have been of earlier date are well seen on the northern slope of Worle Hill from above the level of Kewstoke Church to the shore. The road leading from the lodge-gate, at the entrance of the wood, to the shore of the bay, is cut through a series of them, and they appear as terraces in the adjoining field, with the modern sand-hills at their base. The upper road, through the wood from the lodge, traverses them for a considerable distance up the hill, and outside the plantation they may be traced to the base of the craggy knolls overlooking the road, a height from the shore of at least 150 feet. These are, therefore, an additional evidence of change of level of the sea-line, extending probably much farther back in point of time, than the beaches at Woodspring.

Similarly, there are the remains of ancient Dunes above the raised beach at Birnbeck Cove, which beach, from its height above the sea, may probably have been contemporary with those at Woodspring.

Another hill to which I referred in my former paper, namely Brean Down, exhibits, on its northern side, facing Weston Bay, at least two tiers of sandy accumulations, at heights ranging with some of the terraces in Sand Bay; of which the upper appears to be pure sand, and the lower to contain a large proportion of angular fragments of limestone. So far as appears there are no remains of an actual beach on this range of hill.

We have therefore, so far as observation has at present extended, alteration of relative level of land and sea illustrated very distinctly in these three hills and in one of the intervening bays, with these varying characteristics. At Woodspring we have ancient Beaches without Dunes, and at Sand Bay and Brean Down we have Dunes without Beaches, and at Birnbeck Cove we have both the Beach and the Dunes.

Sea-washed Rocks.—It is worthy of remark that some of the rocks about on a level with the highest of the sand ridges on Worle Hill, are pierced by those peculiar holes, whether made by boring mollusca or otherwise, which one sees everywhere upon sea-washed rocks.

There are also many examples of groves and striations very similar to those made by the mechanical action of the waves upon a rocky shore, but which would seem with greater probability to be due to the solvent power of sea-water, eroding the softer laminæ of the stone, and leaving the harder portions as ridges on the surface.

Parallel Terraces.—From our last illustration of change of level, let us pass to the south-eastern part of our district, and examine the singular isolated hill of Brent Knoll. Standing in the midst of the extensive flats of moors which reach from the foot of the Mendip to the Bristol Channel, about Burnham on the west, and to beyond Bridgwater on the south, it is, from its elevation and peculiar form, a conspicuous landmark from all the surrounding country. Its height is about 500 feet above the sea, or in other words, above the plain, which is little if at all higher than the sea-level. Its form is that of an irregular truncated cone, standing upon the edge of the flat top of a larger one; so that the descent is continuous on the eastern side, but interrupted by an extensive terrace or steppe on the western.

The hill is of Middle Lias, capped with a thin bed of Inferior Oolite. Whether there are any portions of Upper or Lower Lias I cannot say, but the fossils obtained are all characteristic of the Marlstone strata. The whole hill is but a small remnant saved from the extensive denudation which took place after the deposition of the Jurassic series.

The most noticeable feature of the Knoll is the great terrace on the West and North-west. It is almost level from the foot of the upper slope to the brow of the lower one and fully half a mile wide in this direction, with a length of more than a mile. The brow of the terrace may be one hundred and fifty feet high in the highest part, the rise to the foot of the upper hill may be thirty or forty feet, and the height of the latter about three hundred feet, making nearly the total of five hundred feet assigned to the whole hill, on the assumption of which as the true height, the above proportions are given as approximately correct. The denuding agent here was undoubtedly the sea, and according to the principle laid down by Sir Charles Lyall, and adopted by other writers, that terraces of this nature are formed during a pause in the process of elevation or depression, we must suppose that the mean sea-level was maintained at this height for a very long period. The superficial material of Brent Knoll being soft clay, it is reasonable to suppose that the inequalities on its surface, due to the action of the sea, were made during the *later* action. We must therefore refer these inequalities, including this great terrace, to the last rising of the land. On this supposition, the long period during which the sea was cutting its way into the hill at the level of this great platform would be contemporary with the age of the highest of the Sand Dunes and the markings on the rocks on the side of Worle Hill, which I have supposed to be at about the same height above the sea-level. These attempts at correlation are of course only provisional, subject to the test of actual measurement. That the grooves and other markings on the hard rock must have occupied a long period, during which the mean sea-level must have been pretty constantly at one height, will be probably admitted; and when we find, at the distance of eight miles, indubitable evidence, at about the same elevation, of the same fact, we may fairly consider the two sets of phenomena as contemporaneous in their production.

In addition to the great terrace, which cannot fail to arrest the attention of the most careless, there are two sets of minor terraces which, so far as I know, are not mentioned by any writers. They occur on the north-east and north-west sides of the Knoll respectively, the former series being above the great platform, and the latter below it. The higher series occupy the upper half of the steep declivity of the hill as you descend from the summit to the village of East Brent. They are from fifteen to twenty in number, arranged like the seats in an ampitheatre. and varying in height from one to four or five feet, and in breadth, as nearly as I can remember, from one to two feet. Mr. Mackintosh, in *The Intellectual Observer* for August, 1867, has maintained, with a great show of evidence, that the Cheddar ravine was cut out by marine agency. If this were so, the upper part of Brent Knoll during that period must have been above the water, and these terraces would probably be contemporary in formation with the highest and oldest portions of that remarkable gorge.

The lower series of terraces is on the side of the hill towards South Brent. The stages are more numerous than those in the upper set, and occupy the whole declivity from the edge of the great platform to within twenty feet of the base of the hill. There must be thirty or more of them, and like the others they vary much in height and breadth. The hill side is somewhat hollowed out here and there by small ravines, and the terraces mostly follow these inequalities of the ground, and show that the hollows have not been altogether formed by more modern agencies. The lowest stage being some twenty feet above the plain, corresponds notably in height with the raised beaches of Woodspring and Birnbeck. The occurrence of drift on some of the summits of the Mendip range, is evidence of the presence of the sea, at still greater heights than those I have alluded to, but to this I have not paid sufficient attention to enable me to speak with precision upon it.

The evidences I have adduced of alteration of the sea level in a distance of ten miles in extent in geologically recent times, are briefly these :—

1. Raised beaches at Woodspring Hill, and Birnbeck Cove, and lowest terrace on Brent Knoll, twenty to thirty feet above mean sea level.

2. Sand Dunes in Kewstoke bay, and Birnbeck Cove, and on Brean Down, ranging to one hundred and fifty feet.

3. Sea washed rocks on Worle Hill provisionally correlated with the great terrace on Brent Knoll, about one huudred and fifty feet.

4. Terraces on Brent Knoll to four hundred feet.

The reading of Mr. Ravis's paper concluded the proceedings.

MEETINGS OF SECTIONS.

ZOOLOGICAL SECTION.

The Meeting of this Section took place on THURSDAY, November 12th.—Mr. WILLIAM SANDERS, F.R.S., President of the Society, in the chair.

After the transaction of the ordinary business of the Section,

Mr. ADOLPH LEIPNER gave an account of the *Seals* in the Museum of the Bristol Institution. He stated that by reason of the scattered information respecting these animals, and the very imperfect diagnosis, especially as regards the differential characters, he found considerable difficulty in identifying, more particularly the lately acquired specimens from Newfoundland. The specimen, which hitherto had been the only representative of seals in the Museum, was *Halichoerus grypus*, Nilson, the original of the drawing in "Jardine's Naturalists' Library." This seems to be the most frequent species on the South-West coast of England and Wales. The specimen which, two or three years ago, was shot at Weston-super-Mare—the stuffed skin and the skull of which Mr. Charles B. Dunn had kindly brought up for the inspection of the Members of the Section—also belonged to this species. Those seals which had lately been added to the Museum belonged to two other species, viz. *Cystophora cristata*, Erxl., a young female, without crest, four and a half feet long, and three specimens of *Phoca barbata*, Fabr. One of these three is an adult nearly eight feet long, the other two are young, respectively four feet seven inches and four feet ten inches in length.

After Mr. Leipner had entered fully into the specific characters of these animals, and had given the full measurements of the most important parts, he made a few remarks on the various seal skulls in the collection. These proved to be:—four skulls of *Pachophilus Grœnlandicus*, one skull of *Cystophora cristata*, and a cranium and some large canines of *Trichecus rosmarius*.

GEOLOGICAL SECTION.

DECEMBER 9th, 1868.—Mr. WILLIAM SANDERS, F.R.S., F.G.S., President of the Society, in the Chair.

The Minutes of the last Meeting having been read and confirmed, Mr. ADOLPH LEIPNER continued his Paper, "On the Carboniferous Corals in the Museum Collection of the Bristol Institution." (The first part was given before the Section at the October Meeting.)

5, Genus CAMPOPHYLLUM. C. Murchisoni, M.Edw. The authors of the Monograph state in reference to this species, page 184, "Specimens of this Coral are in the collection of the Geological Society and of the Bristol Museum, but we do not know in what part of England they were found." This point, I am glad to say, a reference to Mr. Miller's Catalogue has cleared up, for to eight specimens of this Coral (Nos. 149 to 155) he has appended the following memorandum—"Carxophyllia, partly converted into Silex, imbedded in Red Limestone, from below a lane near Weston-super-Mare.—See G. Cumberland, Geol. Transactions." The remainining two specimens, (Nos. 147 and 148) are no doubt from the same locality, and that Clevedon and Weston-super-Mare are actually the localities of this species has quite recently been confirmed, fresh specimens from these places having been brought to me lately. 6, Genus CLISIOPHYLLUM. Cl. Turbinatum, McCoy. Only one specimen (No. 156) from Bristol represents as yet this species in our collection. This has been in the hands of the authors of the Monograph, and is figured plate 33, fig. 1. I said "as yet," for it is by no means a rare form in our rocks, and I hope soon to obtain some specimens good enough to be placed in the Museum. Cl. Coniseptum, Keyserling. Of this species we possess only one specimen (No. 157), the locality of which is however unknown. It is the one figured in the Monograph, plate 37, fig. 5a., is much weathered, and being cherty, exhibits most beautifully the internal structure. *Cl. Bowerbanki*, M.Edw. C. Keyserlingi, Mc.Coy. This also is a Bristol Coral, and the two specimens of it in the collection (Nos. 158, 159) are from our own Rocks. *Cl. Costatum*, McCoy. *Cl. Bipartitum*, McCay. 7, Genus AULOPHYLLUM. A. fungites, Fleming. We have only one specimen of it (No. 164), and the locality of it unknown. *A. Bowerbanki*, M.Edw. 8, Genus LITHOSTROTION. L. basaltiforme, Conybeare. Of the four specimens the Museum possesses of this species, one (No. 179) is from Clifton, another (171) from near Tenby, and of the other two, (No. 172 and 173), with 56 and 58 Septa, the locality is unknown. L. ensifer, M. Edw. All four specimens of this species (175 to 178) are from our rocks, and are very fine. L. aranea, Mc.Coy, is represented by only one specimen, locality unknown, with 42, 44, 46, Septa. L. Portlocki, Brom. is by no means uncommon in our rocks, five of the nine specimens in the collection (184 to 138) are from the Clifton Rocks, where it is sometimes found in huge blocks. The number of Septa I find to range between 26 and 32. *L. Macoyanum*, M.Edw. Of this Coral, Mr. W. Stoddart believes he possesses two specimens, from our own rocks, but it certainly has not been met with of late years, as I have in vain searched and enquired for it. *L. concinorum*, Lonsdale. *L. septosum*, McCoy. *L. decipiens*, McCoy. L. junceum, Fleming., is represented by three specimens, locality unknown. L. Martini, M.Edw. Nine specimens of this Coral are in the collection (192 to 200), but only of two of them is the locality known, No. 199 is from Tockington, and No. 200, (with from 24 to 26 principal Septa) is from Bristol. L. irregulare, Phillips, is in one horizon of our rocks almost the only Coral found, or rather the rocks are entirely composed of it. Twenty-three, mostly very fine specimens, represent this species in our collection, and of these more than half the number are from our own rocks. The authors of the Monograph at page 199 say "We are inclined to think that the Diphyphyllum gracile of Professor McCoy is a specimen of Lithostrontion irregulare, in which the Columella has been accidentally destroyed by the process of fossilization." This I consider a sentence altogether unworthy of the authors. Why should the Columella be more liable to such accidental destruction than any other part; and might not anything and everything be explained in this way? I cannot help thinking that McCoy's Diphyphyllum gracile is distinct from Lithostrotion irregulare, though I have not separated these two forms in our collection, wishing to follow entirely the authors of the Monograph. But Nos 208, 211, 212, 214, 215, 216, 217, and 218, are types of it, mostly from our own rocks, and a careful examination of them will show that all corallites in these specimens are without a Columella, which I think goes far to prove this a distinct form.

L. affine, Fleming, is represented by two specimens, one from Burrington, the other from a locality unknown. Of the rest of the species of this genus I should be very glad to obtain specimens for the collection, they not being fairly represented at all, *L. Phillipsi*, M.Edw., *L. Derbiense*, M.Edw., *L. major*, McCoy. *L. Arachnoideum*, McCoy. *L. Flemingi*, McCoy. 9, Genus PHILLIPSASTRÆA. *Ph. Radiata*, S. Woodw. *Ph. tuberose*, McCoy. 10, Genus PATALAXIS. *P. Portlocki*, M.Edw. 11, Genus AXOPHYLLUM. *A. radiatum*, M.Edw. 12, Genus LONSDALEIA. L. floriformis, Flem (Of the relation of Cyathophylum crenulare, Phill. to the present species I have spoken before.) Nos. 232 to 251 form a very fine series of this Coral, and there are but few among them which have not been obtained in our own neighbourhood, as for example No. 245 from Nunney, near Frome, and No. 248 from Steeraway Hill, Shropshire. *L. Papillata*, Fischer. *L. rugosa*, M.Coy. *L. duplicata*, Fleming, seems to occur but sparingly in our rocks. Our collection possesses but one specimen (No. 252) from Clifton, the other three (253 to 255) are in a cherty Limestone from Derbyshire.

Having now come to the end of my catalogue of Carboniferous Corals, I have but to state, in conclusion, that the Museum possesses besides these a goodly number of British Carboniferous Corals, (a great many of them however without entry of locality), which I have not succeeded as yet in naming. They seem to be forms not described in the Monograph, and require yet greater and more careful study than my limited time has allowed me to bestow upon them. I hope however soon to be able to give some account of them.

Index.

Bristol Microscopical Society.

Wednesday, October 16th.—Mr. W. L. Carpenter, President, in the chair.

Dr. C. T. Hudson made a communication upon some points in the structure of Floscularia campanulata, illustrating his remarks with drawings and living specimens.

Mr. F. Martin read a paper upon the Alkaloids, and the microscopic appearance of their various crystalline salts, &c. He presented to the Society a series of preparations illustrating his paper.

The Hon. Secretary, Mr. W. J. Fedden, brought forward the question of publishing the Proceedings of the Society, and as the meeting thought that publication in some form was desirable, the matter was referred to the Standing Committee to consider and report upon.

Wednesday, November 20th.—Mr. W. L. Carpenter, President in the chair.

The report of the Standing Committee, on the best mode of publishing the Society's Proceedings, was brought up, and its recommendations were adopted. It was resolved to try the experiment for one year, of publishing reports of the meetings, as well as abstracts, &c., of the papers read, and of issuing them with the Proceedings of the Bristol Naturalists' Society.

Rev. Walter Whiting then made a verbal communication upon a simple method of showing microscopic transparencies for a Table-lecture. The apparatus employed consisted of an ordinary lantern, such as might be used with the oxy-hydrogen microscope, the back part of which was removed, to allow room for the oil reservoir of the lamp. A round-wick argand burner was supplied with paraffin oil by a tin tube connected with the external reservoir, thus avoiding all risk of explosion from the overheating of the oil inside the lantern. By condensing lenses in front of the lamp, sufficient light was produced to give a bright disk from 3 to 4 feet in diameter, at a distance of about 5 feet from the lantern. The lenses used for producing the image were the ordinary portrait combination of a camera, and the objects exhibited were all photographs of microscopic preparations, mostly taken by Mr. Whiting himself, and included a great variety of subjects from the animal, vegetable, and mineral kingdoms. Many of these, especially where the object photographed had been perfectly flat, were very successful, and well calculated to illustrate popular lectures at a very small cost, as well as to afford a ready means of producing large lecture diagrams in an accurate and simple way, since the outline of the image projected on the screen could be readily traced with a pencil.

It is hoped that, in the next issue, fuller reports will be given of Dr. Hudson's and Mr. Martin's papers, read on October 16th.

Bristol Microscopical Society.

WEDNESDAY, DECEMBER 18TH, 1867.—Mr. W. L. CARPENTER, President, in the chair.

The minutes of the last meeting, relating to the publication of the Society's Proceedings, were approved.

Mr. Charles Hill, and Mr. William Budgett, were proposed as members to be ballotted for at the January meeting.

The HON. SECRETARY laid on the table a quantity of sand rich in Diatomaceæ, and of fossil Polyzoa, both from Warnhambool, Australia, for distribution amongst the members. A quantity still remains, which may be obtained on application to Mr. Fedden.

Mr. E. A. PRAEGER read a preliminary notice of some points in the microscopic examination of human teeth, and promised to continue the subject at the February meeting. The publication of this paper is therefore deferred.

ON FLOSCULARIA CAMPANULATA,

By C. T. HUDSON, M.A., LL.D.,

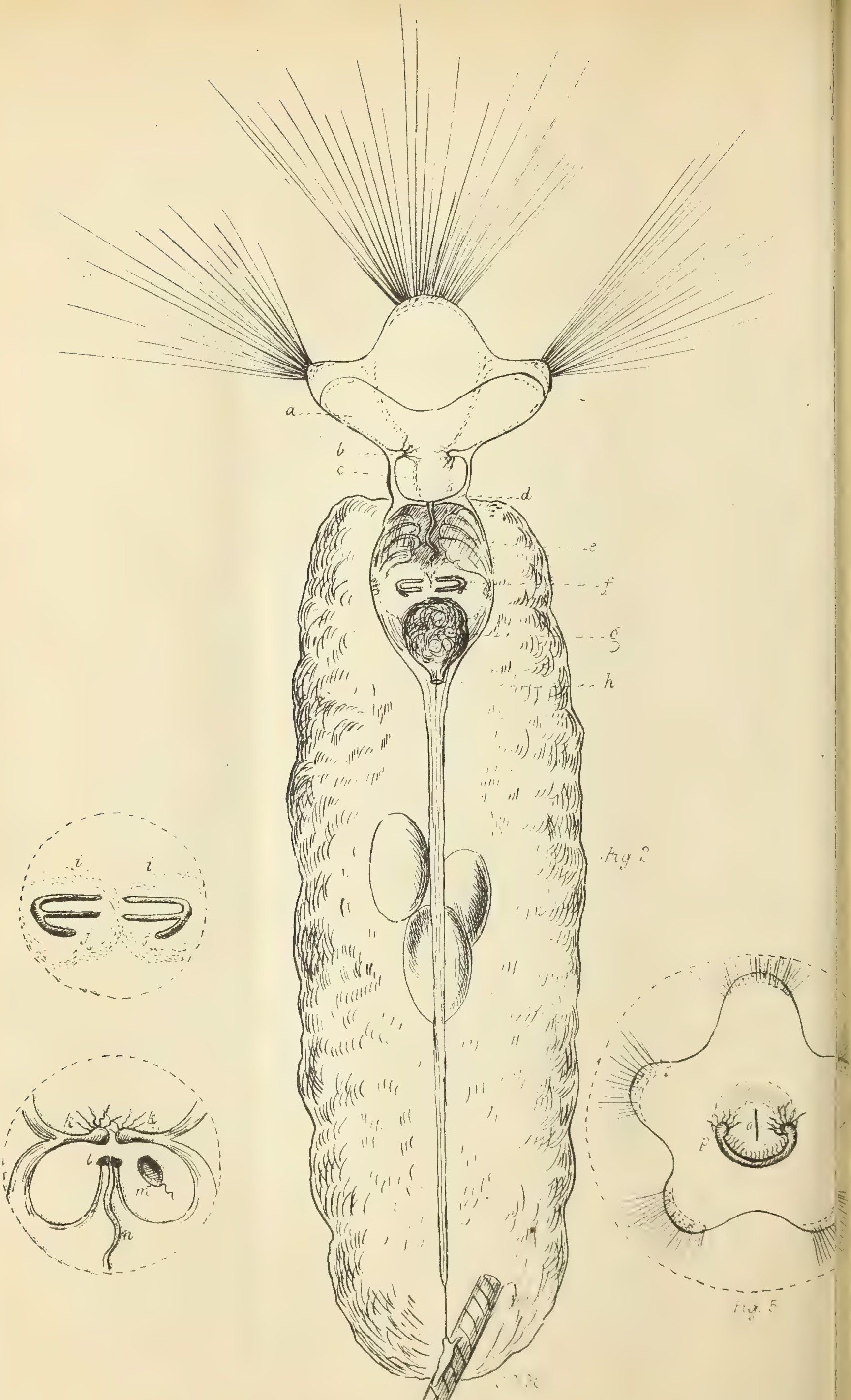
Read October 16th, 1867.

FLOSCULARIA can generally be procured in the Autumn from the pond in Garaway's nursery gardens, and this year it was very abundant on the algæ attached to the stems and under-surfaces of the leaves of the plants growing in the pond. The species was F. Campanulata, which has been well described by Dr. Dobie in the Annals of Natural History vol. 4, 1849; but he has left several points of this Rotifer's structure undetermined, and some of these its fortunate abundance this autumn has permitted me to clear up.

In the first place Floscularia, up to the present time, has been held to be in the anomalous position of a Rotifer, whose rotatory organ *does not rotate.* The five lobes of the trochal disc are fringed with very fine long hairs, which are generally extended and motionless; in figs. (1) and (2,) these setæ are only drawn to three of the five lobes, in order to prevent any confusion in the figure; they are also drawn only on the summits of the lobes, as if forming a tuft on each. They really, however, fringe the whole of the circumference of the trochal disc (a fact I believe not hitherto noticed), but as they are set in constantly (though regularly) varying directions, a large portion of them lie out of focus, and are thus by their delicacy rendered invisible when the main outline of the Rotifer and its principal tufts of setæ are distinctly seen. I have also observed that as the roots of the setæ approach nearer and nearer to the bottom of the cavity between two adjoining lobes, the setæ themselves slope further and further away from the trochal disc, until at last those at the bottom of the cavity are actually directed backwards towards the suctorial foot.

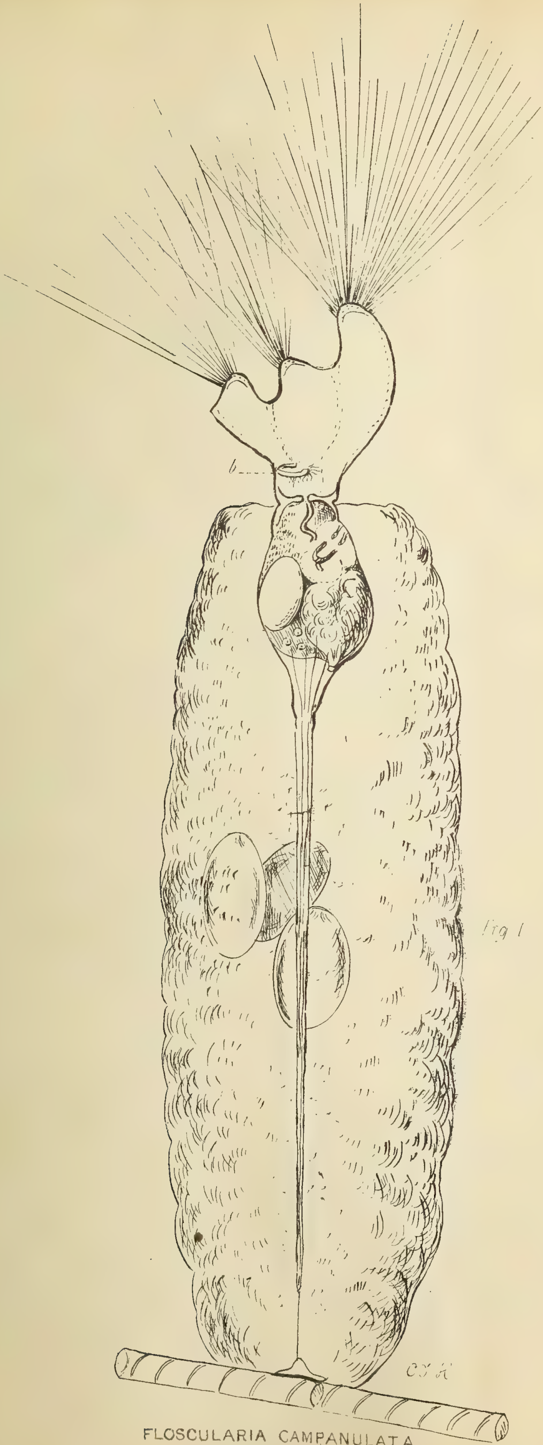
Floating particles may be constantly seen to enter the funnel-shaped trochal disc (fig. 2, *a*,) and to pass thence down to the mouth. The long setæ take no part in this process beyond that of preventing the return of the captured prey by interlacing in a dense network over the mouth of the funnel, or by individually (but only occasionally) lashing at the returning object so as to throw it back again into the funnel. The interlacing of the setæ is accomplished by the heads of the lobes being made to approach each other; and, should the prey be very large and vigorous, the lobes are all compressed tightly together, so that the aperture of the funnel is completely closed. I once saw Floscularia catch a small Rotifer which nearly filled the cavity of the funnel; the prey struggled vigorously to escape, and I was surprised to see how tenaciously the delicate lobes of Floscularia retained their grasp, although obliged at last to let the Rotifer go. Shortly after one of the style-bearing Infusoria sailed into the funnel, but it seemed quite conscious of the protection that its thorny bristles gave it, and lay quite still while Floscularia slowly and carefully distended the aperture to its utmost limit and withdrew its tender lobes from all chance of contact. On watching the animal when quiet and fully expanded, it is obvious (as Gosse has remarked) not only that a continued current sets down the funnel to the mouth, but that the prey is swept round inside in a vortex, which lies in a plane bisecting the animal in the direction of its greatest length. As this vortex could not possibly be caused by motionless setæ, Gosse rightly supposed that there must be somewhere inside the funnel minute cilia producing the current, and which cilia with their supports make the true rotatory apparatus of Floscularia.

Now on looking at fig. (2) it will be seen that the funnel (*a*) is separated from the main trunk by a chamber (*c*) called the "vestibule" by Dr. Dobie; and the funnel meets the vestibule in a thickened rim, which is capable of being completely contracted upon itself so as to close the vestibule, and prevent the escape of any thing that has entered it. About half the rim is thicker than the rest, and is covered with very minute cilia; its extremities are knob-shaped and bear long slowly-waving cilia, which are readily seen. This is the true rotatory apparatus of Flos-



FLOSCULARIA CAMPANULATA

View



FLOSCULARIA CAMPANULATA
(Side View

cularia; it is drawn at (b) in fig (1), and its knob-shaped ends are seen at (b) in fig. (2), and at (k) in fig. (4), while fig. (5) (which is a view of Floscularia seen from above—the observer looking down the funnel) shows that this rotatory organ (p) lies opposite to the largest of the five lobes.

Dr. Dobie has drawn the knobs and has seen the cilia on them; but he has figured the latter as motionless setæ, and has failed also to see the connecting rim with its rotating cilia. Indeed the rim is very difficult to be detected unless Floscularia happens to be presented to the objective so that the optical axis of the microscope pierces the plane of the circular rim, (fig. 2, a,), from beneath and obliquely; and even then it is necessary that the animal should be carefully illuminated with the paraboloid.

The vestibule (fig. 2, c,) is separated from the main trunk by another diaphragm (d) in which is a slit (fig. 5, o,) which is the mouth, and leads to a long spiral tube (fig. 2, e,) down which the food passes to the maxillary apparatus (f). The tube (e) is constantly in motion, and has been described by Dr. Dobie, as long cilia hanging down from the mouth into the upper stomach; while Gosse, in the Philosophical Transactions of 1855, has drawn it as a thin partition hanging at right angles to the diaphragm (d), and constantly thrown into waving folds. It is with considerable hesitation that I presume to differ from such excellent observers, but I am tolerably confident that it is a tube; for not only does it present the same appearance in whatever position the animal is (which a plane partition would not do), but also when Floscularia is dissolved in caustic potash the tube remains undissolved, as well as the mallei (f).

I have also seen water taken in at the mouth, and allowed to pass slowly down the tube, dilating one portion of it after another.

When Floscularia has captured any prey by closing the contractile rim (fig. 4, k, k,), the mouth can be protruded upwards so as to seize it, which it does with a sudden snap. The mouth is capable also of being widely dilated, so as to take in an object nearly as broad as the vestibule. When the upper stomach, which lies between (d) and (f) fig. (2) contains food which cannot be passed beyond the maxillary apparatus to the lower stomach (g), the fœcal matter is got rid of by the sudden protrusion of the mouth, right through the vestibule into the funnel; at the same time the lobes of the funnel are drawn down and, so to say, furled; and the fœcal matter is shot out through the mouth; the true anus is at (h). The upper stomach has also a remarkable set of muscles on either side of it (fig 2, e,) which give it a fluted appearance, and the use of which is to throw the food backwards and forwards from one side to the other, so as to give the constantly snapping jaws a chance of acting on it; these jaws are shown at (fig. 3, j, j,), and are imbedded in what appear to be muscular bulbs (i, i,). The other portions of the structure of Floscularia have been well described by Dr. Dobie and Mr. Gosse.

Bristol Microscopical Society.

WEDNESDAY, JANUARY 15TH, 1868.—MR. W. L. CARPENTER, President, in the chair.

The minutes of the last meeting were approved. Mr Charles Hill and Mr. William Budgett, were balloted for and elected members.

DR. HENNY FRIPP read a paper on the anatomy of the eye of Pterocera (pectinibranchiate mollusc.)

WEDNESDAY, MARCH 18TH, 1868.—MR. W. L. CARPENTER, President, in the chair.

The minutes of the last meeting were approved. Dr. Beddoe and The Rev. W. Dallenger, were proposed as members to be ballotted for at the next meeting. Mr. Ralph Bernard was re-elected as a member.

MR. E. A. PRAEGER read a paper on human teeth, in health and decay.

WEDNESDAY, APRIL 22ND, 1868.—DR. C. T. HUDSON, in the chair.

The minutes of the last meeting were approved, Dr. Beddoe and The Rev. W. Dallenger, were ballotted for and duly elected members. Mr. Keall was proposed as a member to be ballotted for at the next meeting.

DR. HERAPATH made a short communication on the recent case of poisoning by oxalic acid.

MR. F. MARTIN gave a few notes on Thallium and its salts as objects for the polariscope. He remarked that Thallium was discovered by Mr. Crookes, by means of Spectrum Analysis, its presence being indicated by a bright green band in the Spectrum-Metallic Thallium, closely resembles lead in its physical properties; the freshly cut surface has a bluish white lustre, which rapidly tarnishes on exposure to the air. It undergoes gradual oxidation and is best preserved in water. It occurs in many specimens of iron pyrites, often taking the place of arsenic, a common impurity of this substance. The salts of Thallium having lately been noticed as possessing very brilliant polarizing properties, Mr. Martin felt induced to procure a series, and mount them as objects for the microscope; and he presented a set of a dozen slides for the Society's Cabinet. The Bitartrate, Oxalate and Sulphate, produce the most pleasing effects, but all give more or less colour. A vote of thanks was accorded to Mr. Martin for his donation.

The HON. SECRETARY placed on the table a gathering from the Bristol Float which afforded many interesting objects for the inspection of the members present. Amongst other forms were noticed Brachionus urciolaris, Rotifer vulgaris, Actinurus neptunius, Stentor rœselii, Vorticelea convallaria, Actinophrys sol, Bacillariœ, &c., &c., &c.

PROCEEDINGS

OF THE

Bristol Microscopical Society.

October 21st.—Mr. W. W. Stoddart, President, in the Chair.

The minutes of the last meeting having been read and confirmed,

Mr. S. K. Swayne, M.R.C.S., read a paper on "Some structural changes in growing mammalian bone, especially with regard to the Vascular canals." After some introductory remarks on the structure and development of osseous tissue generally, the author proceeded to describe some of the chief characteristics exhibited by sections of the shafts of the long bones in young mammals, as distinguished from those taken from the adult or aged. The only published reference to this subject that the author had been able to find was the following passage in Köllicker's Human Microscopical Anatomy—"Fœtal and unfinished bones present, in cross sections, almost no transversely cut canals, but chiefly such as run horizontally in the direction of the tangent and radius, so that the bones appear to be wholly composed of short thick layers, each of which, on close examination, is found to belong to two canals, which relation is also indicated by a faint line of separation in the middle of each layer. In man this condition is still observable at the eighteenth year."

This passage, and the accompanying illustration, has been copied into subsequent compilations and manuals. Mr. Swayne had found that this condition existed in all the young mammalian long bones that he had examined, these being taken from the ox, sheep and hog. Transverse longitudinal-radial and longitudinal-tangential sections of these bones were exhibited, showing a much freer development of the vascular canals than aged bones exhibit, and a very imperfect formation of the circular Haversian systems with their laminæ and lacunæ, which are found in older bones.

In some of the transverse sections, scarcely any of the Haversian systems are visible, but only horizontal looped canals, running more or less parallel to the exterior of the bone and to each other, and sometimes passing off regularly from each side of a main trunk like the branches of an espalier tree.

The lacunæ appear more equally distributed throughout the tissue than is observable in older bones, and their canaliculi, especially in fresh bones, are not so readily seen. Instead of the transversely-cut canals, with their surrounding circular systems of laminæ and lacunæ, there is generally found only a sort of knotted appearance where a longitudinal trunk is cut across. The few imperfect Haversian systems to be met with, are found generally in that part of the section which is nearest to the marrow cavity, and surrounding larger canals or "Haversian spaces."

The appearance of longitudinal-radial sections is not very unlike the transverse—a similar net-work of canals more or less parallel to the surface of the bone, for the most part with transverse or oblique communicating canals. Tangential sections exhibit a more irregular net-work springing from the main longitudinal trunks with finer and more polygonal meshes.

The passage from this young or adolescent condition of bone to the adult or aged state appears to be brought about by the absorption of the young bone at certain parts, and the formation of "Haversian spaces," which become filled up again by successive layers of new bone deposited within, accompanied by a fresh growth of lacunæ and canaliculi. While this change in the longitudinal trunk is taking place, the lateral branches appear not to be renewed in proportionate degree, until we often see, in a transverse section of aged bone, no lateral communicating trunks, but only circular Haversian systems cut across.

November 18th.—Mr. W. J. Fedden, Vice-President, in the Chair.

The minutes of the last meeting having been read and confirmed,

The Rev. J. Whiteside, Mr. T. Isaac, and Mr. T. H. Yabbicom were balloted for and duly elected Members of the Society.

Dr. C. T. Hudson read a paper a Paper on "Triarthra longiseta." (*Vide Monthly Microscopical Journal, February,* 1869.)

December 16th.—Mr. W. J. Fedden, Vice-President, in the Chair.

The minutes of the last meeting were read and confirmed.

Mr. W. W. Stoddart, F.G.S., F.C.S., President, then read a paper entitled "A Microscopical Examination of the Water Supply of the Bristol Water Works Company."

The author, after some preliminary observations concerning the necessity of having pure water for dietetic purposes, proceeded to prove that the water from town wells was the means of spreading diseases, and that none procured from a town spring *could* be pure. This view was supported by many examples from the City of Bristol.

The water supply of the Bristol Water Company was shewn to be as pure as any in the kingdom. A list of various analyses were read to shew this, from which the following are taken for the sake of comparison :

	Total Contents per Gallon.	Grains of Organic Matter per Gallon
Bristol Water Co.	19·2	·098
Grand Junction Co., London ...	21·72	3·073
East London Co., ,, ...	23·5	4·13
New River Co, ,, ...	19·5	2·74
Manchester Water Co.	5·35	·749
Pump, Trenchard Street, Bristol ...	118·4	31·36
,, Picton Street ,, ...	118·0	27·60
,, King Square ,, ...	82·4	·11
,, Guildford Place ,, ...	223·0	17·52
,, Ashfield Place ,, ...	91·56	1·96
,, Wine Street ,, ...	98·89	·19

In some of these the most disgusting substances were shewn under the microscope, which could only have their origin from domestic waste, and could be better imagined than described.

One or two of the pump waters contained from five to ten drops of sewage matter per pint. An analysis of the Bristol Company's present supply was very satisfactory; the inorganic salts it contains being nearly all the usual lime salts. On the table were slides showing the organisms collected by deposition from 448 gallons of water. Many of the specimens were extremely fine and beautiful examples of vegetation, although so minute as to be totally invisible to the naked eye. The chief of these were :—

DIATOMACEÆ.

Synedra radians	Gomphomena olivaceum
Nitzchia sigmoidea	Gomphomena tenellum
Pinnularia viridis	Meridion circulare
Onthaseira arenaria	Himantidium
Epithemia	Tabellaria

Desmidiæ.

Micrasterias rotata	Closterium lunula
Tetmemorus Brebissonii	Euastrum didelta
Arthrodesmus convergens	Scenedesmus quadricandi

Although to the non-microscopical reader this may appear a formidable list of organisms inhabiting the water we drink, yet it is not so in reality. Nay, their very presence proves its purity, for they will not live in any but good fresh water. The absence of *animal* life is very remarkable, and redounding highly to the well-known skill and ability of the Company's Engineer. In concluding his paper the author congratulated his fellow citizens in having such a supply at their disposal.

PROCEEDINGS

OF THE

BRISTOL

NATURALISTS' SOCIETY,

(Established 1862,)

FOR THE YEAR 1869.

EDITED BY ADOLPH LEIPNER,

Hon. Secretary.

NEW SERIES.

VOL. IV.

Bristol:

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1870.

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VOL. IV.

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ERRATA.

Page 6. Line 10. Read "observatories" for observations.

,, 6. Insert after line 3 from bottom. Read at the General Meeting, March 4th, 1869.

,, 24. Line 3 from bottom. Read *Kirauea* for Kirdnei.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

I.

Recent Discoveries in Solar Physics.

By William Lant Carpenter, B.A., B.Sc.

Read at the General Meeting, January the 7th, 1869.

ABSTRACT.

The speaker stated that this more detailed communication was made in compliance with the wish of the Society, as expressed at the December (1868) Meeting. After expressing an opinion that solar physics was now the most progressive department in science, through the agency of the spectroscope, he briefly explained the construction and mode of action of that instrument of research, and dwelt at some length on the three great classes of spectra revealed by it; 1.—continuous spectra, where the source of light was invariably an incandescent solid; 2.—spectra of detached bright lines, where the source of light was an incandescent gas or vapour (each gas producing a line or set of lines characteristic of itself, and by which its presence could be recognised); and 3.—spectra like class 1, in which the continuity was broken by dark lines or bands crossing the spectrum.

The spectra of the sun and of most of the stars were stated to belong to this last class, and the dark lines were shown to be caused by the absorbing influence, exercised by certain gases and vapours in the atmospheres surrounding these bodies, upon the light given off from the glowing masses themselves. Kirchoff's demonstration of the presence of the vapours of metals in the solar atmosphere was explained.

By applying the spectroscope to the light of the nebulæ and comets, Mr. Huggins had, in 1864, discovered that most of the nebulæ, and all the comets hitherto examined, were gaseous in their nature, their spectra consisting of bright lines (Class II.), some of which were identical with those in

the spectrum of burning hydrogen gas. The existence of this gas in meteors, as shown by the spectroscope, had been confirmed by an examination of some of the Lenarto meteorite, by Professor Graham, who had shown that free hydrogen gas had been absorbed by the substance of the stone itself.

For a considerable period two rival theories had existed as to the cause of the sun spots namely, that of M. Faye—that they were produced by an up-rush into the photosphere of a superheated and therefore less brilliant atmosphere, existing between the mass of the sun and its photosphere, and secondly, that known as Wilson's (first propounded one hundred and fifty years ago, and since confirmed by De La Rue and others), according to which, the photosphere was surrrounded on the outside by an absorbent atmosphere, which rushed down into the photosphere, cooling it, and making it less brilliant in spots. In 1866, Mr. Norman Lockyer, F.R.A.S., had settled the question completely, by means of the spectroscope, in favour of Wilson's theory, and he, at that time, suggested that the same beautiful method might solve the problem of the constitution of the red flames or protuberances, generally seen at total eclipses of the sun. Several expeditions were prepared and sent out by various governments, to observe the phenomena accompanying the eclipse of August the 18th, 1868. M. Jannsen, who represented the French Academy of Sciences, was stationed at Guntoor, two hundred miles north of Madras, to observe specially the spectra of these protuberances. He, and others, unanimously agreed in referring them to the second great class of spectra, thus showing that the red flames were gaseous in their origin. During the eclipse the idea occured to M. Jannsen, that it might be possible, by artificially obscuring the light from the sun itself, to see the spectrum of the protuberances at other times than during an eclipse ; he succeeded in carrying out this idea, and worked at it for seventeen days. Before the news of these results reached Europe, Mr. Norman Lockyer had obtained a new spectroscope (at the expense of the government grant of the Royal Society), and on October the 20th, 1868, carried into effect the idea that had occurred to him two years previously, and obtained a distinct view of the spectrum of a protuberance, without being able to see the protuberance itself.

By a singular coincidence, the results of the independent discoveries of M. Jannsen and Mr. Norman Lockyer, were communicated to the President of the French Academy of Sciences almost simultaneously, and, very nobly, the honour of priority of idea, was fully granted to the English Astronomer, by M. Faye.

The speaker stated that Mr. Lockyer had shown that these protuberances were simply local accumulations of a gaseous envelope which everywhere surrounded the sun. Two of the lines in the spectrum were identical with those of hydrogen gas, and by directing the spectroscope to the edge of the sun, they could be seen simultaneously with the solar spectrum, sometimes overlapping it, and their position could be exactly measured. The thickness of this gaseous envelope was about eight thousand miles, and observations were in progress with a view to determine its approximative temperature.

II.

The Wandering Mollusk: Dreissena Polymorpha.

By Thomas Graham Ponton, F.Z.S.

Read at the General Meeting, January the 7th, 1869.

ABSTRACT.

This mollusk had, said the author, well merited the name of "The Wanderer," for it had spread from its original habitat in the Aralo-Caspian Provinces throughout almost the whole of Europe.

He then mentioned the various points at which it first appeared in England, and traced its progress through the country, from the period of its introduction in 1827, to the present time.

A large map was exhibited on which the various localities were marked, where, as far as the author had been able to ascertain, it was now found in England and Scotland. So far as he was aware, it did not occur in Ireland.

The author then described the anatomy of the animal, which had been previously done in a great measure by M. Van Beneden, in a paper read before the French Academy of Sciences, in 1825, and published in the Annales des Sciences Naturelles for that year.

III.

Tortoise Shell.

By R. Haynes.

Read at the General Meeting, February the 4th, 1869.

ABSTRACT.

Tortoise Shell, which is a true epidermic appendage, is formed on the carapace of a Marine Turtle, Caretta Imbricata, popularly known as the Hawk's Bill Turtle.

In its structure, Tortoise Shell is identical with horn, being composed of an aggregation of cells filled with horny matter. A vertical section displays a laminated structure, whilst in a horizontal one, the cells are seen as they approach the surface to become flattened into mere scales. Mingled with the horny epidermic cells are others which secrete pigment, and it is to these that Tortoise Shell owes its beautifully mottled appearance. Only the plates from the carapace of the Turtle are employed in the arts, those of the Plastron being useless. There are thirteen principal plates on the centre of the carapace, and twenty-five smaller ones which form its rim. These last are technically termed " Noses " the larger are designated as " Heads." The Hawk's Bill Turtle is an inhabitant of all warm seas, but is found principally within the tropics. Our chief supply of Tortoise Shell is derived from the numerous Islands of the American and Indian Seas, but mainly from that of Ascension. One or two specimens have been known to reach our own coasts. In general form the carapace of the Hawk's Bill Turtle is flattish heart shaped, in young animals the centre of each scute or plate is pointed, but in the adult the points are worn away. The thickness of the scutes increases with age, a fresh layer being added every year. The most general modes of capturing the Turtle, are either harpooning them out at sea, or taking them when they come on shore to deposit their eggs, by cutting off their retreat from the water, and turning them on their backs, in which state they are helpless. The Chinese use the Remora or Sucking Fish in capturing these animals. The Fish are kept in tubs, in a boat, and when a Turtle is observed, they are put into the water with a string tied to their tails. No sooner does the fish see the Turtle than it darts at it, and adheres so firmly to the shell, by means of its sucking apparatus, that both Fish and Turtle are drawn into the boat by means of the string. The removal of the plates from the carapace of the Turtle is rather a cruel process, the poor animals being exposed to a strong heat, which causes the plates to separate from the bone. After the plates have been removed the Turtle is set at liberty, and it is, after a time, furnished with a new set of plates, but inferior in quality and thickness to the old ones. When first removed the plates are crimpled, dirty, opaque, brittle, and quite useless for the purposes of manufacture. After being boiled and steamed, however, they become quite clean and soft, and are easily flattened by pressure, and are then fit for artistic purposes. Tortoise Shell possesses the valuable property of being easily welded, simply by the application of heat and pressure. Its application in the arts is so well known, that I need not dwell upon it here.

IV.

The Cephalopoda: their Structure and Habits.

By the Rev. Frederick Smithe, M.A., F.G.S.—Corresponding Member of the Bristol Naturalists' Society.

Read at the General Meeting, February the 4th, 1869.

ABSTRACT.

The author prefaced his essay by considering the efforts made now-a-days in the Natural History direction, and doubted whether very many persons profited by them. He put the case of a person stumbling over an *Ammonite*, when out on an excursion with the Bristol Naturalists, and asked what would be the result to an intelligent and inquiring person. Why, he would seek to ascertain its nature. And the object of the writer was to show the inquirer what class of animals built up such shells, and to learn from their living representatives, even now tenanting our seas so abundantly, what they are through their ways and habits.

Without going much into questions of anatomy and physiology, and technicalities, the Cuttle Fishes of our British Seas were the first to notice. The three found in our waters are, 1.—the *Octopus*, or Poulpe (also the rarest); 2.—The *Loligo*, or Calamary (the Pen and Ink Fish); 3.—The *Sepia*, or Squid (containing the Cuttle Fish Bone of the Apothecary's Shop).

In classification, they are Molluscs of the highest organization, and in fact standing at the head of all invertebrate animals. The points of these animals which exhibit contrivance, and show such proofs of creative wisdom, seemed to be especially interesting Their mode of propulsion through the water has been imitated in Ruthven's patent propeller, in the *Enterprise* and the *Nautilus*, sea going ships, with one of which our late fellow citizen, Captain Claxton, was concerned so intimately; and the principle is identical with that in the flight of a rocket, or the kick of a rifle. Their sucker dotted arms suggested to Professor Simpson, an improvement in the obstetrical forceps of surgeons. Then, their wondrous ink-bags, and the pigment Sepia—its properties and natures—its preparation and price, were noted, and the observations of Plutarch, Pliny, and other ancient writers not only as to the Sepia, its colour and action, applied morally and to human character; but what was curious enough, their testimony to the gastronomic excellences of these Molluscs, said to resemble tripe in flavour. Of their edible qualities several illustrations were adduced, and a strong case made out, that they (ink bags inclusive) formed a chief constituent in the Blackbroth of the Spartans. Then, in spite of the gross exaggeration of old

writers, as to the size they reach, sufficient proof was afforded to place their formidable bulk and voracity beyond question. The Kraken, that giant of Scandinavian romance, was a Cuttle Fish; and the famous Terra Cottas in the Gregorian and the Vatican at Rome, show us Hercules strangling a great Cuttle Fish or Man Sucker; for a sensational account, no modern naturalist can cap Victor Hugo's Devil Fish (as the Cuttles are called in the Channel Islands)—the description is related by him in the "Toilers of the Sea." The poetry of Aristotle and the early Greeks, touching the Nautilus and Argonaut was examined face to face with prosaic facts, and attention drawn to the marine observations under water, established by the Emperor Napoleon III; assistants being on the watch, ready to summon on the instant, the chief naturalist in charge. The author also mentioned the valuable assistance rendered by Madame Power, in Sicily, who had placed cages in the sea, in which she actually brought up the young Argonauts from the egg under her very eye, and noted their habits from day to day. Such was the transparency of the waters that wash the Sicilian shores, that M. Quarterfages, on looking over the bow of a boat at sea there, fancied himself suspended in mid air. The writer touched on several curious points of structure, such as the eye, and its optical construction, and noticed the chameleon-like power that some foreign genera possess of changing their colour, and what is more extraordinary, their surface, changing a smooth skin, when irritated or excited, into a warty or tubercular coat. After adducing many other facts illustrative of the typical Cuttle Fish, the author briefly applied his previous descriptions to the elucidation of those that tenanted and built up the shells of the extinct Fossil genera, such as the Orthoceras of Silurian, the Clymenia of Devonian, and the Ammonite and Belemnite of the secondary formations, closing with an exordium in favour of theology and science going hand in hand, the one being a light to man's eyes, opening the mysteries of the universe, and the other "a lamp to his feet," leading him to the immaterial and eternal.

V.

The Typical Races of Mankind.

Illustrated by Casts of Crania in the Phrenological Museum of Edinburgh, lately presented to the Bristol Museum, by Dr. Charles H. Fox.

By John Beddoe, M.D., President of the Anthropological Society, London.

Dr. Beddoe remarked that the collection of skulls in the Edinburgh Museum, though small, was comprehensive, and that of the nine extant species of man acknowledged in the recent system of classification of Dr. Haekel, seven were represented on the table by skulls or casts, (viz., Homo Caucasicus, White Species; H. Americanus, Red Sp. ; H. Mongolicus, Yellow Sp. ; H. arcticus, Polar Sp. ; H. polynesius, Malayan Sp. ; H. Alfurus, New Holland Sp. ; H. Afer, Central African Species), the exceptions being the Homo papua, and the H. hottentottus. He then proceeded with his discourse, taking as a starting point a cast of a very fine ancient Greek skull, well developed in every point without striking excess anywhere, yielding a modulus or breadth index of seventy-nine, and thus taking a position between brachycephali and decided dolichocephali. The other heads, he said, might be ranged round this one, and found to exceed or fall below it in various directions. Keeping with the usually recognised limits of the so-called Caucasian variety, he took up the head of a Hindoo from Bombay, and that of a Cingalese. Each of these represented a people composed of an Aryan and native element, the Cingalese being the descendants of a colony (probably to a great extent of Aryan or highest blood) who invaded Ceylon from Bengal several centuries before the Christian era. The two heads were very much alike, being both small and regularly oval, and without strong lines or prominences, and thus fairly representing the common low caste Hindoo Type. The modulus in the one was seventy-four, in the other (the Cingalese) seventy-one. A Swiss head cast was next examined, and found to be extremely brachycephalous, the modulus being eighty-six ; and Dr. Beddoe entered at some length into the history of the *race types* of Switzerland and Swabia, showing how the orginal (Rhœtian) *brachycephali* had, in course of time, come to preponderate over the *dolichocephalous* Allemans and Swabians, who had conquered them. He then contrasted the Swiss head with two belonging to the so-called Mongolian variety—one Turkish, the other Chinese. The modulus was nearly the same in all three, but the Swiss was most elevated about or before the coronal suture ; the others in the region ascribed tofirmness by the phrenologists. The Zygomata and Malars were much more developed in the Mongolian specimens, and the general result was that these were more rounded, the Swiss head more square. The Chinese head, he said, was perhaps an extreme specimen; as a rule the Chinese were less *brachycephalous* than the tribes of the hill countries south, west and north of the plains of China ; and it was suggested, hypothetically, that the influence of civilization might perhaps tend to reduce a strongly-marked type towards an average or medium form.

Other heads were then successively passed under review—a Blackfoot Indian, a Carib—hideously distorted, and two Peruvians ; an Inca (?) skull from the Bristol Museum, and an Aymarà cast from Edinburgh, the former very short and with very small occipital and post-parietal development, the latter rather long, and neither bearing marks of great compression in any part, though the posterior flatness of the former one appeared to bepartly induced by pressure. A very good specimen of the long roof-shaped Eskimo skull, with broad cheekbones and lozenge face was next examined, and then an Ashanti one and a good specimen of an Australian, with frowning brows and deep nasal notch. With some remarks on a particularly fine Maori skull, exhibiting in a marked manner the Polynesian characteristic of prominent parietal bosses, Dr. Beddoe concluded his discourse.

SECTIONAL MEETINGS.

At the Annual Meetings of the various Sections, held in January, the Officers were re-elected, and the ordinary business transacted.

THE ENTOMOLOGICAL SECTION

has, during the past quarter, been chiefly occupied in exhibitions of local specimens, and in perfecting, as far as possible, the first part of a list of the Lepidoptera of the Bristol District, now in course of preparation by Mr. E. Hudd, assisted by other members of the section.

THE BOTANICAL SECTION

has continued its labours in mounting specimens for the Society's local Herbarium; and at the January Meeting the Hon. Secretary, Mr. Yabbicom, made a communication on "The Mural Plants of the District," enumerating and discussing 37 species of Phanerogamic Plants.

No reports have yet been received from the Geological and Zoological Sections.

DONATIONS TO THE LIBRARY.

Preliminary Report, by Dr. W. B. Carpenter, V.P.R.S., of Dredging Operations, presented by the Author.

Entomological Magazine, 2 Vols., and The Entomologist, 1 Vol., presented by the Entomological Section.

Zoological Record, Vol. iv., presented by the Zoological Section.

Notes on the Palæozoic Bivalved Entomostraca, by Prof. T. Rupert Jones, F.G.S., and Dr. H. B. Holl, F.G.S., presented by the Authors.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

VI.

A Notice of Recent Observations on Amœbæ and Monads, By Richard Greef and L. Cienkowski.

By Henry E. Fripp, M.D.

Read at the General Meeting, May 13th, 1869.

The discovery of certain species of Amœbæ and Rhizopods living in the earth is one of great interest and startling novelty; for all previously observed species have been found only in water, either fresh or salt, and all that we have hitherto learnt of the mode of life of these creatures seemed to indicate the impossibility of their being able to enjoy an active existence in any other medium. Least of all, should we have conceived it likely that they could find in the driest earth or sand all the conditions necessary to their well-being. A fresh and fruitful field of microscopic research is opened to our observation by Dr. Greef's interesting discovery, and in introducing it to the notice of our Natural History Society, I take the opportunity of recommending further researches in this direction to such of our members as are desirous of turning the field operations of our summer campaign to good account. Our excursions will yield ample occasion, during the period of the year best suited to the purpose. The history of the Protozoa, though greatly advanced in late years, has many voids and wide gaps, and doubtless some of the missing links in our record may be supplied by careful microscopic examination of "mother earth," teeming with minute life. Besides the future prospect, however, a present and special value attaches to this enquiry, as it bears closely on a question much discussed but still far from settlement, namely, this—Does structural adaptation precede specialised function or *vice versa?* or are both coincident? The facts I have to relate support the doctrine not yet held in favour by many, that the earliest specialisations of the primal endowments of living organic matter coincide exactly with structural differentiation. The classification of the different groups of Protozoa, including all the lowest types of animal life is, in our present ignorance of the exact cycle of changes occurring in each individual, and of the limits of the several types with which we are as yet acquainted, necessarily incomplete. Huxley's first group (Monerozoa including Amœbæ and Rhizopoda) contains animals in which a noticeable advance in organization may be recognised, when we compare the simplest member of the group "Protrogenes" with the typical Amœba princeps, in which a generative organ (nucleus) and a vesicle or vacuole are always found present in the diffluent plasm of which its body is composed. It is, I think, questionable whether the original notion of a distinct species or genus can be retained under the term Amœba. The occurrence of well-recognised Amœboid stages in the life history of the other groups of Protozoa, and the remarkable alternation of what at one time appears to be vegetable at another time animal protoplasm in the body of the same Monad, during successive periods of its life, seem to indicate that the Amœboid state of organic matter is a very general phenomenon. If it really be the life-long condition of one animal it is certainly but the occasional and transitory condition of another. On the other hand, this Amœboid state of organic matter is as certainly associated with a definite constitution of the organic compound, and with an equally specific manifestation of vital properties. Contractility is perhaps the most fundamental endowment of the simplest and entirely structureless particle of living protoplasm. But the contractility of an Amœba has a method of its own—that is to say, it has become specialised so as to exhibit a motility exercised in a particular manner, and apparently responds only to special stimuli. The motility of an Amœba destitute of "organs of motion," could hardly be denied a material cause, and this again can only be sought for in a specific molecular constitution of its contractile substance—*i.e.* molecular constitution is here the only "structural adaptation" which stands in place of organ, or instrument of the newly-acquired motility. Our finite senses cannot discern any visible apparatus, but we must acknowledge the existence of an agent where we see an act performed. And whatever be our explanation of vital force, we must admit that its physical basis is a material "sui generis." Apart from the animal's power of self-preservation, growth, and propagation, the chief characteristic of the Amœboid state of animal matter is its peculiar motility, derived, so to speak, from the primal endowment of contractility, and the loss of this character is always coincident with some change of organic constitution of the living plasm. Another kind of motility we find associated with corresponding structural adaptation in the Zoospore (animal or vegetable.) Cienkowski's observations prove that certain Monads take in food and pass through phases of development which entitle them to be considered animals.

In their motile stages, the Monad body consists of a naked plasm, containing vacuole and nucleus. In the absence of all definite form, this body is the equivalent of an Amœba; but with the addition of a tail, which is often developed, it is a Zoospore, an organism equally mobile with the Amœba, but differing in the manner in which its mobility is exercised. In after periods of the Monad's life a motionless encysted condition obtains, during which assimilation of food previously taken in goes on, until a new generation of Zoospores begins in a sac contained within the capsule of the encysted parent. This encysted stage of the Monad yields in one species Amœboid forms like actinophrys, in another a cluster of Zoospores,—the latter form of reproduction being in all respects the exact parallel of the encysted state of algæ, &c.

Again, certain infusoria exhibit an encysted state of two kinds—one corresponding with the motionless reproduction cyst of algæ, the other with the monad cyst full of Zoospores.

The motility of the pseudopodia of Rhizopods is obviously of the same kind as that of the Amæboid substance. The pseudopodia look indeed more like "organs" of motion, but their temporary form and function implies no further structural adaptation than that of the Amœboid mass.

Facts such as these prove, in my opinion, that there is throughout the lower forms of animals an approach towards specialisation of functions, associated in each case with a correlative change of molecular constitution. If Amœboid forms of matter be destitute of structure in the sense of distinct apparatus developed and set apart for the constant exercise of a particular function, such imperfect specialisation of function and incomplete differentiation of the organic matter by no means warrants the assumption, that this matter is intrinsically indifferent, and without any trace of organization.

With respect to the place of the typical Amœba in our classifications it follows, I think, from the views here expressed, that this animal must find its position in the scale according to its whole life history. The possession of a body composed of contractile plasm is, as we know, a common character of all Protozoa at some period of life,—probably also a common character of all living creatures in their elementary state. The Amœboid state of a white blood corpuscle, even in man himself, is to all appearance the same as that of the body of Protogenes, and this fact is well expressed by Huxley in his recently published *Lecture on the Physical Basis of Life.* To determine the proper limits of the Amœba as a species, the complete revelation of its life-history and the observation of fresh species is required, and Dr. Greef's researches have therefore great value. While considering the subject matter of Dr. Greef's paper, it may be well to keep in mind the present state of opinion in England respecting the absence of all organization in that class of Protozoa which includes the Rhizopods and Amœbæ. For this purpose I give here an extract from Huxley's Lectures, published in 1864. In his elements of comparative anatomy, the Author thus introduces the Rhizopod :—

"It seems difficult to imagine a state of organization lower than that of Gregarinida, and yet many of the Rhizopods are still simpler. Nor is there any group of the animal kingdom which more admirably illustrates a very well founded doctrine, and one which was often advocated by Hunter himself, that life is the cause and not the consequence of organization. For in these lowest forms of animal life there is absolutely nothing worthy the name of organization to be discovered by the microscopist, though assisted by the beautiful instruments now constructed. In the substance of these creatures nothing is to be discovered but a mass of jelly, which might be represented by a little particle of thin glue,—not that it corresponds with the latter in composition, but it has that texture (?) and sort of aspect. It is structureless and organless, and without definitely formed parts; nevertheless it possesses all the essential properties and characters of vitality. It is produced from a body like itself; it is capable of assimilating nourishment and of exerting movements. Nay, more, it can produce a shell,—a structure, in many cases, of extraordinary complexity and singular beauty."

"That this particle of jelly is capable of combining physical forces in such a manner as to give rise to these exquisite and almost mathematically arranged structures—being itself structureless, and without permanent distinction or separation of parts—is, to my mind, a fact of the profoundest significance." (pp. 10, 11.)

In a later chapter (p. 83) Huxley returns to the discussion of the limits and subdivisions of the class Rhizopoda, and briefly states the following as the conclusions to which a careful study of the extant literature of the subject, as well as his own investigations, lead.

It appears that three, or perhaps four, types of structure obtain among the Rhizopoda.

1st. That of the Amœbæ, Rhizopods with usually short pseudopodia, a nucleus, and a contractile vesicle.

2nd. That of the Foraminifera-Rhizopods, devoid of nuclei and of contractile vesicle, and for the most part with long pseudopodia, which commonly run into one another and become reticulated.

3rd. That of the Thalassicollæ, provided with structureless cysts, containing cell elements and sarcode, and surrounded by a layer of sarcode, giving off pseudopodia, which commonly stand out like rays, but may, and do, run into one another, and so form networks.

The fourth type of structure is probably furnished by those anomalous creatures, the Acinetæ; the radiating processes of which serve as suctoria tubes, down which the juices of their prey are conveyed.

On the question of the causal connection between life and organization introduced by Huxley in his prefatory remarks, I shall, if time admit, say a few words after we have become acquainted with the new species of land Amœbæ described by Dr. Greef. Suffice it here to say, that without straining the terms of Huxley's own definition of Amœbæ, organizations of a very definite kind may be claimed for animals which possess a nucleus and contractile vesicle, and present an approach to a sexual mode of reproduction, besides multiplication by division of substance.

In his Hunterian Lectures (1868), Huxley specially mentions the nucleus and contractile vesicle of Amœbæ, their multiplication by fissure, and by a low form of sexual reproduction. The Amœboid stage of the Gregarinida, ending in an encysted condition, in which reproduction by pseudonaviculæ, is also maintained by Huxley. The observations of Greef considerably augment our knowledge of structural changes, and of the mode of reproduction of the Amœbæ, and tend, as I think, to modify the broad assertion that these animals have no organization in the strict sense of the word.

To Dr. Greef's account I shall now direct your attention.

And first, in respect to their habitat and mode of life. Dr. Greef finds these animals very commonly present in sand, and at the root fibres of mosses, grasses, and other plants which grow in shallow mass upon stones, rocks, walls, house roofs, trees, &c., that is, upon a firm bottom. They appear, therefore, in exactly the same places as the Arctiscoidæ, wheel animalcules, anguillulinæ, &c., *e. g.* in the sand under thin liverworts and lichens, and are found generally in company with these,—may therefore be sought for wherever these creatures are found. Dr. G. however has often searched for them in vain where the above-mentioned animals exist in abundance, while at other times a numerous population of Amœbæ is to be seen under every moss examined. The conditions favorable to their presence Dr. G. has not been able to determine with accuracy, but considers that a position exposed to the sun, and the greater or less abundance in the earth of small diatomaceæ and other algæ, which naturally constitute their chief aliment, must materially influence their presence. As to their condition of life, these Amœbæ, living generally in company with Arctiscoidæ, must share in common with them the power of withstanding a high degree of dryness for a long time. The nature of their habitat renders it certain that a rapid drying-up of the earth or sand, especially in summer, must often occur, during which the active life of these Amœbæ is interrupted—that is to say, the creatures become torpid, just as the Arctiscoidæ do, a fact which Dr. Greef has shown in an essay on these latter animals, (2nd vol. of Schultze's Archiv.) Their power of retaining life is indeed wonderful. The outer tough coriaceous but transparent layer draws together as the surrounding medium becomes drier, and thus protects the inner softer granular parenchyme from drying up. In this perfectly motionless and apparently lifeless state, the creatures are met with in dry sand, from the particles of which they are scarcely to be distinguished. But by moistening the sand in which they may have dried up thus for months, they regain quickly an active existence.

The following species are described by Dr. Greef :—

Amœba temiola. The adult animal measures 0·35 to 0·4 mm. in greatest diameter = $\frac{1}{75}$ to $\frac{1}{62}$ English inch.

Amœba brevipes = $\frac{1}{620}$ to $\frac{1}{400}$ inch in size.

——— *granifera* = $\frac{1}{400}$ inch.

These two species are probably only young specimens in early stage of development.

Amœba gracilis. Wormlike in form, about $\frac{1}{300}$ inch long.

——— *Amphizonella.* Dr. Greef considers this creature to be rather a new genus altogether, of which he describes the following species, viz.

Amphizonella violacca. Measuring about $\frac{1}{200}$ inch.

————— *digitata.* $\frac{1}{250}$ inch.

————— *flava.* $\frac{1}{600}$ inch—adult size.

These species will be characterised after we have given Greef's description of his typical Amœba Terricola.

This creature, found in dry earth and sand, looks exactly like a small particle of grit or silex, having a dull glassy surface, and a number of short stiff knoblike protuberances on its external surface. The body is of irregular shape, and divided by clefts or fissures; it contains in its interior a number of yellow or brown-colored granules, which are seen in pretty active motion, streaming hither and thither, as they are impelled by the movement of the contractile sarcode. The locomotion of this land Amœba differs strikingly from that of the water species. Its external transparent ectosarc is of a much firmer and tougher consistence than that of the water Amœba, and the contraction of this ectosarc is much more powerful. The knotty protuberances do not spread with a smooth flowing motion like the projected masses of the water Amœbæ, but remain stiff. The outer surface is wrinkled into folds, meeting and crossing each other when the animal collects its endosarc into a globular mass of comparatively small size, (as, for instance, when resisting the pressure of the covering glass,) exhibiting great contractile power. After a moment of rest, the animal projects its sarcode in a broad stream towards some point of its periphery, while at the opposite point the sarcode contracts and governs the direction of the forward movement until the animal falls over by change of its centre of gravity, and thus, by a series of rolling movements, it makes its way.* The projected arms appear to seek the free spaces between the particles of earth or sand in which the creature is moving, and thus the direction of movement follows the line of least resistance. The movement results from the strong contraction of the ectosarc at the point opposite to that of the yielding surface, which allows the endosarc to be pressed forwards. During these movements the whole of the interior can be seen in turn, and peculiarities of structure are thus best observed.

The distinction between the tough ectosarc aud semi-fluid inner mass is much more marked in land than in water species of Amœbæ. Greef remarks that the body must be composed of two kinds of plasm greatly varying in consistence and physical appearance; the outward hyaline ectosarc, firm in substance, the inner mass soft and granular.

Wallich and Carter have noticed a similar differentiation even in water species. Wallich distinguishes the outer and inner portions as ecto and endosarc, but appears not to have found any differentiation of contractile capacity or physical constitution. Carter recognises a difference of substance and property between the outer and inner sarcode. In the clear ectosarc, which, according to Carter, has a distinct membranous envelope, he places the locomotive and prehensile power, whilst in the soft endosarc he recognises a loose movement of the organic particles on each other—*i. e.* a rolling movement. Carter also considers that the ectosarc is chemically as well as physiologically different from the endosarc, having found that the ectosarc turns purple on application of iodine.

In fresh water Amœbæ, the inner sarcode is often, during forward movement, projected through the outer rind to its very edge. This is not the case with the land Amœbæ. The layer of ectosarc forming the boundary of the

* This movement cannot be called creeping. When, by a change of centre of gravity, the animal rolls over, the firm protuberances do not yield or flatten, but present blunted ends, on which, as on points of leverage, the creature is upheld in its rolling gait backwards or forwards, The movement is often very active, and carried on with energy and grace.

advancing mass shews a deep border of clear unwrinkled yielding sarcode, whilst the portion of ectosarc at the opposite side of the body is contracted into firm folds; the endosarc takes at first no active part in contraction, but is impelled forwards as the advancing front yields and spreads out. The ectosarc alone performs the functions of muscle envelope, such as is seen in mollusca. In comparison, therefore, with the sarcode of the water Amœbæ, this ectosarc shows an advance in special function approaching that of muscle.

Is this enveloping ectosarc invested with membrane? Greef maintains that it is *not*, and further that its inner surface or border is not sharply defined, or separated from the inner sarcode. The lines and folds seen on the exterior are occasioned by the compression resulting from the construction of the ectosarc, which Greef conceives to have acquired a muscular character, though not strictly possessing the appearance of a muscle substance. The reactions of acids, alkalies, iodine, &c., do not indicate the existence of any membrane. The inner mass is a granular soft protoplasm, not contractile. In it are seen transparent vacuoles, either in bubbles or cavities, filled with fluid. These are of various size, and change place quickly under pressure of contractile action. They sometimes run together, forming a large bubble, at other times break up into a number of smaller ones. When the creature is motionless, a large bubble will slowly work its way to the periphery, then break into a group of smaller vesicles which gradually unite again into a bubble of the original size. They can, therefore, have no membranous wall, and are not contractile.

In the endosarc are found other contents—diatoms and algæ, taken in as food. Besides these there are seen highly-colored yellow or brown particles which have often a distinct form, and contain a distinct nucleus. Sometimes these particles are agglomerated together, and the whole group is surrounded by a clear space. Sometimes a diatom or alga is included. Greef thinks these colored particles subservient to digestion of food, and compares them with the yellow cell-like bodies of many lower animals (so called liver cells)—in any case they are not a portion of the reproductive system.

Other crystalline particles are also seen, which Greef considers to be excretion. Auerbach, Wallich, Carter, and others, have seen the same kind of particles in all Amœbæ and certain Rhizopods.

Every Amœba has a nucleus, and generally but one. This has no regular position, is soft, and is of an oval shape. It is composed of—1st, a capsule or transparent membranous envelope; 2nd, a tough and thick second coat, apparently supplied with pores (that is to say, the substance is broken at intervals by radial lines); 3rd, an internal plasm, structureless and homogeneous, in which are imbedded a few strongly refracting particles. This description represents the early stage of the nucleus. At a later period the plasm becomes turbid, and in a short time there appear round granules. By degrees the whole interior is filled with them—large, distinct particles (ova) are then seen at the periphery, and in these a central transparent spot soon appears. At this stage the capsule disappears, and the matured granules or ova are scattered through the parenchyme of the body, which now contains but few of the original food and other elements. The nucleus is thus broken up and lost. The activity of the animal is now greatly diminished, and it appears to exist chiefly for the conservation and further development of the new brood. The next stage of their development consists in the growth of the ova or cells, which contain now a finely molecular plasm with a central clear spot. Soon after a large round vesicle appears by the side of the central spot. (This is the first so-called contractile vesicle.) The young Amœba, as its protoplasm increases and its vesicle enlarges, begins active movement; more vesicles appear, and finally a nucleus with distinct nucleolus is formed from the clear central mass of the early protoplasm.

The young brood has not been seen in the body of its parent after it has reached the ovum condition. The ova probably leave the parent as a mass of protoplasm, with central spot. The creature is not, therefore, viviparous. Wallich, however, observed in the Amœba princeps—a water species—the viviparous brood escape from the parent. Carter also describes the development of a brood from the nucleus of a water Amœba as commencing with *partition* of the nuclear substance, followed by regular segmentation.

Greef describes in one specimen of Amœba Terricola, two elongated dark outlined bodies which contained in their interior thread-like filaments. One of these bodies protruded partly from the body of the parent. He surmises them to be equivalents of the male organ of Infusoria (nuclear). A villous mass adheres to one point of the external surface of the animal. Wallich found the same in his water species, and observed that the villi or hairs are not stiff, but move like the pseudopodia of Rhizopods. He regards them as prehensile organs. Carter noticed the same appearance, but considers it inconstant, and not affording any ground for constituting a new species as Wallich does. (Am. Villosa?) Greef found the position of this villous appendage to be not always at the same end of the body, but attached indifferently to any part of the body. The villi of the land Amœbæ are not so extended as those of the water species, but stiff and short. He agrees with Carter in not considering this appendage to be a specific character,—

because the animals which possess it do not differ in other respects from those in which it is wanting. He has watched it, also, detaching itself from the body, and thinks it to be a secretion from the ectosarc—not, however, to be viewed in the light of a cuticular formation—being stiff, and adhering as a cap-like appendage to the ectosarc. He thinks it might serve either as a point of leverage for locomotion, or as a prehensile organ to assist in taking up food.

The other species require but brief description, and may be quickly dismissed.

Amœba brevipes—rare ; its small spherical body filled with a granular substance composed of darkly-glancing particles. Its sarcode, in the interior of which are vacuoles, is not differentiated, but it projects from its surface short, stumpy, transparent rays. Its movements are sluggish. It multiplies by cleaving of nucleus and body.

Amœba granifera—$\frac{1}{400}$ inch. Has a creeping motion like that of water Amœbæ. Its sarcode is differentiated, the ectosarc being soft and transparent, the endosarc granular, with included nucleus and vesicle. Probably immature—the young form of some other species.

Amœba gracilis—$\frac{1}{300}$ inch. Wormlike in aspect with a villous appendage of a disc shape at one end (sucker ?). The villi disposed round this disc extend or contract, and fix themselves on the glass slide (pseudopodia.) In the centre of the disc-like appendage is a vacuole. It has a nucleus in its body.

Besides these species Dr. Greef found an Amœboid animal for which he proposes the name of Amphizonella, and considers that it should constitute a new genus, inasmuch as, besides other peculiarities, it differs from the naked-bodied Rhizopoda in being enveloped in a thin but complete membranous covering.

The first species, Amphizonella violacea is a spherical animal of about $\frac{1}{200}$ inch in diameter in its adult state. The membranous investment has a distinct outer and inner contour-line, and shews reactions when heated with Acid Acet. and Ac. Sulph. dil., which differ from those exhibited by the inner sarcode. Under pressure, the capsule bursts, and through the rift a different inner mass streams out. This interior mass is deeply coloured with a dark violet pigment, with which a yellow pigment is intermixed, while the external capsule is clear and transparent. On account of the dark colour of the pigment little else of the contents is to be seen with exception of a large nucleus $\frac{1}{600}$ inch, and numerous small vesicles (vacuoles)—the nucleus being less colored. The violet pigment is very sensitive to reagents, being immediately decomposed by acids, alkalies, iodine, &c. The inner sarcode, heated with iodine, discolours, becoming first yellow, afterwards brown black, whilst the substance of the outer capsule retains its hyaline appearance, but tinges slightly yellow after a time (by imbibition of iodine). When the inner mass has, by pressure, been squeezed out of the capsule, and rendered colourless, the foreign matter ingested can be seen (chiefly diatomaceæ and the shells of small arcellæ and euglyphi). The large nucleus is soft, large, and transparent. It consists of a membrane which encloses a cavity filled with solid granules. The development of these granules is probably similar to those of the nucleus of the Amœba terricola before described. The young Amphizonella has no capsule. The movement of the animal is particularly sluggish—its change of form slow, and contraction unenergetic, consisting in slight undulations and indentations of the outer surface. The outer capsule appears not contractile, but only yields to the movement of the active plasm within. From this inner mass pseudopodia, conical or finger-shaped, are thrust forward apparently through the substance of the capsule, *penetrating* it, as it would seem, inasmuch as these processes have no double outline, so that the capsule is not pushed out in front of them. The pseudopodia can be seen making their way with conical points through the substance of the capsule, notwithstanding that the substance of the capsule powerfully resists the destructive agency of acids, alkalies, &c. The softness of its material appears in this—that it is so easily bored through and closes up again when the pseudopodia are withdrawn. They do not extend far, but sometimes when longer than usual some of the granular sarcode and colored pigment streams into their bases. The movements of these arms are more active than that of the rest of the body.

Dr. Greef once observed two individuals coalesce by their outer capsules touching, and the substance of the capsules being fused or soldered together, but the inner sarcode of each animal remained distinct and separate; a species of union was however effected by a band of yellow hyaline substance, forming a sort of bridge or commissure between the two masses of sarcode. Greef considers the phenomenon described as conjugation of two animals, as has been seen in other Rhizopoda. The history of the nuclear evolution indicates a process of sexual generation, or rather a production of brood in the interior of the female parent.

Greef describes three species of Amphizonella—First, A. violacea, already described, $\frac{1}{250}$ inch. Second, A. digitata—having a distinct double outlined capsule and endosarc, with colored granules, a vacuole, and large nucleus with distinct nucleolus, movements, more active than those of the violacea; pseudopodia small. Third species: Amphizonella flava. Capsule firm, membrane loosely investing the endosarc, and following its movements; it is very extensile, so that it spreads over the pseudopodia as it spreads outwards, until quite thin and colourless, whereas it is ordinarily of a yellow tint. It has vacuoles, but no nucleus was observed.

Another Rhizopod is mentioned by Greef, which, resembling in form and color the Arcella vulgaris, a water species, is named by him Arcella arenaria, It is found in sand under mosses, liverworts, &c. &c. It measures $\frac{1}{250}$ inch in size; its surface is smooth, not marked as A. vulgaris, by a network of regular lines; its color is deep brown, inclining to yellow. It possesses numerous pseudopodia, projecting everywhere from its surface; these are lobed, or digitate with pointed extremities. The movement of the sarcode is very active.

Much as I have shortened Dr. Greef's account of these new genera and species, I yet fear that I have exhausted the patience of my hearers. I reserve therefore for another occasion a notice of Cienkowski's observations on Monads. The only point to which I now, in conclusion, would direct your attention is this,—that the typical Amœba, and also all Amœboid forms of the Protozoa, stand at a considerably higher point in the scale than the class Monera of Haeckel. This accurate observer and lucid writer restricts his definition of Monera to creatures which consist solely of naked protoplasm, without vacuole or nucleus, and are entirely destitute of any organization whatever, no difference of internal and external molecular constitution being perceptible, whereas our land and water Amœbæ have distinct generative organs, and their mode of reproduction closely approaches that of the Infusoria. In particular, the differentiation of the substance of the nucleus and development of ova, possibly even of sperm, as well as germ elements, reminds us of Balbiani's account of the sexual organs of Infusoria.

The morphological unit known as a cell, with or without membrane, can no longer be regarded as the primary or simplest form of living matter, and all unicellular organisms may be said to have already reached a definite standard of organization. Amœbæ, Arcellæ, &c. present a recognisable type, which apparently prevails throughout a large series of the lowest Protozoa, and from which, as a point of departure, we can trace progressive evolution. But in the group Monera we arrive at organic matter which may be either vegetable or animal, for no boundary line can be drawn where there is nothing to mark the limit. A definition founded on usual criteria of structural adaptation or characteristic function is no longer possible. Physiologically, indeed, we may perhaps assign the ingestion of foreign bodies, and particularly the digestion of animal matter, as an indication of animal function; and further, the diffused contractility of living animal plasm might be considered distinctive if we could attach to it the faculty of spontaneity. But it may fairly be doubted whether the assimilation of food or the exercise of motility is in any sense more spontaneous in a monad than in a particle of vegetable plasm. For my own part, I reject all belief in the spontaneity of action as related to *consciousness* and will in all animals destitute of cerebral ganglia. For the will of the creature, I substitute that of the Creator, manifested by the conditions and laws of creation, by virtue of which animal life exists; thus I place the source of all actions of the lower animals in that organic necessity which is not of the animal's choice. Irrespective of *volitional* movement, there can be no dispute as to contraction of protoplasm under the influence of external irritants; the retraction of pseudopodia when coming suddenly in contact with foreign particles may however be motility without sensation or conscious perception. I compare it with what is called reflex action, in animals where this is distinctly referable to nerve organization of a peculiar kind; but all that we know of terminal nerve matter, leads to the inference that it is a formless soft albuminous plasm, possessing a peculiar molecular constitution. The formed ganglion or nerve is not sensitive or motory in property merely because it is thus organised, but because, its contained softer substance has an endowment associated with its ultimate constitution rather than that which we call structural differentiation into "organs."

The vital action or vital force of living organic matter, whether animal or vegetable, when reduced to its most elementary form, may be summed up in the words—self-preservation, growth, reproduction. Assimilation of matter and reproduction are equally the phenomena of vegetable and animal life, and morphologically the modes of reproduction are exactly parallelled in both cases. The process of fissure, of encystation, of development of zoospores, &c., are essentially the same in cryptogamous plants, and in cryptogamous animals, and there is no a priori ground for expecting differences of organic instrumentation where there is no difference of function.

To return from this digression. My original intention in this paper was to place before you the widely varying life-histories of the Monad and the Amœba, and for this purpose to have given, in addition to the foregoing account of new Amœbæ forms, an abstract of Cienkowski's careful observations of certain Monadinæ. I hope to supply what is now omitted, and to discuss some questions of great interest in connection with these lowest forms of organic life—their possible origin and conditions of existence. But I must here content myself with repeating the opinions before expressed, that amœboid phenomena are too universal to be considered distinguishing characters of any one species of animal. Our knowledge of amæboid life is no longer confined to a particular series of individuals, nor indeed to the province of Protozoic animals alone. And our conception of matter in the amœboid phase is that of a special molecular constitution of organic plasm, always associated with a limited specific functional activity, If, therefore, the word Amœba be retained as the distinctive appellation of the creatures originally thus named, it should not be incautiously given to animals or animal protoplasm much lower in physiological rank and structural organization. Finally, I would claim for the typical Amœba the full admission of its title to a structurally differentiated organism.

VII.

On "The Scales and other Tegumentary Organs of Fishes."

By S. H. Swayne, M.R.C.S.

Read at the General Meeting, October 7th, 1869.

Abstract.

The author first compared the many forms presented by the tegumentary organs in mammalia, birds, reptiles and fishes in regard to variety and beauty, remarking that fishes equal mammals in the variety, and birds in the beauty of their clothing. For the sake of convenience he considered the various forms under the four orders of Agassiz—Cycloid, Ctenoid, Ganoid, and Placoid; although it is to be observed that these divisions are of far less significance in relation to recent fishes than they have been allowed to be in regard to the fossil. Thus the succession of the different forms in geological time, and the strongly marked characters of the clothing of ancient fishes may be contrasted with the occurrence of very diverse forms of skin-covering in closely allied genera in recent fishes, as e.g. in the Pleuronectidæ.

The skin of fishes is divisible, like that of other vertebrates, into derm and epiderm; all the skin organs are developed in the derm, and have a covering of epiderm. The Cycloid and Ctenoid forms were described first by the author as being less organised than the others. The names Cycloid and Ctenoid are derived from the rounded shape of the first, and the comb-like projecting edge of the second, but the two forms merge into one another. Both are called "horny" because the calcareous matter is small in amount and is not in the

form of true bone. They present two kinds of surface markings—the concentric and the radiating—the concentric are ridges, which may be few or many; and the radiating are grooves, which in the ctenoid often divide the anterior implanted portion into lobes. The comb-like posterior part shows successive rows of prominences as the scale increases in size, but the *surface lines* are *not* the edges of successive layers as often described, but as Williamson has shown (*Philosophical Transactions for* 1849 *and* 1851) mere surface elevations of the upper layers. Vertical sections show that the scale consists of an upper and under part, of which the latter is by far the thickest. Both are divisible into laminæ, and are more or less consolidated by calcareous matter, which in the upper laminæ of the under part occurs in the form of layers of oval concretions. The scales of the "lateral line" are of different shape to the rest, and generally more ossified. The scale of the Eel (*Anguilla*) was selected as an aberrant form of considerable beauty. This scale has been differently described by authors, but Mr. Swayne considered that the circular or oval markings represent simply a peculiar modification of the ordinary surface pattern.

In the Ganoid and Placoid—*ganos*, splendour; *plax*, a broad plate—the scales are more organised, and consist of true bone or a modification called "kosmine" closely allied to "dentine." The outer thin structureless layers are made of an enamel-like substance called Ganoin. The under part is traversed by delicate tubes called by Williamson "lepidine"

The comprehension of the skin organs under the designation "dermoskeleton" seems most applicable in the Ganoid and Placoid orders. In the Palæozoic fish the excess of calcareous matter in the exoskeleton was balanced by a diminution in the endoskeleton. In modern fishes several having bony scales are not included in the present order of Ganoids, which is divided into Lepido-ganoids and Placo-ganoids. The Lepido-ganoids—*lepis*, a scale—are divided into Cyclo-ganoids and Rhombo-ganoids, the latter having rhombic scales. The Rhombo-ganoids (now very few) were the most common in the Palæozoic period. These had rows of scales mutually fastened by a peg projecting from one edge; a great variety of forms have been observed. The Placo-ganoids include the sturgeons and the fossil Ostracostei. The sturgeons have five rows of overlapping oval bony scales with wrinkled surface. The Ostracostei (including Coccosteus, Pterichthys, &c.) had the forepart covered by a bony cuirass of broad, closely-fitting pieces; the back part of the body was often undefended. The Trunk-fishes (*Ostracion*) seem to represent them at present. The Globe-fishes (*Diodon*) are covered by spines supported on a trifid base, which are capable of erection by inflation of the sk n.

The Globe-fishes lead us to the Placoids, where the scales are in the form of tubercles, plates, or spines springing from a disk. The "shagreen" of the Dog-fish is composed of closely-set tubercles of dentine-like structure with a central cavity. The Thorn-back Ray exemplifies the second variety of spines springing from a disk. In some the surface is closely covered with these disks; the spines are traversed by minute tubes like those of dentine. All the hard rays in the fins of Acanthopteri belong to the dermoskeleton. The curious trigger-like spine in the dorsal fin of Balistes is an aberrant form. The numerous "Ichthyodorulites" which belonged to fossil sharks were ancient examples of this kind of weapon. The rostral teeth of the saw of the Saw-fish curiously connect the spine of the dermoskeleton with true teeth. All teeth however seem properly to belong to the dermoskeleton.

The brilliant coloring of fishes has been referred to pigment cells containing a colored oil. The changing colors of fishes, especially when dying, have been celebrated by the poets.

VIII.

Analysis of a Report presented by the late Professor Hopkins of Cambridge to the British Association "On the Theories of Elevation and Earthquakes."

By William Sanders, F.R.S., F.G.S.

Read at the General Meeting, November 4th, 1869.

In the first part of the paper Mr. Hopkins remarks that a volcano may be assumed to consist of a mass of fluid lava, contained in a cavity of the solid crust of the earth; which cavity communicates with the external air by means of the volcanic vent. The volcanic mass has an excessively high temperature. The formation of elastic gases is constantly taking place—and the elastic force generated is extremely great. Respecting the dimensions of the cavity, some have supposed that it communicates with a fluid nucleus beneath a few leagues of solid crust. To this the author states his objections. Others suppose that a communication subsists between volcanoes not far removed. But this is refuted by the absence of synchronism in the action of neighbouring volcanoes, such as those of Vesuvius, Stromboli, and Etna.

There are many proofs of the long continued generation of gases—as at Stromboli, where the evolution of vapours has continued for centuries; also at Kirdnei in the Island of Hawayi. The fluidity of lava is supposed to be (not perfect but) imperfect—that a large portion of the lava consists of minute solid particles floating in a perfect fluid, which is so sustained by elastic vapours. The enormous expansive force of the gases is attested by the violence of the eruptions, and by the height to which lava is raised. Explosions require two conditions—the force to be produced instantaneously—and the mass moved to be small. Perhaps steam accumulates in the upper part of a cavity, in quantity and tension, until the surface of the molten lava is depressed below the lower end of the volcanic vent, and then the steam suddenly forces up the lava and any solid masses included in the lava. Possibly explosive action may be connected with some modification in the process of generating elastic vapour.

In treating on geological phenomena we must refer them to natural causes acting under conditions, the former existence of which may be deemed admissible. There are two hypotheses of volcanoes—one assumes that the earth has been in a state of fluidity, and this does not preclude the supposition of a prior gaseous state—the other assumes an original, solid, unoxidized nucleus. This the author thinks is less simple than the first hypothesis.

The latter, or chemical theory, was proposed by Davy, and opposed by Gay Lussac. It assumed the admission of water and air to the volcanic mass. Gay Lussac objected that if fissures were open the lava would fill them and prevent the passage of water. Hopkins concurs in this view, and thinks that the suggested process involves a mechanical impossibility. The late eminent Professor of Chemistry at Oxford, Dr. Daubeney, maintained this theory during his whole life, and in his work on volcanoes based it chiefly on the products evolved, both mineral and gaseous.

Bischoff supposed that the earth's crust does not exceed twenty or thirty miles, and that water enters through a passage to the fluid mass, and forces, by its conversion into steam, the lava to rise in another channel. Hopkins makes the same objection to this theory.

The remaining theory assumes the original fluidity of the globe, and includes the elevation of parts of the crust.

This leads the author to treat of the form, solidification, and thickness of the crust of the globe. The form of the earth would become in either case an oblate spheroid, and the density would increase from the surface towards the centre. But as the law of increase is not known, the ellipticity cannot be calculated. Nevertheless, the "motions of precession and nutation of the pole of the earth and a corresponding small inequality in the motion of the moon" are consistent with the spheroidal form, if the earth be assumed to be solid or to have a crust solid to the depth of one fourth or one fifth of the radius. If the earth had been originally a solid sphere and then rotated, the centrifugal force would have produced ellipticity, but not so great as would have resulted on the supposition of original fluidity. And that hypothesis requires to give definite value to an unknown law of density and to an unknown force of cohesion of parts. The fluid theory is therefore more simple.

Herschel has suggested that if the earth had been originally spherical with rotation, the ocean would have covered the equatorial parts, and left bare the polar; and that the degradation by the sea of the polar land would be followed by transfer of sediment to the equatorial regions, and thus a protuberance of those regions would result. This theory has been accepted by some Geologists. But our author has shown that this would account for only such an amount of Precession and Lunar inequality as is less than half the actual amount; and therefore he again insists on the greater probability of that hypothesis which assumes the former fluidity of the globe.

In respect to refrigeration of the globe it may be observed that there are two modes of cooling, that of solid bodies by *conduction*, and that of fluid bodies by *circulation* or *convection*. If the globe was originally fluid by heat, cooling would begin by circulation. But another consideration must be taken into account, the tendency to produce solidification by pressure which increases with increase of depth. But neither this law of increase nor that of increase of temperature is known. The only conclusion is, that if the increase of temperature is so rapid as to resist effectually the increased pressure, then there will be the greatest tendency to become imperfectly fluid, and to solidify towards the surface. Otherwise the opposite result may be expected. In the former case the fluidity towards the exterior would decrease, until a solid crust was formed, and then heat would pass into the planetary spaces by conduction only. In the latter case, the influence from pressure is supposed to prevail; and then the interior would be solid, and the solidification proceed towards the surface; the fluidity would diminish and a crust be formed, the ultimate state being a solid nucleus and a solid crust with intervening fluid. Hence three conclusions may be supposed:

1. A solid exterior and an internal fused mass, of which the fluidity is greatest at the centre.

2. An exterior shell and a central solid nucleus with fused matter between them.

3. An entire solid globe.

The author proceeds to refer to his investigations respecting the amount of solar and lunar precession on each of these three suppositions, from which it appeared that the closest approximation to the actually observed amount was gained, on the assumption that the thickness of the solid shell could not be less than one fourth or one fifth of the radius of its external surface.

Other conditions are then discussed. The crust being commenced, would increase more rapidly in some parts, and the difference would tend to increase; for the generated gases would fracture the lower parts and leave undisturbed the more solid parts. Cavities would abound, filled with gases, in the disturbed portion of the crust, while the undisturbed would increase and tend towards any solid nucleus which may have been formed.

The hypothesis of a previous gaseous state does not rest on reasoning similar to that of the fluidity, nor does it affect that reasoning. The gaseous theory may be true or not true.

The second part of the Report treats, on the effects of subterranean forces on the solid crust of the earth. The fundamental hypothesis connected with the theories of elevation, is that large areas are resting on fluid matter possessing expansive force. The results of pressure are discussed, when applied to areas of different forms, rectangular, circular, oval; and the following conclusions were obtained.

"That two systems of fissures may result from the simultaneous elevation of an extensive area; and such that the mean direction of the fissures in one system, at any point of that area, shall approximately coincide with the mean direction of the strike; and in the other system, with that of the dip of the elevated beds at the proposed point."

A diagram was shown to explain the law of displacement of the beds in connection with the fault; the beds on the under side being raised, or on the upper side depressed. A second figure represented undisturbed strata the moment before dislocation; the fissures having been made. The third figure represented the dislocations after elevation, those wedge shaped parts which present their broad surfaces to the elevating force being elevated above the others. It is supposed that the tension of the generated gases would be relieved by escape through the fissures, and that the uplifted masses would subside as represented by a fourth figure, by which a great horizontal pressure would be created, affecting the detached masses, which pressure would be greater as the subsidence increased. Three diagrams were intended to explain the cause of folded strata when 1st they were horizontal and the pressure horizontal; 2nd when the strata were sloping; and 3rd when both strata and pressure were sloping.

Mr. Hopkins determines that if anticlinal and synclinal lines alternate at intervals not exceeding a few miles; then the thickness of the elevated crust cannot be greater than the same number of miles. He also thinks that such displacements are more consistent with the hypothesis of a small number of great movements than a very large number of small ones. However, a gradual accumulation of force producing slow movements might be followed by a sudden production of fissures and sudden elevation, and then would follow a force of paroxysmal character. Periods of large and long continued deposition of sedimentary strata would usually be periods of subsidence. The consequent rise of the isothermal line is thought by Babbage to cause expansion and therefore elevation, but Hopkins objects to this as usually contrary to facts.

Mr. Hopkins proceeds to consider the manner in which vibrations may be generated and propagated through the crust of the globe, thus causing *Earthquakes.* It is shown what would happen if an impulse were impressed along a cylindrical tube, and how waves would be propagated along the surface of water in a uniform canal; and how they would move in fluids in all directions from a centre. Vibrations along a solid bar are of two kinds—the first longitudinal, and the second transverse, as those of a musical chord. The same would happen with vibrations through a solid mass. The normal wave has its direction from the centre to the moving particle, and its velocity is greater than that of the tangential wave, the direction of which is perpendicular to that of the normal wave. If a wave passes from one medium into another it will be refracted, as shewn by a diagram. It is likewise reflected, and if the angle of incidence upon the separating plane be very small, it will be wholly reflected, as in the case of a ray of light.

Mr. Hopkins proceeds to apply his investigations to earthquake phenomena. The simplest case is when the shock is violent and limited to a small space, and likewise the strata homogeneous. Then the direction of the initial wave must be observed, that being the normal direction. And if the horizontal direction be known at two places, the intersection of these lines gives the point on the surface above the focus of disturbance. Also the difference of the times compared with the distances of the places will determine the normal velocity.

The mathematical process was then explained, by which the position of the origin of impulse was ascertained when the conditions of direction of vibration and the normal and horizontal velocities had been obtained by observation. Mr. Hopkins then discusses cases more complicated, in which the vibrations are supposed to pass through strata of varying density. If the sphere of disturbance is large, the shocks over a large area would be contemporaneous, and probably an elevation would take place. If that sphere is small, and the intensity great, then the results will not differ from those mentioned. But suppose that the impulse takes place at the bottom of the sea, a uniform velocity would be maintained, depending on the depth of the water. Should the water become shallower by approaching the shore, the velocity will diminish, but the front of the wave will be steep, like what is termed the bore. As the wave proceeds, the water recedes from the shore, and then the bore rushes on the land with tremendous violence.

A further conclusion of the Author is, that in order to produce elevation of a thickened part of the crust, a *continuous accumulation* of force would be required, and then fissures would be produced. Also, that an *instantaneous* generation of great force would not be capable of producing those results of elevation and dislocation.

Mr. Hopkins concludes by discussing the requisites for instruments to be employed in making the proposed observation.

IX

Notes on a Novel Application of Tea Leaves,

By a Lady Associate of the Bristol Naturalists' Society,

Read by the Honorary Secretary at the General Meeting, Nov. 4th, 1869.

The authoress ventures to offer the few following notes, because she presumes it to be the duty of all who belong to the Society, to mention whatever may come under their notice, that is new to themselves and may be equally so to others.

In the early spring of this year, some plants which had been brought into the house the previous autumn were drooping, and failing in vigour and freshness. Instead of the leaves and stalks having a healthy appearance and rich green colour, they had the sickly yellow hue, indicative of something wrong. Geraniums and Fuschias were equally affected and much anxiety was felt, lest all should perish before the disappearance of frost would allow them to be again placed in the open air. All the usual applications were tried, such as solution of guano, or sulphate of ammonia in the proper amount of water, but without any beneficial result.

Being "au desespoir," a young servant from the country recommended the application of cold weak tea, a small quantity of which was accordingly poured over the plants, and the spent leaves placed on the surface of the soil of some of the most sickly looking Geraniums. The result was something marvellous. In the course of four and twenty hours, the plants seemed to receive new life, and in a few days the whole, (about 70) to the utter astonishment and intense gratification of the observer, underwent a most remarkable change. They seemed to possess new vigour, and the yellow transparent appearance gave place to a rich solid green, having a darker hue than usual.

Since then, the experiment has been repeatedly tried, and in each case with the same happy result. The alteration caused by this simple application is so rapid and marked, that the fact seemed, in the humble opinion of the authoress, to be worth recording for the benefit of others. It is hoped, that some of the members present may give some explanation of the means by which the effect is produced.

When the leaves of a plant which had been treated with tea leaves are macerated in strong spirits of wine, a solution is procured, having a very much darker green colour than one from a plant, which has not been so treated.

The writer, supposing that some ingredient in the leaves of the tea plant possessed the same constituents as the green colouring matter of plants in general, referred to several books on chemistry, but found the information given rather puzzling to one not versed in the mysteries of chemical science.

The tea leaves are said to contain an alkaloid and an astringent principle, which are dissolved when tea is made. The spent leaves, which are usually thrown away, contain one fourth their weight of gluten, which is a substance rich in nitrogen, and very prone to decompose into compounds containing ammonia. The colouring matter of plants, or Chlorophyl, as botanists call it, is a green resin, existing plentifully in healthy plants, and it also has a large quantity of nitrogen in its composition The probable explanation, therefore, naturally seems to be, that the gluten of the tea leaves, when gradually decomposing, furnishes the food most suitable for the formation of Chlorophyl.

It is also recorded, that wheat, grown with manure containing little ammonia, yields a flour with little gluten, while those crops, manured with plenty of ammonia, yield a corresponding abundance of gluten. This fact seems quite applicable to the present case, for the tea leaves, when decaying, give off a decidedly ammoniacal and sulphurous smell.

In conclusion, the writer again apologizes for taking up the time of the Society, but thought that others would like to hear of so simple and inexpensive a method of restoring the vigour and growth of plants, and hopes that the remedy may prove as effectual in the hands of others, as in her own.

X.

On the Cause of the Descent of Glaciers.

By the Rev. Canon Moseley, F.R.S., Instit. Imp. Sc. Paris Corresp

Read at the General Meeting, December 2nd, 1869.

As you look at the hollows scooped out between mountain and mountain in an Alpine chain you see the surface of the snow that fills them and is perfectly smooth near the top gradually and almost imperceptibly changing the uniform smoothness of its hollow face, until at length there is a sharpness of definition at its edges which marks the line of its course, and tells you that it has become solid ice. That ice is a glacier. It has come from under the snow far above the point where you first see it, and it continues winding far down into the valley below. Glaciers do not take their origin in the highest Alpine regions. It is not there that the snow chiefly falls, but on a belt girding them below. This wide belt is divided horizontally into an upper and lower part by the snow line, at a height of, from 3000 to 3300 yards. Above that line snow always lies, and rain very rarely falls ; beneath the snow line the snow disappears every summer, and rains are abundant. It is from this belt about the snow line that the glaciers are seen emerging. They lie like huge slugs along the descending valley, swelling themselves out to fill their channels where they are wide, and thinning themselves to pass through the gorges and narrow places in them. They seldom come down to a lower level than 3400 feet. Between this level where they end and the snow line, 9000 feet high, where they begin, they traverse sometimes a very long space—lying for the most part at a low pitch. The resemblance to a huge mollusk, sometimes 10 miles long and more than a mile broad, is kept up in *this* that they move with a strange slow motion, not altogether unlike that of such an animal. The parallel will be complete if we conceive it to have its tail continually renewed as it withdraws it from under the snow line, and its head continually melted away as it thrusts it forward below the level of, from 3000 to 4000 feet. If we further imagine the steep sides of the valley through which the glacier, descends to have similar but smaller glaciers crawling down them to the principal glacier, we shall understand what is meant by tributary or secondary glaciers, which are *thus* placed in regard to the principal ones; having a far greater pitch or slope than they, and flowing into them like tributary streams to a river. The slope of a principal glacier is often as little as 3°, and yet it may move with a velocity of 24 inches a day. The slope of a tributary glacier is sometimes 50° and it does not advance more than 4 or 5 inches a day at the most.* Masses of rock of different sizes, from huge boulders to stones, are constantly broken by the frost from the sides of the valley of the glacier, and are carried down slowly on its back to the level where its head melts away, and there are deposited. These are called moraines. They lie along the course of the glacier in ridges protecting the ice beneath them from the sun's rays. That ice does not therefore melt as the rest of the ice does, and so it forms a ridge of ice. A moraine is therefore a ridge of stones standing on a ridge of ice.

The descent of a glacier is not a descent of the whole together, or bodily like that of a block of stone. There is an internal descent of every particle in the glacier over and alongside of every other particle. If a plane section be imagined to be made across it; the particles of ice passing through that section at any given time, must be conceived to be all moving at different rates so as to be sliding over and beside one another; the particles at the surface moving faster than those below, and the particles nearer the centre moving faster than those at a distance from it, exactly as the particles of a stream of water move.

The cause of the descent of glaciers has long been, and still is, the subject of controversy. Some philosophers say that they descend by their weight only. Others say that their weight does not supply power enough to bring them down. To the first class belonged the Swiss philosopher De Saussure, who was the first to study the subject with care, and wrote on it about 60 years ago. He held that glaciers slip down the slopes on which they rest by their weight, just as other bodies slip down inclined planes. This explanation is simple and was generally accepted as long as it was thought that glaciers slipped down bodily like blocks of stone would, with an equal motion of all their particles; but when the internal motion of their particles upon one another, like that of running water, came to be discovered, and when it was found that the high pitched tributary glaciers moved slower than the low pitched principal ones, it was brought into doubt, for it was in direct contradiction to these facts.

Looking (like De Saussure) for no other force than the obvious one of their weight as the cause, M. Rendu Bishop of Annecy, who had made glaciers the subject of a very profound study, thought that solid as they *seemed*, they were *not* so; but viscous, and descended as *mud* would descend, or soft plaister, or honey, or pitch; and this is the famous viscous theory taken up and advocated with remarkable knowledge of the whole question, and great

* The motion of the Glunberg, a tributary of the Aar glacier inclined at 30° to 50° was found by Desor to be 22 metres a year, while that of the Aar glacier inclined at 4° was 77 metres.

energy, industry, and ability by the late Principal James Forbes, whose various works on glaciers have exhausted the whole field of *observation* and supply most of the facts on which the true solution of the problem, whenever it is arrived at, must be founded. When however at another stage of the enquiry, it came to be discovered by Faraday and Tyndall that ice, when broken up, was capable of being united again by sufficient pressure, so as to become as perfectly solid and homogeneous as it was before, it became evident that supposing a sufficient pressure to be exerted on the glacier, in the direction of its descent, and its substance to be thus crushed through the contractions and gorges of its channel, and over the irregularities in its bed, it would re-form itself and solidify, and become a compact mass again as it was before, when it had passed the obstructions. The fact of the more rapid descent of the ice at the surface than at the bottom, and at its centre than at its sides, has moreover since been shewn to be not incompatible with a solid state of the ice by the remarkable experiments of M. Tresca, on what he calls the flow of solids. Forcing lead and other metals (and also ice) under enormous pressure, through a strong hollow cylinder of a smaller diameter from one of a larger, he found that the continuity of the mass was preserved, as it would be if it were a liquid, and that the particles of the solid nearest the axis of the lesser cylinder were made to move faster through it, than those further from the axis, as those of a liquid would. Supposing a sufficient pressure to thrust it forward, to act in the direction of the length of a glacier, we are no longer obliged, therefore, to have recourse to the supposition that it is viscous to account for its descent. The whole question resolves itself into that of the amount of the downward pressure and its sufficiency to thrust the glacier forwards, not with a *common* motion, but with that *differential* motion which has been described. Is the weight of the glacier sufficient for this or is it not? The mass of a glacier is so enormous and it reaches so high up into the mountains, that, thinking of the question in a loose way, the pressure of its weight seems to be enough for anything. Closer consideration shows us, however, a fallacy in this estimate of it. I will try to give a popular illustration of this fallacy. Imagine for an instant the ice of the Mer de Glace to be all removed, and the bed of the glacier to be laid bare up to the "Col du Geant." Let a line of men be supposed to stand across the bed of the channel opposite Montanvert, and another line close behind them, and another behind them, and so on up to the Col du Geant. Every man of that multitude would stand as firmly in his place on the floor of rock as though he were the only one; no pressure would be produced on the first line by putting the second behind it, or the third behind *that;* nor would the crowding of the men close to one another make any difference so long as they stood motionless and rigid like statues. Now let these rigid statue-like men be imagined all to become giants 150 feet high, which is about the height, perhaps, from the bottom to the surface of the glacier there. These taller men would stand just as firmly as the shorter did. No pressure downwards would have been created even by *this* addition to the mass. That of every part would be borne in its own place, and would not add itself to any other. Now let each of these giants become a rectangular column of ice, fitting to the adjacent similar columns, and let it be supposed that no column would slip on its base—for we are not here concerned with the sliding theory. It would not crush upon its base—it must be 700 feet high to do that,|| nor would one cross line of rigid columns press downward on the next below, any more than one line of rigid men did. Now these columns, thus brought closely in contact, would freeze together. Their freezing together (without expansion or contraction) would it is true, introduce a new set of forces; but these forces would be in equilibrium with one another, and could not, therefore, interfere with the equilibrium of the first set. A glacier would thus be constituted such as actually exists, and would not, by its weight, descend.

But we know, as a matter of fact, that this glacier *would* descend. There must then be some other and greater pressure than that of its weight acting upon it in the direction of its descent. This conclusion depends, you will see, upon the fact proved by experiment, that it requires a height of 700 feet of ice and upwards to cause ice to crush itself, and that the columns of ice of which the glacier is imagined to be composed are rigid, so that the glacier would not bulge out at its sides by its own weight, as a mass of mud would, or soft plaster, or soft pitch, or putty; for we see, in point of fact, that glaciers do not so bulge out when their sides are laid bare.

There is another way of looking at the question, which leads to the same conclusion. If, instead of ice, the glacier were water it *would* descend by its weight. The same would be true if it were of oil or soft mud, or probably of pitch or quicksilver; but if it were of iron, or of copper, or of lead, it would not descend by its weight only, unless, indeed, these metals were in a state of fusion. There must, therefore, be some substance between the consistency of iron and quicksilver, which would just, of which if the glacier were composed it would *only* just, descend by its weight. The difference between the substances, say, iron and quicksilver, (so far as this result is concerned) is that the

|| The crushing force of ice measured, in the case of a solid cylinder $1\frac{1}{2}$ inches in diameter and 6 inches long, was found to be at the rate of 120 lbs. per square inch.

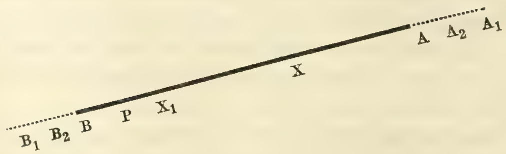
particles of quicksilver may be moved more easily upon one another than those of iron may. The pressure necessary to move a given portion of the surface of a body on any other given portion of the same body is called the force of shearing. A quicksilver glacier would descend because it shears easily, a cast iron one would not because it shears with difficulty. There must exist a relation between the shearing-force and the weight of a given volume of a glacier, so that it may just descend by its weight only. Now, it is possible to investigate mathematically what that relation is. That investigation has been made, and it results from it that in order that a glacier should descend at the slope at which the Mer de Glace descends, and *as* the Mer de Glace descends, the force requisite to shear one square inch of it over another square inch must be less than 2lbs. But it requires from 75 lbs. to 120 lbs. to shear one square inch of ice over another square inch. The ice of the Mer de Glace cannot therefore descend by its weight only; it does not shear easily enough. It must be ice of about the consistency of soft putty to descend by its weight only,—for that substance shears with a pressure of from $1\frac{1}{2}$ to 3 lbs. per square inch. Some other force, in addition to its weight, acting in the direction of its descent, must therefore act on a glacier, causing it to descend. This force must, moreover, be such as would produce those molecular displacements and strains which are actually observed in glacier ice; and it must, to do that, be 34 times as great as the pressure which the weight of the glacier produces in the direction of its descent. What is that force?

The fact of the descent of a sheet of lead when placed upon the inclined surface of a roof, however low the pitch, has long been known; I myself first observed it on the southern side of the roof of the Choir of the Bristol Cathedral, in 1855. I have verified it by the following experiment:—I fixed a deal board 9 feet long and 5 inches broad to the southern wall of my house, so as to form an inclined plane, and upon it I placed a sheet of lead, turning its edges down over the side edges of the board, and taking care that it should not bind upon them, but be free to move with no other obstruction than that which arose from its friction. The inclination of the board was 18° 32′, the thickness of the lead $\frac{1}{8}$ of an inch, its length 9 feet, and its weight 28 lbs. The lower end of the board was brought opposite to a window, and a vernier was constructed, which could be read from within, and by which the position of the lead upon the board could be observed to the 100th of an inch. I began to measure the descent of the lead on the 16th of February, 1858, and recorded it every morning between 7 and 8 o'clock, and every evening between 6 and 7 o'clock, until the 28th of June. I have preserved all these observations. In the night, between sunset and sunrise, the lead scarcely descended at all.

It was on days when the Thermometer in the sun varied its height rapidly and much—as on bright days with cold winds, or when clouds were driven over the sun—that the descent was greatest. So remarkably, indeed, was this the case, that every cloud which shut off the sun for a time from the lead, and every gust of wind which blew upon it in the sunshine, seemed to bring it down a step. On such days it would descend from $\frac{1}{4}$ to $\frac{1}{2}$ an inch. On the contrary, when the sky was open and clear, and the heat advanced and receded uniformly, the descent was less, although the difference of the extreme temperatures of day and night might be greater. It was least of all on days of continuous rain. The sun was the obvious cause of the descent of the lead—a dilatation and contraction of it was caused by the passage into it, and the withdrawal, of the sun's radiant heat, and this dilatation and contraction of the lead caused it to descend. Why it should do so may be easily explained.

Let A B (fig. 1) be an elementary plate of the solid, and conceive it to be divided into an infinite number of equal elements by planes perpendicular to its length. Let X be a point so taken in it that, if it were divided in X, the thrust necessary to push the part X A up the plane would equal that necessary to push X B down it. Let the element at X be imagined to have its temperature so raised as just to equal this thrust; and let the temperatures of all the elements in X A, beginning at X, be equally raised in succession. Each will thus be dilated more than the one before it, because its dilatation will be opposed by a less resistance; and the displacement A A_1 of the extremity upwards will equal the sum of these several dilatations. In like manner,

Fig. 1.



if the same temperature be added to the elements of X B in succession beginning from X, each will be dilated more than the one before it, and th displacement B B_1 of the extremity B downwards will equal the sum of thes several dilatations. The point X will obviously be nearer to A than to B because the same thrust of dilatation of the element at X would not be able to push so great a length of the bar up the plane as it would down it.

In this state of the temperature of the plate, let a point X_1 be taken such that, if it were divided there, the strain necessary to pull the part X_1 A_1 down the plane would just equal that necessary to pull X_1 B_1 up it. Let the temperature of the element at X_1 be so diminished as by its contraction just to produce this strain, and let the temperatures of all the elements from X_1 to A_1 in succession be similarly reduced. Each will contract more than the one before it, because a less resistance will be offered to its contraction; and the displacement A_1 A_2 of A_1 down the plane will equal the sum of these separate contractions. In the same way the displacement B_1 B_2 of B_1 up the plane will equal the sum of the separate contractions of the elements of X_1 B_1. The point X_1 will be further from A_1 than B_1 because the same strain of contraction of an element at X_1 would pull a greater length of the bar down the plane than up it.

It is by the dilatation of the greater length of the plate XB favoured by its weight that the extremity B is displaced down the plane when the temperature is raised; whilst it is by the contraction of the less length X_1 B against its weight that it is displaced up the plane when the temperature is lowered. The extremity B is therefore more displaced down the plane by a given raising of the temperature than it is displaced up it by a corresponding lowering. On the whole, therefore, the extremity B is made to *descend* the plane by a given alternation of temperature. It is by the dilatation of the less length X A that the extremity A is displaced up the plane, and by the contraction of the greater length X_1 A_1 that it is displaced down the plane. It is therefore less displaced up by dilatation than it is down by contraction, and on the whole it descends by a given alternation of temperature. Both the extremities A and B of the plate are therefore made to descend when it is subjected to a given elevation and then to a corresponding depression of its temperature; that is, the *whole* plate is made to *descend.*

Now, a theory of the descent of glaciers, which I have ventured to propose myself, is that they descend, as the lead in this experiment does, by reason of the passage into them and the withdrawal of the sun's rays, and that the dilatation and contraction of the ice so produced is the proximate cause of their descent, as it is of that of the lead. All Alpine travellers, from De Saussure to Forbes and Tyndall, have borne testimony to the intensity of the solar radiation on the surfaces of glaciers. "I scarcely ever," says Forbes,* "remember to have found the sun more piercing than at the Jardin." This

* "Forbes' Travels in the Alps," p. 97.

heat passes abruptly into a state of intense cold when any part of the glacier falls into shadow by an alteration of the position of the sun, or even by the passing over it of a cloud.

There is no substance the dilatation or contraction of which, by changes of temperature, is more thoroughly and accurately known than that of ice. Experiments were made upon it by three independent observers, at the observatory of Pultowa, in the winters of 1845 and 1846, between the temperatures of 0°9 R. and 22·82 R., from which it resulted that ice is by far the most dilatable of all known solid substances, being nearly twice as dilatable as lead.* These experiments have been described by Baron W. Struve, in the transactions of the Academy of St. Petersburgh.†

The ice of a Glacier behaves itself in its descent exactly as the lead did in my experiment. The Mer de Glace moves faster by day than by night. § Its mean daily motion is twice as great during the six summer as during the six winter months. The connection between its rate of motion and the external temperature is most remarkable. It has been carefully observed, and the results as recorded by Prof. Forbes|| leave no doubt of the fact, that no change of external mean temperature is unaccompanied by a corresponding change of glacier motion. From this it follows that the two are either dependent on same common cause, or that the one set of changes stands in the relation of a cause to the other. That both sets of phenomena—the changes of the sun's heat, and the changes of glacier motion—should be due to some common independent cause, seems impossible. We are forced therefore on the conclusion that one is caused by the other. And as the changes in the glacier motion cannot cause the changes of solar heat, it must be the changes of solar heat which cause the changes of glacier motion. Nor is this to be considered a startling or improbable conclusion. Heat is but another form of mechanical power. This power is constantly streaming into the glacier; for ice is dia-thermanous. It is readily penetrable by radiant heat. This has been shewn by Tyndall; who having sent a beam of heat through a block of Wenham Lake ice, saw its course starred by the dilatations of the ice. I have, moreover, myself obtained an ice lens by causing ice to be turned in a lathe to a spherical surface by means of a templet of iron. Through this lens the rays of the sun streamed in abundance, and were concentrated in its focus with such intensity as to burn the hand and instantly set fire to a match. There can be no doubt therefore

* The coefficient of the dilatation of ice is ·00002856 for 1° F.

† "Forbes' Travels in the Alps," p. 97.

§ *Forbes' Occasional Papers*, p. 12.

|| *Forbes' Travels in the Alps*, p. 148.

that the rays of the sun, which in those Alpine regions are of such remarkable intensity, find their way into the depths of the glacier. They are a *power*, and there is no such thing as the loss of power. The mechanical "work" which is their equivalent, and into which they are converted when received into the substance of a solid body, accumulates and stores itself up in the ice under the form of what we call elastic force or tendency to dilate; until it becomes sufficient to produce actual dilatation of the ice in the direction in which the resistance is weakest; and by its withdrawal to produce contraction. From this expansion and contraction follows of necessity the descent of the glacier. How much heat entering the surface of a glacier is necessary to this result has been made the subject of calculation. Supposing the depth of the ice to be the same as that at the Tacul, its motion at different depths that which Tyndall found it to be there, and its surface motion that which he measured lower down the Mer de Glace at Les Ponts, and supposing the resistance to shearing of ice to be 75lbs. per square inch; then the mechanical work, which acting within the mass is necessary to put the glacier in motion, as it actually moves is $61\frac{3}{4}$ units of work per square inch of the surface of the glacier per day. Now this quantity of work would be supplied by .0635 heat-units entering the ice per square inch of surface per day and diffusing itself through it, each heat-unit being the heat necessary to raise 1 lb. water by 1°F. Far more than this heat probably falls on the surface of a glacier.

It has been argued in opposition to this theory that the temperature of the ice of glaciers is, by the observations of Agassiz,‡ but very little below 32°, and that if radiant heat found its way into it, it would not expand, but melt it. To this there is the obvious answer that radiant heat does find its way into ice as a matter of common observation, and that it does not melt

‡ The observations of Agassiz on the temperature of the ice of the Aar glacier in 1841, 1842, were made in borings from 15 to 200 feet deep. Thermometers placed in these borings never fell below 0.3 Cent., although the external temperature descended at night to 5° or 6° Cent. Commonly they shewed exactly zero. (*Bulletin de Geneve, tom.* 44, *p.* 349.) Nothing can, however, be concluded from these experiments because the thermometers were not *frozen into the ice* of the glacier, or the mouths of the borings so effectually stopped as to prevent the access of air, or the percolation of water from the disintegrated ice near the surface. The maintenance of a constant state of humidity in the air of the boring not being thus provided against, the included thermometer could not but remain at zero, however low might be the temperature of the surrounding ice. For the water of the contained air freezing on the sides of the boring (like hoar frost) would raise the temperature around the bulb, by the latent heat set free in freezing, to zero, Cent. And the humidity of the air being continually renewed this process would always go on.

it, except at its surface. Blocks of ice may be seen in the windows of ice shops with the sun shining full upon them, and melting nowhere but on their surfaces. And the experiment of the ice-lens shews that heat may stream through ice in abundance—of which a portion is necessarily stopped in the passage—without melting it, except on its surface. My theory supposes that the ice beneath the surface of a glacier is a solid. That is all.

Being a solid, and receiving into its substance heat—that is force—in great quantities, that force (by the principle of the conservation of force) cannot but be stored up in it, under the form of "potential energy," and wherever it is present, produce a tendency to dilatation. When that tendency takes effect, it is in the direction of the least resistance to the dilatation of that part. It matters not whether the temperature of the ice be below 32° or above it, provided only that the condition of solidity be satisfied. Being a solid, it cannot but dilate and contract under the variations of temperature to which it is subjected; and dilating and contracting it cannot but descend. To shew that the ice of a glacier does not dilate when heat is received into it, it would be necessary to shew it not to be subject in this respect to a law common to all other bodies.

Great alternations of temperature are not necessary to cause the motion of a glacier. A succession of small alternations produce the same effect as one great one. Their effect is cumulative. Alternations backwards and forwards, of 2° each, six times repeated, would carry the glacier (under certain assumed conditions) as far down as a single alternation of 12°.

XI

Notes on Rain-Water collected in Bristol.

By W. W. Stoddart, F.G.S., F.C.S.

Read at the General Meeting, December 2nd, 1869.

Those, who heard a paper by the author at a late meeting of the Microscopical Society, will recollect that some slides and drawings of the various salts &c. found in rain-water were exhibited.

Since then Dr. Angus Smith has published engravings of the residues of rain-water collected in the north of England, but the crystals differ so much in appearance and character from those collected in Bristol, that the discrepancy has been thought worthy the notice of the Naturalists' Society.

The salts dissolved in rain-water falling in manufacturing towns are very considerable in amount, and become of great importance in the calculations of analytical chemistry. The moisture on the earth rises by evaporation into the atmosphere at an average of .033 inch every 24 hours. This would amount to 120 cubic feet, or 720 gallons from every acre. The vapour retaining its vesicular form floats in the atmosphere, forming what we call clouds. When the atmosphere becomes too light, or cold, or from the presence of electricity, the vesicles coalesce, and becoming too heavy for suspension fall to the earth as rain.

At this stage rain-water is very pure, probably the purest kind of natural water, only containing traces of Ammonia. Rain, falling in the open country, leaves scarcely any residue when evaporated to dryness; but when falling into the midst of a crowded city, the atmosphere of which is filled with all inorganic and organic abominations, the result is far otherwise. The drops of rain freely dissolve these impurities, and when collected will yield them up to the examiner. The greater the purity of the water, the greater its solvent powers are known to be.

The smoke from our factories—bone black, soap, and candleworks—the combustion of coal from hundreds of chimnies, the effluvia from dwellings, the odours we admire and the smells we dislike, all combine to pollute the air we breathe. Consequently these impurities are dissolved and brought down by every shower of rain in very large quantities.

The specimens alluded to this evening were both collected on September 6th; one in North Street, and the other in King Square. The rain was what we call "drizzling" and was collected by means of a clean wide glass funnel inserted into the mouth of a bottle and afterwards evaporated in a warm air apparatus at a very gentle heat. The amount of residue was startling, and the difference between the two samples very surprising, although the two localities were so short a distance apart. That in North Street was very acid to test paper, while that in King Square was decidedly alkaline from the presence of Carbonate of Ammonia, and effervesced when touched with an acid.

The following were the analyses calculated in grains per gallon:—

[North Street.]

Sulphate of Ammonia	.84
Sulphate of Soda	1.13
Chlorides of Soda and Ammonia	1.87
Nitrate of Ammonia...	.76
Free Sulphuric Acid...	1.96
Carbonaceous Matter...	1.12
Greasy Organic Matter	2.63
Total Grains per Gallon ...	10.31

[King Square]

Carbonate of Ammonia	.24
Sulphate of Ammonia	.82
Sulphate of Soda	1.23
Chlorides of Soda and Ammonia	1.45
Nitrate of Ammonia...	.63
Carbonaceous Matter	.96
Greasy Organic Matter	1.43
Total Grains per Gallon ...	6.76

This apparently small quantity of only a few grains per gallon of solid matter, when multiplied by the total annual fall of rain, becomes extremely large. According to the late Mr. Burder the average annual fall of rain in Bristol is 30 inches in depth. This would equal 194,451,840 cubic feet, or 701,360 gallons on every acre.

If then we suppose the contents to be as in the above analyses, we shall have 9 cwt. of solid matter in North Street, and 6 cwt. in King Square per acre, annually separated from the atmosphere and carried into our soft-water cisterns and drains.

This is an important fact for an Analyst of the present day, who regards the presence of nitrates in spring or well-water as a sign of an impure source, and of probable origin from sewage contamination. So that, although a chemical analysis may be thoroughly true and correct in all its details, yet the evidence deduced therefrom may be, to some degree at least, fallacious.

It should however be remembered, that rain, collected at the commencement of a shower, is always more charged with impurities than at the close. Also that the atmosphere is constantly varying in its rate of purity from barometrical and other obvious causes.

SUMMER EXCURSIONS.

The first Excursion of the Society, for the season, took place on Thursday, June 24th, 1869, the destination being Malvern.

The Members and Visitors, under the guidance of the President, Mr. William Sanders, F.R.S., having arrived at Malvern station, were joined by Dr. Wright, F.R.S.E.. F.G.S., of Cheltenham, Dr. Grindrod, of Malvern, Edwin Lees, Esq., F.L.S., of Worcester.

The party, in the first place, proceeded to Colwall by rail, and thence walked to the railway cutting, (near the tunnel end,) where Dr. Grindrod called their attention to a plainly marked termination of the Wenlock shale. This having been considered, all passed through the beautifully ornamented grounds of Mr. Ballard, to the Winning's Quarry—thence onward to examine, in the centre of a bye-road, a well-marked junction of the Woolhope limestone with the May Hill sandstone. An earnest invitation to lunch, made by Mr. Ballard, having been respectfully declined, on the ground of prior arrangements and shortness of time, all moved forward to a quarry, showing the Corals of the Woolhope formation, just below the Wyche; thence onward to examine a finely stratified mass of nodular Wenlock limestone in the vicinity of some lime-kilns. From here a walk through the woods brought the party to the fine Brockhill section, where attention was given to a most interesting series of rocks, comprising the Upper Ludlow, the Downton Sandstone, the situation of the unfortunately now extinguished Ludlow Bone Bed, and the junction therewith of the Old Red Sandstone. From thence the road lay over Malvern Hill, by St. Ann's Well, into Malvern.

At the kind invitation of Dr. Grindrod, the whole party then proceeded to inspect his magnificent, and in some respects unique Museum of Fossils, the contents of which Dr. Wright, at the earnest request of the Members, explained in a very clear and interesting Address.

On their return to Bristol, all Members agreed, that this had been one of the most enjoyable and successful Excursions of the Society.

At the second Excursion, the Members of the Bristol Naturalists' Society joined the Members of the Cotteswold Naturalists' Field Club, at their third Field Meeting. This took place on Tuesday, July 20th, 1869.

The party proceeded to Frocester Station, thence walked to Frocester Hill, passing on the way the Old Barn at Frocester Court, an object of much interest, and carefully examined the well-exposed sections of the base of the Inferior Oolite and Supra Liassic Sands. Here also some rather rare plants were collected.

From the Hill the route was through Woodchester Park (W. Leigh, Esq., having kindly given permission) to Nailsworth, a walk of singular beauty, and interesting alike to the Geologist and Botanist. From the Monastery at Nailsworth the party was conveyed by carriages to Stroud, where dinner was provided.

It was the wish expressed by all who took part in this Excursion, that this first, so successful meeting of these Sister-Societies might be productive of still further and more frequent intercommunication.

SECTIONAL MEETINGS.

THE GEOLOGICAL SECTION.

FIELD WALKS.

The first walk took place on April 30th, when twelve members, under the guidance of Mr. W. W. Stoddart, F.G.S., proceeded to Dundry, examined there the Inferior Oolite (obtaining some fossils) also the junction of the Inferior Oolite with the Upper Lias, and procured some good ammonites from the Upper Lias cephalopoda bed.

The second walk was taken on June 10th, when the party, conducted by the President, Mr. William Sanders, F.R.S., examined some Lias quarries at Keynsham, containing some enormous ammonites; and further on the gravel beds, (the ancient bed of the river Avon) obtaining there some teeth and bones of Rhinoceros. The members then walked to the cutting on the Mangotsfield Railway, where the Lias beds were exhibited. Here also, the great fault was pointed out and carefully examined.

The third walk, on August 15th, was taken for the purpose of examining the Aust Cliff. Large blocks of the Lias Bone bed were broken up, and some teeth and bones obtained.

On September 8th, a break conveyed the members to Whitchurch, where a section of the Middle Lias on the North Somerset Railway was examined, and the peculiarities explained by Mr. W. W. Stoddart, F.G S. Some good fossils were found here, including Straparolus. From the Railway Cutting a short walk brought the party to Maesknoll, a Roman camp of large size. Here the Upper Lias and Inferior Oolite were examined. From the former some good illustrations of Pholas borings were taken away, and in a conglomerate of the Inferior Oolite were found many teeth of Hybodus.

No reports have yet been received from the other Sections.

DONATIONS TO THE LIBRARY.

Cooke, M. C. Microscopic Fungi—(rust, smut, mildew, and mould.)—Presented by Mr. T. H. Yabbicom.

Hassell on Food and its Adulterations;—Airy's Lectures on Astronomy;—Müller's Physiology of the Senses;—G. F. Browne: On Ice Caves in France and Switzerland;—Tyndall: On the Glaciers of the Alps;—Maury's Physical Geography of the Sea;—Ansted's Geological Gossip;—Darwin: A Naturalist's Voyage round the World;—Reports of the British Association, from 1847 to 1868, also Index to Transactions of do. (1831 to 1861). Presented by Mr. F. F. Tuckett.

Journal of Quekett Microscopical Club, Nos. 8, 9. Presented by the Club.

Seeman's Journal of Botany, Vol. VI. Presented by the Botanical Section.

Kenngott, Prof. Microscopical investigation of thin polished laminæ of the Knyahynia Meteorite;—Prof. R. Jones, W. K. Parker, and J. W. Kirkby: On the Nomenclature of the Foraminifera;—Prof. R. Jones: On the Palæozoic Bivalved Entomostraca. Presented by Prof. T. Rupert Jones.

Keys, I. W. N. Flora of Devon and Cornwall, Parts 2, 3, 4. Presented by Mr. Wm. Pockson.

PROCEEDINGS

OF THE

BRISTOL NATURALISTS' SOCIETY

FOR 1870.

PART I. EDITED BY

ADOLPH LEIPNER,

Hon. Sec.

PART II. BY

EDWARD W. CLAYPOLE, B.A., B.Sc.

Hon. Rep. Sec.

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1871.

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Vol. V.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

I.

Temperature and Life in the Deep Sea, being some Account of the Deep-Sea Dredging Expedition in H.M.S. *Porcupine*, in the Summer of 1869.

By Wm. Lant Carpenter, B. A., B.Sc., a Member of the Expedition.

Communicated at the General Meetings held on Sept. 2, 1869, *and Feb* 3, 1870.

The earliest known notice of the existence of animal life at great depths in the sea was reported by the present President of the Royal Society, General Sir Edward Sabine, who in 1818 accompanied Captain (afterwards Sir John) Ross on one of his Arctic expeditions. At a depth of 1000 fathoms (6000 feet) from the surface of the sea there were obtained, in the operation of sounding, two or three marine animals—a star-fish and some small worms. The next observation of any moment was afforded by the report of the late Prof. Edward Forbes on his observations in the Ægean Sea. Mr. Forbes was only able to obtain animals at a depth not exceeding 230 fathoms, and the result of his observations led him to the belief that beyond 300 fathoms there was no life existing at all. The difficulties in these investigations were so great, and Prof. E. Forbes occupied so prominent a position as a naturalist, that this conclusion was for a long time universally accepted. About the same period Sir James Ross, in an Antarctic expedition, obtained animals at a considerable depth, 400 fathoms. In 1855, it fell to the lot of Professor Bailey, of the United States, to examine the produce of a series of soundings (upon a very small portion of the sea bed) taken at great depths in the Atlantic, 2000 fathoms or upwards. He came to the conclusion, from microscopic examination, that a number of animals, chiefly of minute size, lived at the bottom of the sea. In 1860, during the voyage of the Bulldog, Captain Sir Leopold McClintock, Dr. Wallich being naturalist, there were brought up in the process of sounding, fragments of star fish, and sometimes living star fish, worms, and one or two shell-fish, from a very considerable depth—even up to 1,200 fathoms. So completely, however, had Edward Forbes' idea got hold of the minds of naturalists, that what eventually proved to be the just conclusions which Dr. Wallich drew from these observations were by no means universally received. There was no question now that these animals did come from that very great depth. In 1861 the telegraph cable between Sardinia and Algiers was taken up for repairs, and a celebrated French naturalist found animals attached to the cable, which were living at the very great depth of 1500 fathoms. In 1866 the son of the celebrated Swedish naturalist, Prof. Sars, had the opportunity, through being Inspector of Fisheries under the Government, of dredging considerably over the bottom of the sea off the coast of Norway and Sweden. At a depth not exceeding 300 fathoms were found some very remarkable animals, more than one of which were representative of and closely allied to animals, which were considered to be long ago extinct. A very important point was thus raised, and this was the cause, as it were, of the expedition sent out by the British Government. One specimen was closely allied to the group of crinoids or sea lilies—in fact a degraded type of the Apiocrinidae. Specimens were sent over to Professor Wyville Thomson, F.R.S., of Belfast, and were shown by him to other English naturalists, and the discovery was considered so important, that it was determined to urge the council of the Royal Society to press on the Admiralty the advisability of sending out an expedition and carrying on these very interesting investigations.

In the summer of 1868 the council of the Royal Society, at the instance of Dr. Carpenter, V.P.R.S., urged the Admiralty to allow a vessel to be fitted out for such explorations in the North Atlantic Ocean. Her Majesty's Government was so good as to put a ship (H.M.S. Lightning) at the disposal of the Royal Society, and allow it to be fitted with apparatus. In August, 1868, the expedition sailed, accompanied by Dr. Carpenter and Professor Wyville Thomson. This expedition covered the ground between the North of Scotland and the Faroe Islands, and some of the results of it has been detailed before a special meeting of the Bristol Naturalists' Society in September, 1868, by Dr. Carpenter himself.

It was but a tentative expedition; those who accompanied it had not all the apparatus they could have liked, but the results were so remarkable that in the spring of 1869 it was determined by the Royal Society to make a further effort and ask the Government to grant another vessel, so that the observers might go out with all the experience gained in the first cruise, and not only confirm the particular observations then made, but also investigate other questions which were opened by those researches. Accordingly in May, 1869, H.M.S. Porcupine, one of the surveying ships of the Navy, Staff-Commander E. K. Calver, R.N., was fitted out with every kind of apparatus which experience could suggest. The Porcupine was engaged in the investigations from the end of May to the first week in September. Speaking broadly three sets of inquiries were conducted, (1) an investigation into the temperature of the sea at great depths, with a view to ascertain the extent and direction of the submarine polar currents supposed to exist; (2) an inquiry into the existence and distribution of animal life on the sea bottom at these depths; and (3) an examination of the nature of the water at different depths, for its physical and chemical properties, the amount and nature of the gases dissolved in it, &c. During the first half of the cruise the zoological inquiries were under the charge of Mr. Gwyn Jeffreys, F.R.S., the celebrated conchologist, and the physical and chemical investigations under that of the speaker, and the area of their work was the very deep water about 200 miles off the west coast of Ireland, extending as far north as Rockall. The next portion of the cruise, under the charge of Prof. Wyville Thomson, F.R.S., and Mr. John Hunter, both of Belfast, explored the extreme depths off the south-west coast of Ireland and the north-west coast of France; and during the last three weeks under Dr. Carpenter and Prof. Thomson, assisted by Mr. P. H. Carpenter, the investigations were carried on in the triangular area bounded by imaginary lines drawn between the Faroes, Shetlands, and Hebrides, in which the "Lightning" had been engaged in 1868. It will be convenient to consider together the results of the first and second portions of the cruise, reserving until later those of the third division.

The apparatus employed was described in detail, the explanations being aided by diagrams. The dredge was of the ordinary form of "Naturalist's dredge," but much larger, stronger, and heavier. For very deep water the weight of the dredge employed was nearly 8 cwt., but for shallower depths a lighter dredge sufficed. The bag was so contrived, that it could be easily detached from the iron frame, and was made of closely-netted sounding line, an inner bag of fine canvass being provided which was readily turned inside out to empty the contents, and was always washed between each time of using, to avoid the possibility of error as to the locality of any animal. In depths less than 750 fathoms it was found useful to attach two horizontal arms to the frame of the dredge, to which "swabs" were secured, in the hempen tangles of which large numbers of animals were caught, so that the bottom of the sea was swept as well as scraped. The dredge rope was the best 2 inch Chatham rope, of which three miles were provided in coils upon the bulwarks. The dredge and its contents were "hove in" by a small double-cylinder donkey engine, at the rate of 1,000 fathoms per hour. By these means several cwt. of material were brought up at one time from the sea bottom at enormous depths, the utmost quantity obtainable by a sounding machine being about 2lbs. The animals were separated from the sand or mud by a series of graduated sieves, on which the mud—which from depths over 500 fathoms closely resembled china clay—was washed in a tub of water, and the animals were deposited upon the sieves, according to their size.

The operation of sounding, or ascertaining the exact depth, was performed by a weight attached to the end of a small but very strong line, which was marked at intervals; when the weight touched the bottom the distance of line run off was read. Many precautions had to be observed to obtain a correct depth, one of the most important being to use a sufficiently heavy weight in deep water, so that the line might continue to run out rapidly during the whole operation, and not run the risk of being deflected sideways by submarine currents. To avoid the risk of breaking the line and consequent loss of it and of the instruments attached, in drawing up the weight, an apparatus known as the "Hydra Machine" was employed, which caused the weight (frequently 3 cwt.) to detach itself on striking the sea bottom. Both the sounding line and the dredge rope were carried over pullies fastened to a derrick at the stern of the vessel, and these pullies were attached to an "accumulator," or set of india-rubber springs, by which the effect of any sudden jerk from the rise or fall of the vessel in the sea was much diminished, and the rope was consequently not strained or broken.

The temperature determinations were made by a modified form of Six's self-registering thermometer, which was attached to the sounding line, immediately above the weight. Two or more instruments were employed for every observation. The modification was one, whose object was to counteract the error, caused by the effect of pressure upon thermometric bulbs in forcing the mercury too far up the column, thus causing the thermometer to register an apparently higher degree of temperature than really existed. This pressure amounted to one ton per square inch for every 8o0 fathoms depth, and the error at that depth was about 4° Fah. Several experiments were made on the subject in the spring of 1869, in the course of which Dr. W. A. Miller, the treasurer of the Royal Society, suggested a very simple plan by which this error was obviated. The ordinary bulb of the thermometer was surrounded by a second, and the intervening space nearly, but not completely, filled with spirits of wine, the vapour of that liquor occupying the remainder of the space. The pressure only acted upon the outer bulb, and was not transmitted to the inner in any perceptible degree. These instruments were tested by being exposed in a strong vessel filled with water to great pressure, (three tons to the square inch,) in an hydraulic press, before being used at sea. They took longer to indicate, but that was unimportant. A full description of this instrument, and of the preliminary experiments connected with it, will be found in the Proceedings of the Royal Society for June 17th, 1869. In the course of a long series of comparative experiments made at sea, these instruments were found to work perfectly, while no other form of thermometer which was tried gave satisfactory results.

The apparatus for obtaining samples of water at various depths consisted simply of a cylindrical brass tube, furnished at each end with an accurately ground valve, opening upwards. The tube was tied to the sounding line, and as long as it was descending water passed freely through it, but as soon as the motion was reversed, the pressure of the water above kept the valves closed, and the water that entered the bottle at the lowest point of its descent was retained there, and brought up for examination. As long as the bottle, or tube, was kept nearly vertical, it answered its purpose admirably. The water thus obtained was examined without delay for (1) the nature and quantity of the gases dissolved in it, (2) the organic matter in it, and (3) its specific gravity, and some samples were preserved for a more complete chemical investigation on shore.

It will now be desirable to give some account of the results obtained. The greatest depth at which the dredge was worked was 2,435 fathoms, 14,610 feet below the surface of the sea, a depth nearly equal to the height of Mont Blanc above it. At this, and at every lesser depth, living animals were found, representatives of almost every type of marine Invertebrata, many of them possessed of eyes and colour, rendering the inference that light penetrated to these profound depths almost unavoidable. Many of the creatures discovered were altogether new, and others were hitherto only known as fossils. In the Mollusca alone the dredging results added one-fourth to the list of species of British shells, and it is believed that some other classes, as the Foraminifera, will be increased in a still larger proportion. In the case of species previously known there was no perceptible difference between individuals found in their ordinary habitat and those obtained from great depths. The Mollusca dredged off the west coast of Ireland resembled in some respects those found in the Mediterranean, and in others, Arctic forms; a detailed report upon them will be found in *Nature* for Nov. 25 and Dec. 1, 1869.

It appears, therefore, that a complete disproof has been furnished of the doctrine, that a certain amount of Bathymetrical pressure must be prejudicial, if not absolutely fatal, to the higher forms of animal life. According to the well known hydrostatic law, the pressure of fluids is equal in all directions, and this pressure, however great, acting on an animal consisting entirely of solids and liquids, and containing no air cavities, can produce no alteration in its shape. Human beings are not conscious of the enormous pressure of the air on their bodies (14 lbs. per square inch), which in actual amount is greater than that upon many minute animals at great depths in the sea. Further, the direct experiment has been recently tried of subjecting living marine worms immersed in water to a pressure of 3 tons per square inch (equivalent to a depth of 2,400 fathoms), which apparently had not the least effect upon them.

In some dredgings Echinodermata were very abundant, in more than one instance many hundreds of specimens of the hitherto very rare Echinus norvegicus being obtained. In another locality, at a depth of about 500 fathoms, the dredges came up full of the beautiful branching coral, Lophohelia prolifera, specimens of which were presented to the Institution. In the "warm area" to be presently described, between the north of Scotland and the Faroe Islands, at a depth of about 600 fathoms, siliceous sponges of large size were found in extraordinary abundance, to which the generic name Holtenia had been given. Quitting the subject of the animal life, to which the attention of the speaker had only been casually directed in the intervals of his physical and chemical investigations, he then described the temperature results obtained.

The temperature of the sea at various depths was taken both by serial and bottom soundings, *i.e.*, in some observations only the temperature at the bottom was ascertained, while in others a series of determinations were made at intervals of depth below the same spot at the surface, *e.g.*, in depths up to 500 or 600 fathoms the temperature was determined at every 50 fathoms; at greater depths at every 100, 200, or 250 fathoms.

In no case was there any perceptible difference between the temperature on the sea bottom at any given depth, and the temperature of the sea at an intermediate depth of the same number of fathoms, where the whole depth at that spot was greater, *i.e.*, the temperature at 600 fathoms was always about 45°8 Fah., whether the sea were only 600 fathoms deep at that spot, or whether it were much deeper. The following table comprises the results of many hundred observations upon the temperature of the sea at various depths in the North Atlantic basin, taken off the N.W., W., and S.W., coast of Ireland, the northern limit being 57° 30′ N., the western 15° 25′ W., and the southern 47° 35′ S.

Relation of Temperature to Depth in the North Atlantic basin.

Temperature. Degrees Fah.	Depth in Fathoms.
54	Surface.
53	
52	
51	100
50	200
49	300
48	400
47	500
46	600
45	
44	700
43	
42	800
41	
40	900
39	1000
	1100
38	1200
	1300
	1400
37	1500
	1600
	1700
	1800
	1900
	2000
	2100
	2200
	2300
	2400
36·5	2435

The surface temperature of course varied considerably with the weather, but the influence of the sun's rays did not appear to penetrate beyond about 100 fathoms, and hence while the amount of fall in the thermometer in the first few hundred feet was subject to considerable variations, below that depth the rate of descent in the mercury column, though not varying in proportion to the depth, was the same in all the observations made within the above named limits. An inspection of the table will show that from about 100 to 550 fathoms the temperature decreased gradually and with tolerable regularity, while from 550 fathoms to 850 fathoms the fall was much more rapid, and after that depth the rate of decrease was extremely slow, getting slower and slower as the depth increased. It will presently be shown that there is the strongest reason to believe that in the intermediate depths (550 to 850 fathoms) where the most rapid fall takes place, the cold current at the greater depths (which was traced in the third cruise as entering the North Atlantic basin between the Faroes and the Shetlands) mixes with the warmer water at and near the surface, which is flowing from the Equatorial towards the Polar regions.

The third cruise was occcupied with a re-investigation of the area examined by Dr. Carpenter and Prof. Thomson in the "Lightning" in 1868. It started from Stornoway, in the Hebrides; its northern limit was Thorshaven, in the Faroe Islands, its western limit was 9° 20′ W., and its eastern 0° 35′ E. In no part of this area was a greater depth than 750 fathoms reached, but careful temperature serial soundings revealed a very remarkable state of things. The existence of the warm and cold areas referred to in the "Lightning" report was fully confirmed, their boundaries were determined with precision, and the depth at which the ice-cold water flowed, and where it mixed with the warmer surface water, exactly ascertained.

The following tables give the relation of temperature to depth in the warm and cold areas respectively, deduced from many observations, both by serial and bottom soundings, the results of which agreed closely among themselves.

Warm Area.		Cold Area.	
	DEGR. FAH.		DEGR. FAH.
SURFACE.	52	SURFACE.	52
	51		51
	50		50
	49		49
100 fathoms	48	100 fathoms	48
200 do.	47		47
300 do.	46		46
400 do.	45		45
500 do.	44		44
600 do.	43	200 do.	43
700 do.	42		42
750 do.	41		41
			40
			39
			38
			37
			36
			35
		300 do.	34
			33
		400 do.	32
		500 do.	31
		600 do.	30
		650 do.	29·5

A glance at the Tables will show that the inferences drawn in 1868 from the few temperature soundings taken by the Lightning, as to the co-existence of two entirely different submarine climates in the region above alluded to, were substantially correct. It will be seen that in the "warm area" the rate of descent in temperature bears nearly the same proportion to the vertical depth as it does in the North Atlantic basin; there is the same rapid fall in the first 100 fathoms, after which the fall is slower up to 500 fathoms, and then slightly increases after that point. In the "cold area" however, as ascertained by the serial soundings of the "Porcupine," a very different state of things prevails. At a depth of 200 fathoms in the warm area the temperature was 47°, in the cold it was 45°7, but while in the warm area there was a slow and pretty uniform descent in the next 500 fathoms, amounting only to *four degrees* in the whole, in the cold area the temperature fell *fifteen degrees* in the next 100 fathoms, making the temperature at 300 fathoms depth 30°8, but even this was not the lowest, the temperature at 640 fathoms being 29°6. Thus, while the temperatures of the superficial strata of the water in the warm and cold areas are nearly the same, the temperature of the deeper stratum in the cold area, which may have a thickness of more than 2000 feet, ranges from the freezing point of fresh water to $2\frac{1}{2}°$ below it. Between the two is a *stratum of intermixture* of about 100 fathoms thickness, marking the transition between the warm superficial layer and the frigid water beneath. In the North Atlantic basin, as before remarked, this stratum of intermixture occupies the space between 500 and 850 fathoms.

It seems impossible to account for these phenomena on any other hypothesis than that of the direct deviation of this frigid water from the Arctic basin; and this agrees very well with the other facts observed in the course of the exploration; viz. the sand covering the bottom contains particles of volcanic minerals, probably brought down from Jan Meyen or Spitzbergen; and also the Fauna of the cold area has a decidedly Boreal type, especially in the Crustaceans, Echinoderms, Sponges, &c., many of the animals which are found in it, having only been hitherto found on the shores of Greenland, Iceland, or Spitzbergen.

It may be a matter of surprise that this cold current, if it comes, as is believed, from the Arctic basin, should flow to the west of the Faroes, instead of coming by the apparently more direct route between the Faroes and Iceland. It must be borne in mind, however, that this current flows at a depth of 300 fathoms below the surface, and as, except in a narrow channel at the S.E. corner of Iceland, there is no depth so great as this until a point West of the Faroes is reached, an effectual barrier is presented to the movement of the frigid water except in the channel in which it is actually found to exist.

The temperatures obtained in the warm area tend to show, in like manner, that its whole body of water is derived from a southern source. Disregarding the fall of temperature in the first 100 fathoms as due chiefly to local causes, the temperature of the body of water from 100 fathoms to 750 fathoms depth is nearly the same in the Bay of Biscay in lat. 49° N. and in the warm area in lat. 59°5′ N. In the latter case the lowest temperature observed is considerably above the isotherm of its latitude, and this elevation could not be maintained against the cooling influence of the Arctic stream but for a continual supply of heat from a warmer region.

A general review of the temperature observations appears to show, therefore, that there is a great general movement of Equatorial water towards the Polar area going on near the surface of the sea, and that, underneath, there is a general movement of Polar water towards the Equatorial area, which depresses the temperature of the great oceanic basins nearly to the freezing point. Deep sea bottom temperature soundings in the Indian Ocean, and on the American side of the Atlantic, confirm this view.

The speaker then described the investigations which had been made, in the first instance by himself, and subsequently by Mr. Hunter and Mr. P. H. Carpenter, into the gases dissolved in the sea water at various depths, and into the existence of organic matter in the water. The samples were obtained by the apparatus before described, and were always analysed without delay. The gases were expelled from the water by boiling, and collected over mercury, after the method of Dr. W. A. Miller. The adaptation of his apparatus to the requirements of shipboard was first made by the speaker, and was used without alteration by his successors. The mixed gases, confined over mercury, were treated with caustic potash, which removed the carbonic acid; the oxygen was next absorbed by the addition of pyrogallic acid, and the remainder was taken as nitrogen.

The first point of importance established was, that the total amount of gas dissolved in the sea water did not vary with the depth. It had been supposed, that the excessive pressure at great depths caused the water there to hold a large quantity of gas in solution, but there was no evidence whatever of this being the case, the total volume of gas in sea water, at whatever depth, being about 2·8 vols. from 100 vols. of water. No doubt the pressure at great depths was sufficient to retain much more than this if the gas were forced into the water, but in the opinion of the speaker there was no satisfactory hypothesis to account for the means by which the extra volume of gas could be forced in; at any rate, as a matter of fact, it was not there.

The general average of 30 analyses of the gases in surface-water was as follows:—

	Per Cent.	Proportion.
Oxygen	25·046	100
Nitrogen	54·211	216
Carbonic Acid	20·743	83
	100·000	

N.B.—In all cases the results are reduced to 0° Cent. and 760 mm. barometric pressure, (32° Fah., and 30·0 inches nearly).

It was observed, however, that during, and immediately after, strong winds, the surface-water was more highly aërated, containing less carbonic acid, and more oxygen.

Average of 5 analyses of surface-water during windy weather:—

	Per Cent.	Proportion.
Oxygen	29·10	100
Nitrogen	52·87	182
Carbonic Acid	18·03	·62
	100·00	

That this change is really due to the agitation of the water in contact with air is shown by the following analyses of water taken from abaft the paddles, at full speed.

	I.	Proportion.	II.	Proportion.
Oxygen	37·1	100	45·3	100
Nitrogen	59·6	161	49·1	108
Carbonic Acid	3·3	9	5·6	12
	100·0		100·0	

It appears, therefore, that the superficial disturbance of the sea by atmospheric movement is absolutely necessary for its purification from the noxious effects of animal life and decomposition.

As a general rule, the examination of water below the surface showed that the oxygen diminished and carbonic acid increased with the depth, (the nitrogen remaining nearly constant), though not in proportion to it.

Average of 24 analyses of *intermediate* water:—

	Per Cent.	Proportion.
Oxygen	22·03	100
Nitrogen	51·82	235
Carbonic Acid	26·15	119
	100·00	

Average of 35 analyses of *bottom* water:—

	Per Cent.	Proportion
Oxygen	19·53	100
Nitrogen	52·60	261
Carbonic Acid	27·87	143
	100·00	

Hence it appears that there is only about four-fifths as much oxygen at the bottom as at the surface, and in proportion to the oxygen, nearly twice as much carbonic acid, (83 to 143.) In some cases the amount of this last gas was extraordinary, the highest percentage found being 48·3, and the proportion to 100 oxygen being 281! It was frequently noticed, that the proportion of carbonic acid to oxygen in bottom water bore a much closer relation to the abundance of animal life than to its depth, and in several instances, where the depths were nearly the same, the speaker had ventured a prediction as to the abundance, or otherwise, of animal life of high types, as shown by the dredge, from the proportion of carbonic acid in the bottom-water previously obtained and analysed. In every instance, the prediction so made was correct. This excess of carbonic acid, however, does not extend upwards very far from the bottom, as the following series, where the samples of water were collected at various vertical depths over the same spot, will show.

	750 Fathoms.	800 Fathoms.	862 Fathoms—bottom.
Oxygen	18·8	17·8	17·2
Nitrogen	49·3	48·5	34·5
Carbonic Acid	31·9	33·7	48·3
	100·0	100·0	100·0

The speaker had observed that even when animal life was very abundant on bottoms less than 200 fathoms from the surface, this excess of carbonic acid did not exist, and he was inclined to believe that up to this depth there was so constant an aëration of the water at the bottom, by diffusion from the surface, (whether of the water itself, or of the gases dissolved in it) that the excess could not accumulate. He pointed out that the coincidence between this depth and the greatest depth at which vertebrate animals (fish, &c.) were found, was suggestive.

The examination of the specific gravity of sea-water at various depths had been made, but the results were void of much interest. In the open sea, away from the mouths of rivers, the specific gravity, whether of surface, intermediate, or bottom water, varied little from 1027·8, that of fresh water being 1000·0. In some cases the water from great depths, when brought to the same temperature as that at the surface, was slightly lower in specific gravity, and occasionally during wind the specific gravity of surface-water slightly increased.

The test applied to the sea-water for the presence of organic matter was that known as the Permanganate, or Chameleon test. The mode adopted by Dr. W. A. Miller was employed, with an addition suggested by Dr. Angus Smith, which enabled the operator to distinguish between the organic matter in a state of decomposition from that which is only decomposable.

30 Analyses were made of surface waters.		
10	ditto	intermediate.
36	ditto	bottom.

The results of these showed :—

(1). That intermediate water contained less organic matter than either bottom or surface water, what was there being chiefly decomposable.

(2.) That surface water contained more decomposable and less decomposed matter than bottom water.

In addition to the application of the permanganate test, several samples of water were collected, bottled, and subsequently analysed on shore by Dr. Frankland, who fully confirmed these results, and demonstrated the highly nitrogenous character of this organic matter.

This fact has a very important bearing upon the question of the source of nutriment for the vast mass of animal life covering the abyssal sea bed. No evidence of the existence of Plant life at a greater depth than 30 fathoms has yet been discovered, and yet the received doctrine is, that the generation of organic compounds from carbonic acid, water, and ammonia is the special attribute of vegetation, on which the lowest tribes of animals feed. Given the Protozoa in the abysses of the sea, every other tribe of animals can be supported, but on what do the Protozoa feed? A possible solution of this difficulty was suggested in the spring of 1869 by Prof. Wyville Thomson, viz., that just as many forms of Protozoa extracted either silica or carbonate of lime from the sea water to form their exquisite skeletons, so also they were supported by the absorption, through the surface of their jelly-like bodies, of the organic matter in solution in the sea.

The demonstration of the existence of this organic matter, therefore, is an important step in confirmation of this theory.

It may be remarked, in conclusion, that the results hitherto obtained in deep sea explorations by the Swedish and United States Governments, both as regards the existence of high forms of animal life at great depths, and the depression of temperature in the lower strata of the oceanic basins, (as far as they have yet been obtained,) fully confirm those of which some account has been attempted in the foregoing paper.

II.

The Natural History of Frenchmen.

By Dr. John Beddoe, Pr.A.S.L.

Read at the General Meeting, January 6th, 1870.

Abstract.

Dr. Beddoe made a verbal communication to the Society "On the Natural History of Frenchmen." Referring first to the pre-historic inhabitants of France, and the diversity of type exhibited by them, he took the opportunity of exhibiting a cranium of great antiquity and interest, presented to him by P. J. Worsley, Esq., who had procured it from the celebrated cavern of Lombrive.

He then described the location of the races, Iberian or Aquitanian, Ligurian, Kelto-Gallic, and Kelto-Kymric, who occupied France at the beginning of the historic period, and shewed the apparent relation of their distribution to the physical geography of the country.

He passed in review the more important of the successive invasions and settlements of aliens since that time. Such were those of the Greeks, whose physical type is thought to remain at Arles; of the Roman, or so called Roman colonists or legionaries; of the insular Bretons in Armorica, of the Franks in the north, the Burgundians in the east, the Goths in the south; the Alans, Taifals, Saxons, in the west of France; the Alemans or Swabians in Alsace; the Saracens (Arabs, Kabyles or Iberians,) in various isolated portions of the southern half of the country; and the Normans in the province that bears their name, and in the adjacent portion of Bretagne.

This was followed by a sketch of the physical characteristics of modern Frenchmen, and the differences observed, in mental and moral, as well as in physical traits, between the northern and north-eastern French on one hand, and southern and western French on the other; and by an explanation of the theories of M. M. Broca and Boudin, and other French anthropologists, as to the dependance of variations of stature, as observed in the several provinces and departments of France, on the differences of race rather than on those of climate, food, &c.

III.

On the Seeds of Flowering Plants.

By T. H. Yabbicom, C.E.

Read at the General Meeting of the Society, Feb. 3rd, 1870.

The author introduced the subject by noticing the general structure of the inflorescence, and describing the office of each part in the production of the seed, the form of the ovary and distribution of the ovules in different plants being particularly noticed; and then continued:—

On taking a bud of the Fuschia as soon as it appears among the upper leaves, when the whole organ does not exceed one-sixteenth of an inch in length, and making a cross section of the ovary, there appears on the outside a layer of compressed cells forming the exterior cuticle, and corresponding to the upper cuticle of the leaf; within it is a cellular mass occupying the whole of the space between it and the loculi, answering to the parenchyma; and lining the loculi another layer of cells occupying a similar position as regards the lower cuticle of the leaf. The septa are four in number, the edges of the carpels being so curled on themselves, forming the placenta, that they resemble in outline the capital of an Ionic column, and the concave side is connected with the centre of the cellular mass by a tube which serves to convey the sap to the ovules. In each loculus appear four ovules of a pear shape, with a dark nucleus.

As the ovary assumes more definite proportions, but still long before the expansion of the flower, a cross section shows the walls of the loculi to be more regular in outline, and the ovules in the interior of more delicate form, Subsequent examination shows the substance of the ovules to have become more dense, until at the period of the bursting of the petals the loculi are so enlarged, that they are only separated from each other by a thin septum or membrane; the ovules having the shape and being about half the size of the perfect seed. As no pollen has reached the head of the pistil up to this point, it is evident that the growth of the ovules is so far effected independently of the impregnation of the ovary. At this period the outside coating of the ovary is a cellular mass confined between an exterior and interior cuticle. The central column is connected with this by four septa, which were formerly the walls of the loculi, and the ovules are arranged in circle, between the outside coating and the central column. If at this period the stigma be cut off before any pollen can have reached it, it follows that no fertilization can take place, yet the ovary continues to increase in size very considerably some days after the flower has withered and fallen, until it ripens and falls itself. It is then very much distended, being filled with a watery sap, but the ovules are shrivelled and withered. If, however, the stigma receive, artificially or naturally, sufficient pollen for its impregnation, the ovary will increase in size, and the ovaries will be found converted into seeds, with their proper characteristics.*

A description of the structure of seeds, and of the differences between those of the dicotyledonous and monocotyledonous plants followed; also the distinctions in the stem, leaves, and flowers of these two great classes were touched upon. Numerous examples of the different ways in which the cotyledons are folded and curled in various plants were cited, and illustrated by the seeds of Euphorbia, Atriplex, Pisum, Convolvulus, the wall-flower, stock, and others. The nature and office of the albumen in some seeds was also described.

On the subject of the exterior appearance of seeds it was remarked, that the testa or outer covering of the seed often presents markings of very great beauty, especially in the smaller ones viewed with a low power of the microscope. Some, as the Violets and various species of Myosotis, are smooth and highly polished. Several species of Geranium have regular hexagonal markings : in the Euphorbias the testa is traversed by ridges, forming an irregular pattern. In some of the Chickweed family the elevations are isolated, constituting miniature mountains and valleys. In Antirrhinum majus the ridges and depressions are so disproportionate to the size of the seed, that it loses all regularity of form, and might be mistaken for a fragment of cinder. These differences are tolerably constant in each natural order, though some genera, and even species, may have them more apparent than the rest. In the Scrophulariaceæ many of the genera have rough seeds. Such is also the case in the Lamiacæ, while in the Cruciferæ the seeds are smooth ; the Chickweed group having, however, some genera with smooth or only slightly roughened testa, while others, as before mentioned, have a very irregular surface.

The methods, by which the distribution of seeds is effected, were noticed at some length, and several special instances mentioned. Among these were the following :—

The five seeds of the Geranium family are each enclosed in a carpel provided with a long awn, which when ripe curls upwards from the base, and finally becomes detached. This awn is readily affected by hygro-

* Hooker says, "In general, germens whose stigmas have not received the pollen wither away without swelling at all ; but some grow to a considerable size, and in each case the substance of the seed, its skin and even its cotyledons are often to be found, the embryo only being wanting."

metric change of the atmosphere, causing it to curl in various directions, which produces an onward movement on the surface of the ground. In the Balsam family the carpels of the seed-vessel become highly elastic as the seed ripens, until the slightest touch causes them to separate with a spring, throwing the contents to a considerable distance. The pod of Viola canina consists of three carpels united at their edges, which when ripe divide from the point downwards, and fall back to a horizontal position with a sharp report; at the same time the edges of the carpels, loosed from their restraint upon each other, press upon the polished surface of the seed, which is thus, as it were, shot out. The flower-stalk of Linaria Cymbalaria becomes elongated during fruiting, and curls and twists in various directions until the seed-vessel finds a suitable chink in the wall or rock to deposit its contents.

A variety of other agencies for distribution were mentioned, as running streams of water, the seeds being swallowed by birds and animals, and afterwards dropped; the hooked bristles and awns possessed by some, as Geum urbanum, the Carrot, Toriles anthriscus, and others of that order; the teasel and various species of the Rubiaceæ. The pappus of Taraxacum and others of that order; the membranous wing of the Pine and Bigonia seeds, the feathery awns of the Clematis and other like appendages, being acted upon by the wind, are powerful agents of distribution.

The chemical composition of the cotyledons and albumen was noticed, as also the part played by each in the economy of the seed.

The latter portion of the paper was devoted to the consideration of the changes produced by germination, the starch being converted into dextrine and grape sugar for the nourishment of the young plant. The appearance of the embryo and radicle at different periods of growth was described, and the result of some experiments by De Candole on the the vitality of seeds closed the paper, which was illustrated with a number of diagrams and microscopic preparations.

IV.

Monad Life.*

By Henry E. Fripp, M.D.

Read at the General Meeting, March 3rd, 1870.

In a former paper, I brought before your notice an account of certain species of Amœboid protoplasms, found by Richard Greef, and described by him as Land species of Amœba. From his researches we learn that

* The figures mentioned in the paper refer to drawings exhibited at the Meeting. The Editor regrets, that the illustration of papers by plates has not as yet been contemplated.

they possess a higher organization than the Water species, and if rightly named, we must give up the notion hitherto entertained that Amœba protoplasm is as structureless "as a speck of jelly," moving and feeling without "organs," and reproducing itself by simple division of its homogeneous substance. The Land Amœba has a dense and contractile ectosarc, or outer layer, which however is not distinctly separable from the inner granule-bearing substance or endosarc. Its mode of reproduction is by internal evolution of germs. In other respects it agrees with the Water Amœba, alimentation being carried on by gradual enclosure within its substance of the food (diatomaceæ, &c.) with which it comes in contact.

Carter and others had already noticed, even in the Water species of Amœba, a partial differentiation of the plasm into outer (dense) and inner (soft) layers. In Greef's Land Amœba, the outer substance besides becoming denser, has acquired a specialized power of contraction and relaxation, so regulated that when contraction commences at any point of the surface of the animal's body, relaxation takes place at some opposite point, either simultaneously or at the preceding moment, the effect of this consentaneous action being, that the whole mass of protoplasm composing the endosarc is driven in the direction of the yielding portion of the ectosarc. By this means the creature is enabled to make its way through the interstices of the loose earth or sand in which it has its being. And since this regulated movement may occur at any part of the surface, the creature appears to have the power of governing its movements. It is more probable, however, that the direction in which movement takes place, depends on the circumstance, that porous earth offers least resistance where interstices between its particles occur, and thus allows the contents of the body to be pressed forwards by the vis a tergo of the contracting segment, although even this explanation implies something like conscious sensation at the surface of the animal's body. The significance, we might almost say the motive, of this peculiar "adaptation to circumstances" is not far to seek when we consider the particular habitat and mode of life of the earth-dwelling Amœba.

But the interest of the case centres in this: that a change in the atomic constitution of the exterior plasm of the Land Amœba, scarcely amounting to what we may call differentiation of parts, in the sense of "organs," supplies the means by which a peculiar rythmical motion is obtained. The contractility of the whole protoplasmic substance is transferred as it were to the ectosarc, and the now specialized power is exerted for a special purpose. This definite action and direction of the contractile ectosarc is equivalent to, and is in fact, an elementary form of the function performed in higher animals by muscle, though the higher type of muscle structure is not recognisable.

But it is easily conceivable that the first advance towards speciality of structure in a homogeneous protoplasm may be effected by a change in the molecular state of matter, without attaining to such definition of parts as would satisfy our idea of a specialised apparatus. Such a change of atomic arrangement may also, if permanently induced, supply a basis for further evolution, and finally, positive structural differentiation. Thus, then, we may fairly admit that organ and function grow *pari passu* from the nascent to the matured state, neither being the antecedent, but both due to pre-existing condition of organic matter and the operation of special external influences. Strictly speaking, however, we cannot use the terms "organ" and "function" in so simple a case as that under our notice, but must view it rather as a readjustment of the organic action corresponding with a rearrangement of the organic atoms.

Now the question immediately arises—How is this change initiated? and how maintained? Physiologists have answered these questions by inventing a term which expresses the fact rather than the cause—namely, "vital action." To initiate and support this vital action, *a force*, "sui generis" and independent of material agencies is pre-supposed. There are, I think, good reasons for rejecting the broad assertion, that all organic change is due to a *vital force*, if we are therewith required to believe that this force is *not* the exponent of some physical or chemical reaction in organic atoms. Of life, we know nothing apart from matter, but we do know that the elements of which living matter is composed, are chemically identical yet exhibit different properties, and that while they exhibit these different properties, their chemical constitution remains identical. The properties of albumen, fibrin, &c., are in fact preserved only so long as they remain undecomposed.

Chemical change is consequently not the source of the properties of matter, but rather of change in the behaviour of these properties—*i. e.* potential changed into actual energy at the cost of the material concerned, and, in so far, therefore, implies dissolution rather than preservation of matter. On the other hand, the physical constitution of organic atoms may be conceived to be capable of re-arrangement without chemical change, and of alteration in property without decay, so that apart from any hypothesis of vital force, the properties of organic matter, as known to us at present, may be simply considered the expression of physical peculiarity of constitution. It is almost superfluous to remark here, that the primal constitution of living matter as compared with that of inorganic substances, is characterised by differences which separate the two so widely, that we gain little by calling the reaction of an organic substance "vital," for we are forced to couple with this "vitality" the fact, that its manifestation appears inseparable from that of the observed properties of the matter of which living beings are composed.

That organic matter is derived from inorganic matter, so put together as to occasion the manifestation of properties unobserved in dead matter, cannot at the present day be any longer disputed. But, again, those properties of matter, the manifestation of which constitute our only evidence of vitality, are known to us only as phenomena induced by the operation of external agents on the substance under examination. The "property" is a potential quality of matter, and its manifestation is due to the reaction of the substance, not of the agent influencing it. That such reaction should differ in different substances—or, in other words, that different properties should be manifested in the several protein compounds, (*e. g.* albumen, fibrin, casein, &c.—protein compounds of the first class), would lead us to infer that, as their chemical composition is not perceptibly altered, the physical disposition or atomic arrangement of their elements may be changed.

Now, the protoplasm of the lowest animals may be chemically isomeric, just as the protein compounds are, yet capable of different reactions, according as external agents affect them, and as their atomic elements are differently arranged. And if our protoplasm consist of more than one protein substance, we may fairly suppose that the "properties" of the compound protoplasm will differ as one or other constituent predominates. In the chemistry of organic substances, a process of re-arrangement by substitution of elements, accompanied by change of properties, is well-known, and by some such process, the protoplasm of various animals may become possessed of different properties, which would form the starting point of future differentiation and evolution. The influence of the surrounding cosmic media must, in this case, be all important on the behaviour of the protoplasm, for the variable reaction will depend on diversity of stimulus as well as on diversity of organic constitution.

What, then, are we to say to the vital *force* doctrine? Simply this, that it is an expression of the fact that living matter reacts in a determinate direction when influenced by certain agents. The property of living matter thus to react is what we call vitality; but whether it manifests itself as vital *force* will depend on the property being sustained by suitable influences from without. Thus we must accept *vitality* as an ultimate fact, real and patent to every intelligence, until we choose to give it another name, which we may imagine that we understand better. Vitality is conceivable as a property of matter having a given composition ; but vital *force*, in-so-far as it depends on the continuance of external agencies of a material character, and expresses the reaction of "living matter," must be a product of physical or chemical change. Organic matter offers the conditions necessary to the evolution of animal life, but "vital force" can only be understood at present in this sense—that it is set free by the play of material affinities, and in its turn influences the future behaviour of the organism, as its elements grow more and more composite.

To affirm that an animal lives only by virtue of some intrinsic dominant power seems to me to be stating but one half of the case, as it presents no explanation of the *tenure* of that life. The mere existence of an animal implies the presence, and depends on the nature and determining influence of external media. This is the basis of its power to live. Where life persists through varying conditions, it may be said that this is due to tenacity of vital power, but it may with more truth be said that a certain variety of conditions is compatible with the preservation of organic matter in such state, that its so-called inherent vital properties are not destroyed. The capacity of adaptation to cosmic influences is, on the whole, limited ; but within those limits what is called tenacity of life, instead of being interpreted as an effort of vital force, may be better understood as the compatibility of organic matter to exist without injury by accepting passively the conditions imposed in it. But the life thus continued under different circumstances becomes *changed* by them, and we have variety of life under variety of conditions through the instrumentality of the remoulded organic matter. The persistence of external conditions and internal adaptation affords us a rationale of the persistent types of animals. And "variation of conditions" gives us the explanation of variation in type. But in all this we see little of controlling power, in the sense of "vital force"; the animal cannot resist external influences, but is moulded by them or dies. Thus, for instance, our Fresh-Water Amœba dies in sea-water, or a solution of $1\frac{1}{2}$ per cent. salt. In more diluted solutions it lives for a time, and change of form and movement indicate the effect of the new medium.

Allow me for a moment longer to dwell on this point. It is not the number, size, or minuteness of created beings that so deeply challenges the attention of the Biologist as this great fact of "*variety of type*" under "*variety of conditions.*" Were creation moulded on one monotonously recurring type of animals, we should lose our great key to the study of organised life—comparative anatomy. And again, were material influences the same in kind and quantity for all animals, we should have no crucial instances of adaptation from which to deduce a relationship between modified organisation and cosmic condition.

But the survey of animal life, after the work of naming, ordering, and classifying the wondrous series has been accomplished, in order to gratify our natural sense of the external beauty and order of creation, impels us further to consider its deep significance in relation to man, who is made lord of all upon earth. And the great moral of this multiplex creation dawns upon us with no uncertain light, when our study of animal life brings home to us the near solution of questions, which occupy our minds respecting our own organisation, our own being and end, our own place and prospect in the scheme of creation. If by some the naturalist's studies should be looked upon with contempt as insignificant and trifling, I would answer that he is toiling up the steep ascent to self-knowledge in learning to solve the *raison d'etre* of other beings, and looking upwards from nature to nature's God.

But not to diverge any longer from my subject, I repeat that while we accept the "properties" of matter as obviously connected with the constitution of matter, we must be cautious in accepting the hypothesis of an immaterial vital principle as helping us to understand what may possibly be explained on other grounds. Modern research in physics and chemistry, aided by new discoveries of the lowest forms of living matter, has greatly tended to limit the application of "vital force" doctrines. Nothing seems to me more illogical than the notion of a force belonging neither to matter nor place, time or circumstance, yet attaching itself by some inexplicable means to organic substances in order to vivify them for a time; residing therein as a governing principle to arrest or alter the action of material laws; and finally leaving its temporary home to go apparently nowhere. I take it for granted, that none of my hearers are likely to confound the distinct and separate ideas of material life and immaterial existence. Of the latter, we can discover nothing by any analysis of our present material life. The discussion respecting organic life does not touch that respecting the modes of existence of the soul. But for us, the relation between the phenomena of organic life and the state and condition of organic matter constitutes one of the profoundest and most important enquiries in biological science; and the problem comes before us in its simplest enunciation of form, structure, and function, when we enter on the study of the lowest types of living beings. I trust, therefore, that my attempt to carry on further the subject, partially entered upon in my last paper, will not be considered out of place. For while I reproduce the story of Monad life told us by Hæckel, Cienkowski, and others, the discussion of protoplasm theories and of primal organic action will be continued with but slightly changed aspects. Here only, if ever, are we likely to probe nature's well-kept secret, and learn whether vital action be the mere temporary alliance of certain properties of matter, evoked by given conditions, or an indivisible residual phenomenon of forces incompletely balanced, or finally, a separate entity beyond and above all material action.

Since the date of my last paper, there has been published in the *Quarterly Journal of Microscopic Science*, an English translation of a most interesting monograph on Monads and certain other organic plasms, grouped together in a closely allied series, characterised as a whole by the fact of a non-sexual reproduction. The 10 groups of Hæckel constitute what he calls the kingdom of Protista. It is, however, but right to bear in mind Hæckel's repeated statement, that he considers his present attempt an entirely provisional one.

The first group includes Gymnomonera and Lepomonera—the very lowest of all organisations, where the whole structureless body of the fully developed organism consists of a simple speck of sarcode or plasm. Compared with this, the compound unit known as a cell is a superior morphological entity. The relation between the cell and such an individual as is represented by a morsel of plasm is thus defined by Hæckel—"True cells (for the definition of which, I imagine necessary the separation of inner nucleus and outer plasm) have arisen from Monera by an inner differentiation. On the other hand, celliform non-nucleated plasms have originated from Monera by an outer differentiation of plasma and enclosing membrane, or shell."

Thus we have:—

1. Naked plasma masses, without membrane or nucleus.
2. Enclosed plasma masses—non-nucleated (pseudo) cells.
3. True cells—naked plasma masses, with nucleus, but no membrane.
4. Ditto ditto with nucleus and membrane.

N.B.—I introduce this histological view of the relation between simple protoplasm and "*cells*," (which latter are compound structures, having a definite morphologic value, and convenient to refer to as anatomical units, notwithstanding their composite character) in order to dispose of a difficulty which may perplex those, who have not followed closely the gradual change of opinion in respect to the constitution of cells; and also because one German school formerly looked upon the lowest animals as unicellular organisms—whereas it is now accepted that the protoplasms of Monera are in their primary stage not so highly differentiated as the elements of a cell.

The following is Hæckel's technical definition of the group Monera:

"Organisms without organs, which in their perfectly developed condition form a freely-moving, naked, perfectly structureless, and homogeneous mass of sarcode (protoplasm). Nuclei are never differentiated in the homogeneous protoplasm. Movement is effected by contraction of the homogeneous substance of the body, and by the protrusion of processes (pseudopods), varying in form, which either remain simple, or ramify and anastomose. Nutrition is effected in various ways, mostly after the manner of the Rhizopods. Reproduction is monogonous. Often, but not always, the freely-moving condition alternates with a state of rest, during which the body surrounds itself with an excreted structureless covering (encystation). All Monera live in water."

Now, with this definition before us, we turn to Hæckel's table, and find as examples of Gymnomonera—Protogenes and Protamœba, &c., which are animals living in water; and of these animals Hæckel especially notes that they never pass into a resting condition nor become encysted. Consequently the Moner-Amœba has a different life-history from that of the creatures discovered by Greef, and called by him land species of Amœba. Herein I find support for the scruples formerly expressed by me in respect to naming all things Amœboid which shew the phenomenon of a simple contractility. We know that various pseudo-cells, or non-nucleated lumps of plasma manifest this property (*e. g.* the white blood-cells of animals generally, cells found in the seminiferous tubes, and a great variety of other pseudo-cells, such as the Amœboid germs of Gregarinæ, &c,) In short, it is becoming universally accepted that the contractility of the Amœba, as observed in the typical Amœba princeps, is not a special character of this creature, but a primal condition or property of the fundamental protoplasm from which all animals begin.

According to Hæckel's definition, the Amœba, such as we know it, (that is, a nucleated but naked plasm with vacuoles) belongs to his 8th group of Amœboid Protoplasts, and the Land Amœba of Greef is a still higher organism, to be raised altogether above the kingdom of Protista, by the character of its reproductive process. I make this observation here, because Hæckel has retained the word in naming his examples of the very lowest and entirely structureless plasms under the heading Gymnomonera. The "protogenes" and "protomœba" are discoveries of his own, not to be confounded with the familiar Amœba princeps of our handbooks. The confusion occasioned by calling all organic plasms Amœboid which shew the contractile movement first recognised in the typical Amœba, renders it very difficult, as I have remarked in my former paper, to reconcile the statements of different writers who are describing different animals, which should be referred to different species and groups, according to their life-history and phases of development. Thus Huxley's "specks of jelly" are the Protogenes and Protamœba of Hæckel—not the Amœba princeps, Nucleuria, Arcella, and Gregarina-amœboid, all of which have nuclei, vacuoles, and other characters of a differentiated organism. So much I have thought it right to add as a corollary to the statements and arguments brought forward in my last paper. I now confine my remarks to the proper subject of this paper—the Monads of Hæckel and Cienkowski, placed under the heading "Lepo-Monera," which forms Hæckel's second division of Monera.

By the term "Lepo-Monera" we are to understand simple naked plasma-masses, without nucleus or membrane, which at a later phase of their life-history become encysted—that is to say, become motionless, then surround themselves with a covering or shell, and while in this state undergo a special reproductive process. This encysted or encapsuled state during reproduction is common to a variety of vegetable as well as animal organisms whose Zoospores appear afterwards with the characteristic of Amœboid contraction.

The following genera of Lepo-Monera are enumerated by Hæckel. 1, Protomonas—P. amyli. 2. Protomysa. 3. Vampyrella. 4. Myxastrum.

Protomonas. A simple, shapeless, protoplasm body, without vacuoles. It protrudes simple or ramifying pseudopoda, and reproduces by Zoospores which unite together into one netlike plasmodium. Further description is unnecessary, as we meet with the same general character in Monas Amyli, of which I now shew Cienkowski's drawing, and proceed to give a condensed account, taken from the writings of that accurate observer.

Fig. 1 represents the Monad Amyli full of Zoospores. Fig. 2, the Zoospores when free. Fig. 3, an Amœboid development of Zoospore, or rather a contractile plasm which, being devoid of nucleus or vacuole, has no claim to the name Amœba. Fig. 4 represents the union of several such plasms in one string. Fig. 5, the state of rest, in which the animal is shrouded in a capsule of matter formed on its outer surface, whilst within it is seen a mass of Zoospores in process of development, and a smaller mass of refuse aliment. The Zoospores are spindle-shaped, exhibit very active contractile movement, (wriggling like Anguillulæ), and they are supplied with pointed ciliæ or flagellæ. The M. Amyli is found attached to decaying Nitella Plants.

The life-history of this creature is here unfolded. It may be said to begin as a Zoospore, in which state it is not distinguishable from the moving germs or Zoospores of Algæ and Fungi. This Zoospore next becomes a soft contractile mass of plasm, furnished with one or more ciliæ, and now takes in food through its substance, growing therefore in size. The feeding phase complete, it ceases to move about, and acquires a capsular envelope—becomes, in fact, a pseudo-cell without nucleus. Before all the imbibed nutriment is assimilated, the generation of young Zoospores begins within the capsule. One remarkable feature of its middle-life is the well-ascertained fact, that several such plasms fuse into one individual. This was *not* observed by Cienkowski to take place in any other known Monad, and in so far, he considered it, peculiar to the Monas Amyli. But the Zoospores of Fungi (myxomycetæ) growing in mucus, were discovered by De Bary to resemble those of the M. Amyli not only in becoming Amœboid, but also in their capacity of fusing together and forming an indefinite network of contractile plasm. From this stage, however, the parallel between the two fails, and the mode of fructification differs. In the Protomyxa of Hæckel, the combination of many individual Zoospores into one network connecting them together is observed as a special character. To this connected colony of Zoospores the name plasmodium is given.

Cienkowski describes further certain spore-forming Monads—under the names Pseudospora (Monas) parasitica, P. nitellarum, and P. volvox. Figs. 6-11 indicate the life-phases of P. par.; but here we find the Zoospore becomes a true Amœba, for the minute body of plasm contains a nucleus and two or three contractile vacuoles, also ciliæ. The cyst of later development is a simple membrane. Hæckel accordingly excludes it from his list of Monera. Figs. 12, 13, shew Pseudospora nitellarum. Its Zoospore resembling a spermatozoon, and its capsular envelope double, with a considerable interspace; its Amœba is organised, as that of the P. parasitica, and consequently Hæckel rejects it as a Moner.

I may as well here observe that the definition of a Moner by Hæckel has relation to the physiological status of the animal—that is to say, to those characteristics which decide its place in the scale of beings in correspondence with its life-history. Cienkowski's definition of a Monad is based on the idea of a unicellular individual, whose spores pass by metamorphosis into Amæboid plasms, and like the typical Amæbas take in foreign bodies into their substance as aliment. Other characteristics of the cell conditions, during its process of encystation, are included in Cienkowski's description of Monad. The basis of Cienkowski's definition is more morphological than physiological.

Figs. 14-18 shew P. volvocis, a parasite of the V. globator. Like the former, its Zoospore (but much larger) has a nucleus and two ciliæ. The amœboid phase is easily reached without losing its ciliæ. The creature creeps over the surface of volvax, and finally bores its way inside it, devouring in a few days all the colony of young volvoces, and then abandoning this for a new prey. On changing its state, it forms a cyst which is outwardly circumscribed by another membrane or veil of irregular dimensions, which corresponds to the outline of its former Amœba state, whilst within the cyst, which has a double contour, lies the rounded cell in which reproduction goes on. According to this description, the P. volvocis is not a Moner as defined by Hæckel.

Cienkowski describes also as a Monad a new species, to which he gives the name Colpodella pugnax, which I mention here on account of its amusing history. Figs. 19-30 refer to it. In this creature the Amœboid phase is missing. Its Zoospore appears first in the shape of a sickle or lunette with pointed ends and is quite colourless. It has a nucleus, a vacuole, and one cilium at its anterior extremity. Its motion is tremulous as it swims, occasionally varied by vigorous sweeps of its posterior extremity. It is found in company with "Chlamydomonas pulvisculus," and falls foul of its neighbour, fastening upon it with its nonciliated end. In a few seconds the green contents of the primordial sac of its prey may be seen very slowly entering into the Zoospore's body, and the pointed end which serves as mouth widens. The attacking Zoospores at length suck out their victim, and quit it for another, till they fill out in dimensions and resemble the Colpoda in shape, with a curved extremity, which he bears forward in his agitated movements.

The Colpodella Zoospore must have therefore the power to pierce or dissolve the membranous covering of the Chlamydomonad. For if, after the first attack, the Zoospore leaves its prey, green matter flows out of the small opening made just where the Zoospore fastened itself. The vegetable Zoospore (Chytridia) has however the same power of piercing or dissolving the Cellulose skin. Anything like a mouth cannot, however, be seen in the Colpodella, though the entry of the contents proves that there must be some kind of opening.

After this gorging of aliment the Zoospore passes at once into its quiescent stage, without the intervening phase of Amœboid life. The Zoospore balls itself into a round mass, containing the ingested green matter in one aggregate lump and showing a clear peripheral border, which ultimately hardens into a membrane. Assimilation of food now begins, the clear portion of the ball increasing in depth around the body, until after advanced digestion the green colored food disappears, colorless plasm fills the whole cell, with the exception of a red colored residuum of aliment. Segmentation of the colorless mass is next observed, and new Zoospores are gradually formed. Their manner of exit from the parent cell differs however from that of the Zoospores already described. In the former instances the Zoospores make their separate exit through separate openings in the Capsule. The Colpodella parent cell becomes egg-shaped, thins, and finally gives way at one end, and the new Zoospores are born in a mass, surrounded with a membrane, and move about enclosed in this for a time until the membrane wears away, and the individuals are then free.

Lieberkuhn was the first to observe (1855) this peculiar mode of feeding in an oval colorless Monad, which by means of one or more projecting portions of its body, was seen to suck out the primordial cell of Eudorina elegans with such force as to shew the rapid movement of aliment into its body.

Of the second genus of Lepo-Monera only one species (Protomyxa aurantiaca) is given by Hæckel, who alone has seen it. I refer you to the *Microscopic Journal* for full description, directing your attention also to the fig. copied from Hæckel, with the characters assigned to the creature described by the author. "Protoplasm body, a plasmodium of orange red color which originates from the fusion of several Zoospores (0·5—1 mm. diameter) with very numerous and thick ramifying and anastomosing pseudopods, which form a net-work by many anastomoses. In resting phase a globular Lepocytode (encysted mass without nucleus) 0·15 mm. diameter, with a thick cyst, Zoospores pear-shaped; the pointed end produced into a strong flagellum, at first moving in the manner of the Zoospores of the Myxomyceta and afterwards creeping along in the manner of an Amœba."

The third genus is named Vampyrella of which three species are described by Cienkowski, whose account we again follow:—

"The Vampyrella is distinguished from the Moners above described by not having Zoospores. Inside the encapsuled parent cyst in its quiescent state, are formed four germs, which after their exit appear in the form of Actinophrys-like Amœbæ. The Vampyrellæ are thus characterised as reproducing by formation of "Tetraplasts" instead of Zoospores. These Tetraplasts have neither nucleus nor vacuoles, nor do their plasm bodies fuse together into a net-work or plasmodium." Cienkowski gives the following description and life-history of three species of Vampyrella:—

V. Spirogyra fastens its brick-red colored plasm body on the Spirogyra and may be seen in profusion. This body is a round mass enclosed in a membrane which shews the reaction of cellulose. Externally surrounding this membrane is a nitrogenous envelope which our author terms the veil, (velum), found only, or mostly, on the young cell (fig. 37). The content of this cell is red colored, uniform at the periphery, but towards the centre mixed with course granules (38). Fig. 39 shews the development of the young Tetraplasts which escape through separate openings of the membrane (fig. 40) as red Amœbæ; the granules which represent the remains of ingested aliment remaining behind in the cell. As soon as the Tetraplasts are free, they appear as round protoplasms, from which rays like those of the Actinophrys project (fig. 41). In this state it is a membraneless diffluent Amœboid plasm, having the typical creeping motion. Always changing its form, it stretches itself into long thread-like streams, (fig 42) and recovers its form by drawing itself up again into a ball (fig. 43). The substance is purely granular, and of brick-red color, but has neither vacuole nor nucleus. The rays also project to great distance, or retract into the central mass; sometimes a thicker club or waved protuberance is seen, Both rays and club-like projection are hyaline, clear and colorless; and granules may be seen at different points, moving along the rays backwards as well as forwards, (fig. 44) and this movement of granules distinguishes the V. Amæba from others which in other respects are exactly like them. (Rhizopod character?)

The mode of feeding is as follows:—

After gliding along the stems of the Spirogyra (a Conferva) it fastens on a healthy joint; after a moment the conferva stem appears as if suddenly jerked, and at the same moment the primordial sheath within sinks in just where the Monad has fixed itself (fig. 35). Shortly after, the chlorophyll contents together with the sheath is slowly drawn into the Monad's body. The animal having emptied one joint, which it takes about twelve minutes to do, creeps on to another and repeats the process until it is full, upon which it enters into its quiescent state (fig. 38), still hanging on to the Conferva stem. As this Amœba has absolutely no structural differentiation in any part of its body, nothing like an opening or mouth can be seen. But the empty joint, after sheath and chlorophyll have disappeared, shews an opening where, through the rupture, the contents have been extracted. The process implies either an endosmotic movement dependent on different density of chlorophyll and protoplasm, or an active dilatation of the plasm body of the Monad (perhaps also some elastic retraction of the Spirogyra membrane.) The opening seems to shew that the Monad has the power of dissolving the substance of the vegetable membrane. Cienkowski believes that this Monad *selects* its particular plant, as he never observed it attack any other stem placed in its way. (Vaucheria and Oedogonia stems).

After the animal, having fed itself to repletion, has digested its food, the green colored chlorophyll aliment gradually alters into red sarcode. The rays are first retracted, then a thin outer shell or skin of nitrogenous substance is formed, and under this a soft cellulose covering. The contents meanwhile grow red colored, and then the cell-like appearance of the Amœba corresponds to the phase with which we commenced (fig. 38). The contents of this quiescent cell shew a central mass of red colored sarcode, denser in the centre, with a cell wall which sometimes exhibits a warty appearance. The undigested remains of food lie outside the cell (fig. 45).

The history of developement of the animal in its quiescent state is not complete. Are any other plasts formed in the second quiescent cell? The Amœbæ are described as coming from the first cell (fig. 38). What takes place in fig. 45 and its sequel?

The second species of Vampyrella (pendula) so far as its Amœba phase is concerned, is chiefly distinguished by the absence of any moving granules in its substance or in its rays, but the cell state and quiescent phase differ from that of the former in the following particulars:—

The Vamp. pendula is not so choice in selecting Spirogyra stems, but feeds on the chlorophyll of Oedogonia, Bulbochæta and other slender Conferva stems. When passing into the cell stage the Amœba draws in its rays, becomes pear-shaped, and fastens itself by its pointed end to the stem; the food ingested is seen to ball itself together in the centre, as if within a membrane, whilst through the unoccupied small end, a stiff straight spine or thread, runs from the surface of the inner cell to the exact point of the outer membrane, which is adherent to the stem of the plant on which the creature has fixed itself. (figs 46-48). In the cell stage Amœbæ (2–4) are produced, and pass out by separate openings from the cell membrane (which consists as in the before described species of cellulose) fig. 49. The emptied cell with its pear-shaped outline (velum), inner membrane and thread of attachment, hangs still on the stem of the plant (fig. 50). In the subsequent quiescent state, the outer (velum) membrane shews a crenated or zigzag surface; the cyst within is filled with red colored contents; between it and the velum are seen the remains of food (fig. 51).

This Monad was first seen by de Bary at a time when the abundant parasitic life of the Conferva was not recognised, and the whole phenomena were by this observer interpreted as belonging to the normal changes of the dying vegetable chlorophyll. Another and later observer, Karsten, thinks that the phenomena have some direct relation to the development of a wheel animalcule named Rattulus.

The third species, Vamp. Vorax, became later known to Cienkowski. It differs from the others in several particulars. The two first named species are never seen to enclose foreign bodies such as Diatomaceæ, but live on the green chlorophyll of the confervoid plants; the Vamp. Vorax on the contrary does not take in chlorophyll, but lives on Diatomaceæ, Euglenæ and Desmids. In examining the red colored balls which are so abundant on algæ, some were found to contain different kinds of diatoms, and Luders discovered the fact that small Amœbæ were developed in these cells, which afterwards broke out through the enclosing membrane.

The Acemba of Vamp. Vorax is like that of the other species, but of a lighter red color and devoid of moving granules. (figs 52-3) The dimensions of the animal vary greatly; when it lives on small Diatoms its cell remains small, but when feeding on the contents of long Synedra stems it grows quite large. Generally the size of the Monad cell strictly corresponds with the amount of aliment taken in.

As it creeps by the Diatoms in its neighbourhood, the Diatoms stick to, and are finally drawn in, and involved in the Amœboid plasm. With this uncomfortable burden the Amœba moves about seeking fresh food. As it approaches its cell stage, the plasm so arranges itself as to contain its Diatom food in its long axis, (fig. 54) and corresponds in outer shape to the form of the Diatom whereby various forms result. The Vorax cell is simple (without velum) fig. 55; segmentation of contents goes on as in the other described species. In their encysted state no Diatoms are to be seen; the contents ball together within a thick capsule, and remains of food lie outside the capsule (figs. 56–57). But this Vamp. species does not always live on Diatoms; Desmids and Euglenæ also serve as food; in this case the cells are round and of a deeper red color, and remains of unassimilated food form brown colored balls in the middle. The Amœbæ born of these cells are smaller and more colored than those born from cells of V. Vorax that has fed on diatoms. The quiescent state shews the cyst surrounded by a more sac-like velum with appendages, and a larger amount of undigested food.

The above described Monads belong to Hæckel's genus Moner. Cienkowski however describes another creature, which although differing by certain marks of higher organization, deserves notice here as completing the strange history of the predatory feeding habits of the Monad. This creature, called Nuclearia delicatula, appears as an Amœba with pointed pseudopods. Its substance is soft, delicate, and colorless, contains a number of Vacuoles, which slowly disappear and reappear; and also several (1 to 5) clear cytoblasts or nuclei with strongly refracting nucleoli. (fig. 58, 59, 60) It often throws out rays at several points, but sometimes is without rays, and multiplies by fissation (fig. 60).

This Amœba sucks out the remains of chlorophyll left by V. Vorax, &c., and even attacks the Vampyrellæ themselves. A crowd of Nucleariæ may be seen around the putrescent Spirogyræ stems, sucking in greedily their starch particles. In order to get at these the Nuclearia draws itself into a pear shape, with one or more long streaks or tails of hyaline substance, which it inserts into the almost empty Spirogyra stem. Inside the stem or cell membrane of the plant, the threads run into each other forming an intricate plexus or plasmodium network (fig. 61). The substance of the protoplasm threads surrounds the chlorophyll particles enclosing them with a thin covering; then the principal thread or tail retracts, and thus pulls out the chlorophyll entangled in the finer threads. Properly speaking there is no *suction* (as is seen in Acinetæ). If the Nuclearia has fastened upon a stem nearly full of chlorophyll, it simply attacks it with a short projected pseudopod, but it can only bore into stems that are softened by putrescence. If the animal can come in directer contact with its food, it simply encloses it like an ordinary Amœba. It is clearly not a Monad though feeding like it. Possessing nuclei and vacuoles, it stands in organisation equal with the typical Amœba. Its further history is not known, but it enters into encysted condition; in a small and simpler example of Nuclearia the production and escape of young Amœbæ were observed. This Nuclearia simplex has a colorless and nucleated Amœba (fig. 62). It lives on chlorophyll and vegetable starch grains, and enters readily into the quiescent state, which consists of a cell with outer membrane, within which is a colorless cyst much smaller than the cell membrane; within this cyst a young Amœba forms, which creeps out through a small opening in the cyst wall and cell membrane (figs. 63, 64).

From the foregoing history Cienkowski draws the following conclusions: The Monad spore, cell, and cyst, represent morphologically exactly similar states in the evolution of Algæ, whilst compared with Infusoria only two of these states correspond. Morphologically therefore the Monad is more nearly allied to the vegetable. The great contrast however lies in the Monad's mode of alimentation, which being active instead of passive, partakes of the character of animal life. The ordinary Amœba simply encloses the food with which it comes in contact. The Monad goes in active pursuit like an animal conscious of its object; thus the Colpodella attacks Chlamydomonus, plunders it of its soft chlorophyll and decamps. The V. Spir. bores through the plant stem and sucks in the whole contents together with the primordial membrane enclosing them; moreover it selects its particular plant stem, whilst the V. Pendula takes its food from several kinds of vegetable conferva. The final conclusion of Cienkowski is, that the Monad is an animal, which by its spore forming cell indicates a transition stage towards the vegetable life and character. On the other side its Amœba with pointed pseudopods indicates a general relation with the Rhizopod. I hope to have at some future time the opportunity of collecting the numerous histories of Rhizopod life and presenting a comparative view of various recently described Rhizopods.

V.

On some Evidence in favour of Subsidence in the South West Counties of England during the Recent Period.

By Edward W. Claypole, B. Sc., B. A.

Read before the Geological Section of the Naturalists' Society, Jan. 12, 1870.

It is a well known fact to most Members of this Section, that there exist masses of peat on the beaches of many of the more sheltered coves and inlets around our south-west coast.

In the instance mentioned in this paper—that at Gyllyngvaes, Falmouth—sections of which were illustrated by diagrams, the peat bed occupies the innermost part of the curve of the shore and lies upon a bed of very tenacious clay. It is covered by the ordinary shingle and gravel of that coast, which consists mainly of white quartz pebbles obtained from the veins of the same material traversing the slate rocks of the district. This gravel is piled upon the peat bed to such a thickness, that the latter is seldom exposed except at low water spring tides and after heavy gales from the south-east.

The same arrangement may be observed, with accidental differences, dependent upon the varying form and direction of the coast line, at many other spots around the Cornish coast; for instance, at Penzance, Mainporth, the Swanpool, in Falmouth Harbour, &c.

The vegetable remains of the peat bed seem to consist of specimens of the present flora of the county. There is no ground for assuming that any of them belong to species even locally extinct. The Alder, Oak, and Hazel, the latter with nuts attached to the twigs, are common. Branches of coniferous wood, apparently yew, may sometimes be found spread out on the surface of the bed after a storm, like specimens in an herbarium.

In a few of these beds animal remains have also been discovered, chiefly of the red deer and ox, with human skulls. Cut branches of trees have also been observed.

The fact that these beds of peat continue down to low water mark at least, but can hardly have been formed at a lower level than twenty feet above high water mark, seems quite sufficient to prove that since the growth of the vegetation on that spot a subsidence of at least forty-two feet must have taken place.

It is extremely improbable that the peat beds have ever been lower than at present. Their fragility seems to render it quite impossible to suppose that they have been twice exposed to the action of the waves, that is, in sinking below the sea level and emerging again. Probably no appreciable quantity escapes destruction now, so as to be found below low water mark. It seems needless to introduce the supposition in the absence of any real evidence in its favour. The presence of raised beaches round the coast at different levels, which is sometimes brought forward as proving modern elevation, does not prove that elevation to be later than the age of the forest beds. It may be, and probably is, much earlier. Nor does the fact that in these raised beaches occur recent shells suffice to prove them of more modern date than the peat, if we consider how far the life of species among the Mollusca exceeds in length that of the higher forms of vegetable life. But the most satisfactory proof that no elevation has taken place is to be found in the position of the bank of gravel thrown by the sea upon the beach. In many of the deeper bays this bank has dammed back the land water so as to form a pool behind it, which filters gradually through, having no other outlet. Over this bar and into the pool the sea occasionally breaks, but only in high gales from seaward and for a short time at the highest point of spring tides. The level of the top of the bar exactly coincides with the highest dash of the waves. Of course they have piled it there, and it stands as an exact measure of the range of their power.

It is difficult to conceive, if any elevation of the district has taken place, why the bar should lie so exactly at this level. In that case it surely would have shared in the upheaval and would be found above its present position. It would also extend farther inland than it now does. When we add to this the fact that wherever the height of the bar can be determined, that is, wherever it does not lie against a steep bank, it occupies the same position, there cannot remain much, if any, ground for thinking that elevation has taken place since the growth of the forest. Taking into consideration therefore that subsidence has undoubtedly occurred, and finding that there is no evidence of upheaval since the growth of this vegetation, have we any clue to guide us in ascertaining the rate of depression? If we assume it to have been uniform, and failing all evidence to the contrary we cannot do otherwise, the rate would be found at once, did we know the time when the subsidence set in. But this we cannot at present, at least, ascertain. The following suggestions towards it may not however be quite useless or uninteresting.

If St. Michael's Mount be the Ocrinum of Ptolemy and the Ictis of Diodorus, which there is little reason to doubt, it was then as it is now an island at high water only. The isthmus therefore must in his day have been below high water mark. Any depression must accordingly be restricted within such limits as will allow this rocky neck of land to have been below the upper limit of a twenty-foot tide eighteen hundred years ago, and above its lower limit now. That is to say it must not exceed about six feet. Taking this as our guide it would give four inches in a century as the rate of depression, and if the amount before-mentioned be taken into calculation, namely forty-two feet, the time requisite for the accomplishment of the change will be twelve thousand six hundred years, a not very extravagant period, nor one at all inconsistent with the results of observation made elsewhere.

There is however a considerable amount of evidence in the district, tending to show that a much larger amount of subsidence might fairly be assumed, but to detail this would exceed the limits of a paper. Such an assumption would be in harmony not only with the results of observation in the district but also with the traditions of the county, which unmistakeably point to great destruction of land in pre-historic times.

THE NEIGHBOURHOOD OF BRISTOL IN THE QUATERNARY PERIOD.

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VI.

The Quarternary Deposits of the Bristol Neighbourhood.

By W. W. Stoddart, F.G.S., F.C.S.

Read before the Geological Section, February 8th, 1870.

Any one standing on such elevations as Bathford Hill or Glastonbury Tor, and looking northwards and towards the Channel, must be struck with the apparent coast-line which seems to surround him, *but at some distance from the present sea shore.* At the same time an excess of interest deepens into a kind of awe when he contemplates the great changes that must have taken place, geologically speaking, but a short time since, historically, however, a great number of ages—perhaps many thousands, or hundreds of thousands of years ago.

The spots we now walk over or use for growing our food crops were once the home of the Mollusc, and the sporting-ground of the Fish, when the time of high and low water ebbed and flowed as in our day. But how different the scene. No railways or busy hum of the human race, till later times. All was silence, only broken by the calls of the Hyena and the roars of the Lion and the Bear, which then roamed at their will, unchecked by the presence of their human master.

All the changes that took place, with the exception of one, were gradual in their operation and slow in their action.

Nevertheless, simple as the retrospective explanation at first sight appears, no sooner does the Geologist commence it, than many difficulties arise to puzzle and perplex. We see the deposits of sand and gravel, of breccia and conglomerate, collecting and detaining in their grasp bits of rock of great variety, pieces of wood, and the bones and teeth of animals. Many times these are found occurring in places, that seemed to oppose many an apparently good scheme for their production, till at length one feels inclined to "give it up" in despair.

On thinking the matter over, one difficulty appeared to arise from the very circumscribed view that could be obtained from any one stand-point, however elevated; and that if I could obtain a comprehensive bird's-eye view of the whole neighbourhood, I should be more successful in obtaining my wishes. I therefore prepared the accompanying outline map, giving as truly as I could, a sketch of the country and coast-line as it must have appeared at the close of the glacial period which ushered in the Post Tertiary or Quarternary period of our earth's history.

The neighbourhood of Bristol has not undergone *much* change since the chalk age. The land near the Cotteswolds and the Mendips was probably dry during the Tertiary period, for I believe no discovery has yet been made of any Tertiary remains, whether fossil or deposit. When the great subsidence of the northern half of England took place, admitting its surface to be over-spread with the Arctic Ocean and obscured with ice and icebergs, a great change in the mean sea level doubtless took place in the south and western parts which escaped the ravages of the Northern Sea. Then the waters of what is now the Bristol Channel most likely reached the foot of the Mendip and Cotteswold Hills, and washed the sides of the innumerable islands that appeared above the waves—such as Glastonbury Tor, Dundry, Ashton, Clifton, &c., which then were completely isolated from the main land. The Atlantic water covered the moorlands of Middlezoy, Sutton, &c., for in many places we find deposits containing Mollusca similar to those existing at the present time.

Gradually, however, the land rose again, and became covered with dense forests, which once covered the country, and extended over much of the tract now under the sea, and which at very low tides we may at any time examine. These trees, as now, were the Oak, Elm, Hazel, Beech, &c.; and although soaked by the salt water, and being the homes of the Pholads, still shew their structure in the clearest manner. In the open spaces, gradually and naturally, extensive morasses and bogs appeared, giving appropriate shelter to the Rhinoceros. The rivers from the water-shed of the neighbouring coast brought down accumulations of sand, mud, and gravel, from the Oolite and Cretaceous surface *towards the sea.*

The tidal action, as we know it would, opposed this flow and formed a bank, thus building up as it were a huge lake. The remains of this are now visible in the great peat and turf beds of Bridgwater and Burnham. At this time, the animals whose remains we now find in the bone caves of Banwell, Wookey, Loxton, Hutton, &c., flourished. Among many others we have recognized the Rhinoceros, Cave Lion, Hyæna, Elephant, Wolf, Musk Sheep, and Elk. It was formerly thought that these animals flourished in the Eocene period, which is known to have had a sub-tropical climate, and were killed by the cold of the glacial period, and that their remains are those we now find fossil. It is, however, more probable that although this was the case with some species, yet others struggled on for a long time afterwards, until they became contemporaneous with man.

Here it is that we find slight traces of man's presence. Very probably the savage tribes of the highlands came for the purpose of hunting these animals in the tangled forests, the wet bogs, and river-banks of what is now the West of England.

From a careful review of the evidence afforded by the beds of the moorlands of Somersetshire and the worn edges of the Mendips, and here and there the remains of ancient sea-beaches, together with the fact that all along the coasts of Somersetshire, Devonshire, Cornwall, and South Wales, buried forests are found covered up by silt and mud, we arrive at the conclusion that all the changes have been very gradual. It is probable the land has been in a constant state of oscillation; that once at least since the glacial period the surface of East Somerset was 60 or 70 feet higher than it is now; that then the forests before-mentioned grew luxuriantly. The land surface afterwards has gradually declined, though only about 15 or 20 feet, but quite enough to expose the forests to the ravages of the ocean, which soon covered them up, as we now find them.

Sections made at various places shew that sometimes the New Red and sometimes the Lias forms the base on which the Quarternary deposits are placed. For instance at Cumberland Basin, where the Avon passes into the Clifton chasm, a 6-foot bed of gravel lies on the new Red Marl; above that, separated by a 4-foot bed of stiff brown clay, is another bed of gravel in which occur the antlers of the Red Deer, fresh-water Shells, and teeth of Rhinoceros, Horse, and well-preserved specimens of Oak.

Just opposite Burnham and Bridgwater this fossiliferous bed lies 51 feet below the surface. It is there covered over with three beds of peat; in the lowest, 28-feet thick, have been found human remains and pottery. The two upper beds have a total thickness of 23 feet.

It appears evident, that since the glacial period there has been no sudden interruption in the progress of nature. Indeed the great volcanic outburst at the close of the Triassic period or commencement of the Liassic, which formed the magnificent gorges of Clifton and Cheddar, was probably the last natural convulsion of any consequence that took place in this neighbourhood. When the land rose, and the sea retreated to nearly its present level, the elevations that then formed islands became bare, and the perpetual washing of the waves produced our present varying sea-shore—sometimes low cliffs of the hard Carboniferous or Liassic Limestone, as at Weston, Penarth, and Aust, or low sloping shores of the softer Old or New Red, as near Portishead or Clevedon. The Somersetshire Cliffs of the Quarternary ocean are generally formed by Carboniferous Limestone. This Limestone in many places, as at Cheddar, Banwell, and Uphill, are full of fissures, made when the great convulsions before-mentioned took place. Many have been discovered and explored, but very likely many more are hidden, and waiting for the energies of future geologists.

At the time alluded to in our subject some of the fissures were closed cavities—as at Cheddar, West Harptree, Hollwell, &c.—while in other places, by weathering or proximity to the surface, they opened to the air forming caves, which afforded secure retreats to the wild animals and afterwards to man.

At Wookey Hole human remains were discovered in a remote and lateral fissure; among them were jaws and teeth, embedded either in Red Marly Clay or bound together by a mass of Stalagmite. This cave is from 150 to 200 yards long, and in some parts 50 feet high.

At Burrington Comb are several caverns. One 100 feet in length was accidently discovered in 1795, by a man who pursuing a Rabbit suddenly lost it in a heap of stones. On pulling these away, an opening was discovered. Creeping in, he perceived the mouth of an inner opening, closed by a large stone. On entering 40 or 50 human skeletons were found laid end to end—not side by side. The bones were encrusted with Stalagmite. On the floor were the knawed bones of the Horse, Pig, Sheep, and the jawbone of a Fox. Some pieces of charcoal and a flint arrow-head were also collected. It evidently was a burial place, and afterwards a retreat for wolves and foxes.

The most celebrated, however, are the caverns at Hutton, Banwell, and Uphill, and merit a short description. The oldest and most remarkable is that at Banwell. The existence of a cave on the north side of the hill was known for many years without exciting any interest till 1821, when a farmer named Beard, whose attention was attracted by Professor Buckland's description of the Kirkdale caves, determined on having an exploration made. Accompanied by a man he cleared out the entrance shaft, which was found to descend 20 feet. Another shaft 20 feet long was then entered, leading to an inclined plane 100 feet in length, which opened into a chamber by a narrow entrance. The bottom of this chamber was 150 feet long, and still inclined at about an angle of 40°. The chamber is partially divided into two by a depression of the roof; the furthest half being from 50 to 60 feet long and 40 feet high. The roof is covered with beautiful stalactites, and on the floor lie masses of limestone covered with stalagmite. The difficulty of access led to an attempt being made for an easier approach from the western slope of the hill. On examining a quarry at that point a small fissure was seen leading in the direction of the cave. It was partially filled with gravel. Some labourers were set to work in order to enlarge the opening, when it was soon found to expand, and after a passage of 20 feet to lead to another cavern, which is the one now so celebrated for the enormous quantity of bones which have been found therein. At the top of the cave were two short vertical apertures choked with loose stones. The bottom of the cavern was filled with gravel for a considerable depth, which contained the bones. The most numerous were those of the ox and the deer. Besides these, though less numerous, were those of the wolf, bear, fox, mouse and bat. They consisted of more or less perfect skulls, teeth and antlers. Some of the bones, especially of the bear, were of very large size. Many of the horns of the ox were over 12 inches in circumference and 14 inches in length. The antlers of the deer, too, were of immense size.

In the summer of 1826, as some men were quarrying near Uphill Church, they broke open a fissure also containing many bones. The cavern extended for about 40 feet north and south, and varied from 16 to 14 feet in width. The floor was covered with loam, mud and sand, the latter being principally at the entrance. The oldest bones were in the upper part and firmly embedded. It doubtless was formerly the den of a hyæna, for nearly all the bones were knawed and fractured. On examination they were ascertained to be those of the elephant, rhinoceros, ox, horse, bear, hog, hyæna, fox, polecat, water rat, mouse, and birds. It is probable that the cavern afterwards became the retreat of foxes, for the mud at the entrance is filled with the bones of birds, principally of the gull family.

The other cavern, worthy of note for its contents, was also discovered at Uphill, near the village of Hutton, at an elevation of 300 or 400 feet above the level of the sea. Very many years ago quarrying was carried on for the ochre which filled the fissures of the rock. In opening these pits the workmen came to a fissure in the limestone rock filled with ochre. After excavating this to the depth of 24 feet, they came to a cavern 20 feet square and 4 feet high, the floor of which was covered with yellow loam, in and on which were multitudes of bleached bones. In this chamber was a fine stalactite hanging from the centre of the roof, and nearly touching a like mass of stalagmite, which rose from the floor to meet it. In one of the sides was an aperture 3 feet wide, opening through a passage 54 feet long into another cavern, 30 feet long and 15 feet wide. About 12 feet below the entrance of the latter was another lateral passage which continued for 54 feet. All these passages and caverns were filled with the same Yellow Loam, containing fragments of Limestone, Galena, and many bones. Among others were four very fine teeth of the Elephant, an immense skull and tusks of the Boar, the jaw of an Elephant with one molar tooth attached, part of a tusk, a skull, and four thigh bones and ribs, all belonging to the same animal. A full description of all these caves may be seen in *Phelps' History of Somersetshire.*

It appears that the country south of Bristol and west of the Mendips owes its present form and figure to the effects of denudation and wave action, combined with the gradual rising of the ground.

It is, as before said, wonderfully interesting to the thoughtful geologist when he examines these low and comparatively recent deposits, lying in juxtaposition with older beds formed in the same way, but hardened into rocky strata by the lapse of ages, so ancient as to defy their calculation. Yet thousands cover their garden walks with the gravel brought within their reach by the river action from the interior, and build their dwellings with the sand cast up by the waves, without one moment's thought at the wondrous code of the simplest yet grandest laws with which nature silently but surely works her will.

A visitor to Weston-super-Mare can wish for no better spot for observation. If he will take a boat at low water from the Pier-head, he will see the shape and size of the bank of mud formed from the Lias washings to the greatest advantage. While sitting in the boat and looking towards the town, he will be unable to see the vesseels on the shore on account of the high mud bank which intervenes. An observer on the shore or on the Pier can form no conception of the curious effect. Thus it is that the moorlands south of Bristol are almost entirely composed of deposits, derived by denudation of the Lias from the action of waves and rivers.

The relative changes of level have always been a subject of discussion. In the present day the general opinion is, that the sea is less changeable than the land, and that all the great changes on the earth's crust are due to some alteration in the disposition of the solid mass of which it is composed. It is very singular that many ancient writers—as Ovid, Pythagoras, Pliny and Aristotle—should have expressed exactly the same views. A remarkable instance occurs in the Roman Geographer Strabo, when opposing the opinions of Erabosthenes and Xanthus, as to the cause of shells being found at great elevations and distances from the sea. He says, "It is not because the lands covered by the seas were originally at different altitudes, that the waters have arisen, or subsided, or receded from some parts, or inundated others. But the reason is, that the same land is sometimes raised up and sometimes depressed, and the sea also is simultaneously raised up or depressed, so that it either overflows or returns to its own place again. We must therefore ascribe the cause to the ground, either to that ground which is under the sea, or to that which becomes flooded by it, but rather to that which lies *beneath* the sea, for this is more moveable."

The pebble and sand-drifts of the Avon Valley east of Bristol, and other places, indicate that the present small river was once a tidal one for many miles beyond what is now the City of Bath.

VII.

On the Igneous Rocks of Shropshire.

By W. W. Stoddart, F.G.S., F.C.S.

Read before the Geological Section, March 9th, 1870.

Abstract.

After a brief review of the physical character of volcanic rocks, and especially the kinds found in the county of Shropshire, the author chose as a typical example the Wrekin near the market town of Wellington. The hill is the great centre of volcanic action in the vicinity of the Coalbrookdale Coalfield. In the latter the faults are very numerous and extensive, and it is a singular circumstance that the direction of the faults and of the eruptions of trap are nearly identical.

We have in the Wrekin, if not the highest, one of the most interesting examples of a crystalline eruptive rock in England. Picturesque, grand, and abrupt in outline, it rises in the midst of a great plain. Its bold and barren summits have an elevation of fourteen hundred feet above the sea level, and often in particular states of the atmosphere, are hidden by the clouds. The sides are partially covered with fir trees, and the base with snowdrops at the proper season of the year, and which grow here in the greatest luxuriance. The view from the top is extremely fine, comprising the Shropshire coal and iron districts on the east, and Caradoc, Longmynd and Hope Bowdler Hills on the West. The summit and centre consist of red compact felspar, and at the northern extremity are quarries of characteristic Syenite, varying in colour from pink to purple. The strata through which this hill has been protruded are upper Llandovery, containing the proper fossils. On the eastern side is a very good

example of the alteration of a rock in consequence of volcanic heat, the sand being seen completely metamorphosed into granular quartz rock.

The author concluded his paper, which was illustrated by diagrams and views, with a few remarks on the agricultural qualities of soils, formed from the weathering of different geological strata, and gave reasons for the great variation in fertility betweenthe natural soils at the foot of the Wrekin, and those near other similar hills, as for instance, the Malvern range in the neighbouring county, and added that a complete and first rate series of mineralogical specimens might easily be collected from the Wrekin.

SECTIONAL MEETINGS.

BOTANICAL SECTION.

The Members have met with regularity on the appointed evenings during the session, the greater part of the time being occupied in preparing, mounting, and finishing the specimens contributed to the Society's Herbarium. At the November Meeting Mr. Derham exhibited several specimens of Allium sphœrocephalum, gathered in the neighbourhood of Durdham Down, which was at one time a recognized habitat of this plant, though for some years it has been supposed to be lost to the locality.

ENTOMOLOGICAL SECTION.

At the February Meeting, 1869, the President, Mr. Stephen Barton, exhibited a box containing a large number of specimens of Coleoptera, collected in the Isle of Crete, and a few species from St. Helena. Some of these from the former locality have since proved to be new to science.

During the Summer, the Section took Field Excursions to Brockley, Portbury, and the Sea-Mills.

At the December Meeting, 1869, some rare specimens were exhibited, among which were Bryophila algæ, Cucullia gnaphalii, Xylina conformis, Dianthæcia Barrettii, &c., and a paper was read by the Hon. Sec. on the supposed identity of Solenobia pomonæ and Xysmatodoma melanella.

Some of the Evenings have also been spent in perfecting a list of Lepidoptera occurring in the Bristol District.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

MAY TO DECEMBER, 1870.

GENERAL.

VIII.

A few Notes on the Natural History of Filey and the Neighbourhood.

By T. Graham Ponton, F.Z.S.

Read at the General Meeting, October 6th, 1870.

[Abstract.]

Filey, the ancient Porta Felix of the Romans, some few years ago a mere Yorkshire fishing village, has of late risen into a seaside place of resort, a good deal frequented by those who prefer to enjoy the beauties of nature in peace and quietness to being compelled to admire them under the numerous disadvantages of a fashionable watering-place. Apart from the beauty of its coast-line, Filey affords many attractions to the naturalist, the antiquarian, and the pleasure-seeker. To the first, its waters, teeming with varied forms of animal and vegetable life, its valleys, where luxuriantly flourish many a rare fern and flower, and above all, its rocks, where lie entombed the relics of the fauna and flora of a past creation, afford an endless source of delight. To the lover of things ancient, its remains of former greatness, when it was a British camp and an important Roman station, its ancient though despoiled and dilapidated church, and the numerous remains of mediæval art in the neighbourhood, must give pleasure.

To the mere seeker for health and relaxation, it provides enjoyment by its long stretch of sea-beach, though perhaps a shade of sadness may come over him as he sits on the Cardinal Seats, and thinks of those who once sat there, and whose place knoweth them no more.

Passing however to the more practical part of the question, Filey has long been famous for fish and other edible products of the sea; a list of those observed by the author accompanies this paper.

Its mussel-bed is one of the most extensive in England; other molluscs are however somewhat rare. But a three days' excursion by sea to the Dogger Bank, distant some miles from Filey, will afford a fine harvest to those who are prepared to brave the discomforts of an open fishing-boat for that period, and are interested in that branch of Zoology.

The Marine Botany of Filey has long been famous, but the subject having been thoroughly worked out by competent authorities the author did not turn his attention to it.

Geologically, the place is of very great interest, for in the immediate neighbourhood of the town, *i. e.* for about six miles on either side, the whole geological series, from the Chalk to the Inferior Oolite, may be studied, and fossils may be obtained in great abundance. At Speeton, about four miles from Filey, occurs the famous bed of Speeton Clay, correlated with the Gault, from which so many interesting and rare fossils have been procured. They do not now occur so plentifully as formerly, and are difficult to get out of the matrix in perfect condition from its friable state.

North of the town, at about the same distance as Speeton, is the so-called "*Plant Bed*," a black shaly sort of rock, of the same age as the Great Oolite. This can only be approached at low spring-tide, but the specimens obtained amply repay the trouble and fatigue undergone in procuring them. Another of the attractions of Filey, both to the naturalist and the sportsman, is the number and comparative rarity, as species, of the sea-birds frequenting the coast. The author's visit being made in summer, at which time but few comparatively are to be seen, he was unable to study this branch of the natural history of the district so fully as he could wish.

Appendix of Species found at Filey.

CRUSTACEA.

Eurynome aspera.
Perimela denticulata.
Carcinus mœnas.
Portunus puber.
Maia squinado.
Cancer pagurus.
Pagurus bernhardus.
Galathea strigosa.
Homarus vulgaris.
Crangon vulgaris.
Crangon sculptus.
Palœmon senatus.
Mysis chameleon.
Ligia oceanica.
Orchestia littorea.
Tolitrus saltator.

PISCES.

Scymnus spinosus.
Mustelus vulgaris.
Acanthus vulgaris.
Pterocephala giorna.
Raia radiata.
Raia maculata.
Raia clavata.
Raia circularis.
Raia acus.
Squatina vulgaris.
Cottus grœnlandicus.
Cottus scorpius.
Trigla hirundo.
Trigla lyra.
Trigla gurnardus.
Gadus morrhua.
Gadus æglefinus.
Gadus cellarius.
Gadus luscus.
Gadus merlangus.
Gadus pollachius.
Gadus carbonarius.
Lota molva.
Hippoglossus vulgaris.
Rhombus maximus.
Rhombus lævis.
Pleuronectes platessa.
Pleuronectes limanda.
Pleuronectes microcephalus.
Pleuronectes flesus.
Solea vulgaris.
Clupea herengus.
Anguilla conger.

IX.

ON DENUDATION.

BY C. F. RAVIS.

Read at the General Meeting, November 3rd, 1870.

[This paper included one previously read before the Geological Section. The following is an abstract of parts not before reported.]

The importance of Denudation in connection with geological history can scarcely be exaggerated. Great wasting agencies have always been at work, wearing away the surface of the land. Tho action of the sea upon the coast, as witnessed by the pebbly and shingly beaches of our own shores, and the great blocks seen here and there upon the strand; the denuding power of rivers like the Niagara, which at the great Fall has cut its channel backwards through the solid rock for several miles; the effect of torrents and floods; the bursting of natural barriers at the lower extremities of lakes; the wearing influence of rain, frost, &c.; these and other agencies have modified or removed strata, so as to immensely increase the difficulty of reading the original record. The coast about Watchet is very instructive, showing pavements of limestone on the beach, the remains of strata once composing high cliffs of lias such as still form the outline of the coast. The absence of particular beds has been taken by some writers to imply the existence of dry land in that locality while such beds were in process of deposition elsewhere. Such an inference would, in many cases, be far from the truth. A familiar illustration occurs at Dundry, where the horizontal lias is abruptly broken off at each end of the hill, exposing an inferior formation. Such a state of things could result only from denudation by water after consolidation into hard rock.

The distinction is important between valleys of depression and those of denudation. The former are produced by the upheaval of contiguous land or the sinking of that forming the valley, the latter by erosive agencies, such as have been alluded to above. In the former case the inclination of the beds follows more or less the outline of the surface, in the latter the beds are abruptly broken off, and continued in the same plane at points more or less distant.

These phenomena are frequently mixed, so as to form valleys partly of depression and partly of denudation.

Alluding to the vast amount of matter removed from the surface in our own neighbourhood, the writer proceeded :—

The power of the sea to remove so many thousand feet of solid rock can only be doubted by those who would limit the whole of the operations of terrestrial nature to the comparatively brief period of six or seven thousand years. The lapse of uncounted ages, bringing about by fixed and unerring laws results upon which depends the very existence of man upon the earth, conveys a much more exalted idea of the Divine Author of nature than the instantaneous upheaval of a continent or the sudden destruction of a world. The destructive power of the waves upon even the hardest rock is seen in enormous ridges of pebbles, miles in extent, formed by the grinding down and rolling together of masses split from the cliffs by various agencies constantly in operation, and in vast collections of shingle bordering our shores. Even the hardest flint has been subjected to these grinding and polishing processes, until the beach has become a dense mass of flint-gravel of every conceivable degree of fineness.

It is not necessary to suppose that a mass of rock twice the height of Snowdon ever stood at that elevation on the summit of our Downs.

Deposition takes place mostly during *depression*, and denudation during *elevation* of the land. Supposing, therefore, these great geological formations to have been slowly deposited during a gradual depression of the sea-bottom, and upheaval afterwards to begin at various points; as these points reached the surface of the sea denudation would commence, and would continue until the debris created a bank sufficiently high to withstand the further advance of the waves, by which time great part of the whole amount of denudation may have been effected. The rest may have resulted from repetitions of the rising and sinking movement.

The gorge of the Avon exhibits the phenomenon of denudation on a large scale, though it may be admitted that the commencement of the chasm was probably due to a violent rupture of the rocks. The rift would gradually widen and deepen as the land emerged from the sea, and newer strata deposited within the chasm may have been removed during a subsequent elevation, many successive risings and sinkings having occurred in this locality. Professor Jukes attributes the formation of the gorge solely to the river itself, which, existing at a time when the liassic strata spread in a vast sheet from Dundry over all the district, deepened its bed until it reached the limestone, over the seaward edge of which it poured in a cataract, which wore away the rocks backward until it had formed the chasm as it now exists. To call in the aid of a river whose existence at that period it would be difficult to prove, while the sea, even now near at hand, is well known to have many times submerged the whole district, appears however quite unnecessary, seeing that the latter is capable of forming very deep indentations in rocky coast-lines, such as our carboniferous cliffs would have then exhibited. If the river existed so long ago, it would seem more probable that it reached the sea by the valley of Nailsea, until the formation of the Clifton gorge by the united action of internal heat and marine denudation, after which it would avail itself of the more direct channel. A similar phenomenon, on a smaller scale, is exhibited at the mouth of the River Axe in Weston Bay. The sea having eaten its way through the rocky barrier once continuous between Uphill and Brean Down, the stream, which formerly entered the sea on the south side of Brean Down, changed its course and took the new and shorter channel into Weston Bay.

Let us now imagine the hollows of the Palæozoic Strata, after denudation, filled with deposits of the triassic and liassic formations up to th Inferior Oolite inclusive. These strata are in our district conformable and nearly horizontal, having been probably laid down on a gradually subsiding sea-bottom and raised again with a tolerably uniform movement over large tracts, with local exceptions, such as are exhibited in the railway cuttings at Bourton and Uphill. It is uncertain whether the Upper and Middle Lias ever extended to our immediate neighbourhood, as, for instance, to Ashley, Cotham, and Bedminster, where the Lower Lias is now at the surface. The tendency of the Jurassic series, as is well known, is to retreat towards the south-east, but local exceptions to this rule are numerous, and are the result of denudation on a large scale in this district. The sequence of the events which effected these results is difficult to make out. Great waste must have occurred on the last rising of the Palæozoic Strata before the deposition of the succeeding series, resulting in the extensive masses of conglomerate known as Magnesian or Dolomitic. The two upper members of the Trias, if ever present here, were removed before the deposition of the Lower Lias, and in like manner the Upper and Middle Lias, before the commencement of the Oolitic series. As the land emerged during this process, the Severn may have begun or resumed a passage through the plain in its present channel. Subsequent sinkings and risings effected the deposition of the Lower Oolite and further denudation until the surface assumed its present form.

The marks of denudation are various. Perhaps the most conspicuous evidence is in the cliffs of our sea shores. Their abrupt termination towards the sea shows how the beds have been worn away by the action of the waves. The needles and pillars of rock standing here and there at a little distance from the coast are further evidences that strike the most casual observer. To these may be added natural arches and caverns in the cliffs of the sea-shore. In inland districts, long lines of cliffs as well as isolated rocks are proofs of the former presence and denuding power of some ancient sea. The matter resulting from such denudation is found in the boulders, shingle, and sand of our shores, in the conglomerates of the geologic series, and the clays and gravels so widely spread over the surface of the earth.

Besides the marks already alluded to, I may mention repetition of the beds of the series in a section, groovings and striations in rocks, the borings of mollusca, and parallel terraces on hill-sides. Two series of the latter are well seen on the isolated hill of Brent Knoll near Highbridge, as well as one large platform half a mile wide near the middle of the ascent.

The class of agencies called sub-aërial must be referred to. These are silently but surely changing the surface of the dry land in every inland district. Not a river or torrent nor even a purling brook but carries with it particles of solid matter derived from the land over which it flows. The mighty Niagara and the miniature waterfall are each engaged in eating into the strata over which they fall, and the deep pool at the foot of a cascade shows the power of dropping water. Rain softens and carries away the surface of the ground. Frost expands the moisture lying in the interstices of rocks and splits asunder huge blocks of stone, hurling them into the valleys. The heats of summer occasion cracks in soft strata, which widen and cause separation of large masses, as in the Isle of Wight and other districts; and moving ice transports huge boulders and smaller masses of stone from their parent rock to distant localities.

In conclusion, allusion was made to the effects of denudation in producing the varied and picturesque scenery of our own and other countries.

X.

On the Structure of Rubies, Sapphires, Diamonds, and some other Minerals,

By H. C. Sorby, F.R.S., and P. J. Butler,

From the Proceedings of the Royal Society, 1869. *Communicated by P. J. Butler, Esq.,* and read by the Hon. Secretary at the General Meeting, December* 1*st,* 1870.

For many years Mr. Butler has had the opportunity of examining very many rubies, sapphires, and diamonds, and has taken advantage of it in forming a most interesting collection, cut and mounted as microscopical objects. He had very carefully studied the included fluid-cavities, and ascertained many curious facts. Mr. Sorby had for some time paid much attention to the microscopical structure of crystals, and published a paper†

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* Mr. Butler desires here to express his thanks for the courtesy of the Royal Society in granting him through their Secretaries, Dr. Sharpey and Professor Stokes, the use of the stone from which the plate illustrating the paper has been printed.

† Quarterly Journal of Geol. Soc., 1858, vol. xiv. p. 453.

in which he showed that their microscopical characters often serve to throw much light on the origin of rocks. Mr. Butler therefore placed the whole of his collection in Mr. Sorby's hands for careful examination, and it was decided that a paper should be written by the two conjointly; and since Mr. Sorby had previously made many experiments in connexion with the expansion of liquids, as already described in a paper published in the Philosophical Magazine*, he took advantage of the opportunity to investigate the law of the expansion of the very interesting fluid met with in the cavities of sapphire.

In describing the various facts, it will be well to consider them in relation to the following general principles:—

(1) The structure of the various minerals as mere microscopical objects.

(2) The physical characters of the fluid-cavities, as throwing light on the origin of the minerals.

(3) The influence of some included crystals on the structure of the surrounding mineral.

Sapphires.

By far the most interesting objects contained in sapphires are the fluid-cavities. Their occasional presence has been already noticed by Brewster†, who met with one no less than about $\frac{1}{3}$ inch long, two-thirds full of a liquid which expanded so as to fill the whole cavity when heated to 82° F. (28° C.). He thought the liquid was less mobile than that described by him in topaz, and could not see a second liquid in the cavity. Though many thousand sapphires have been examined by the authors, no such large cavity has been found; but several have been met with about $\frac{1}{10}$ inch in diameter; the greater number are far less, and some are very minute; and they seem to contain only the liquid which expands so much when warmed. The size of the included bubble varies much, according to the temperature. At the ordinary heat of a room it is sometimes equal to one-half of the capacity of the cavity, whereas in other cases the cavity is quite full. This is especially the case with the very small cavities, and is to some extent due to the forced dilatation of the liquid. But if we only take into consideration the larger cavities, the temperature required to expand the fluid so as to fill them certainly varies from 20° to 32° C. (68° to 90° F.),

* "On the Expansion of Water and Saline Solutions at High Temperatures," August, 1859, vol. xviii. p. 81.

† Söchting's Einschlüsse von Mineralien in krystallisirten Mineralien, p. 121, who refers to Edin. Journ. of Sc., vol. vi. p. 115.

and this not only in different crystals, bnt also, to a less extent, in the same specimen. As illustrations of the form of such cavities, we refer to the Plate figs. 1, 2, 3, and 4, the extent to which they are magnified being shown in each case. At the ordinary temperature the bubble in the cavity shown by fig. 1 is about one-half its diameter, but disappears entirely at 30° C. By carefully measuring the size of the cavity in various positions, and comparing it with the diameter of the bubble at 0° C., it appears that the liquid expands from 100 to 152 when heated from 0° to 30° C. Fig. 2 is a tubular cavity, and shows in a very excellent manner the boiling of the liquid when it cools, after having been made to expand to fill the whole space. At the ordinary temperature the liquid occupies only about half the cavity; but when heated in a water-bath to 32° C., it fills it entirely. No bubble is formed until the temperature has fallen to 31°; and then innumerable small bubbles are suddenly formed, which rise to the upper part and unite; but instead of the liquid merely contracting by further cooling, it still continues to boil for some time, as represented in the drawing. Two other large cavities contained in the same specimen also behave in the same manner, and become full and suddenly boil at almost absolutely the same temperature as that figured. We need scarcely say that such cavities are extremely rare, and are very remarkable, even when looked upon as microscopical objects, independently of their interest in connexion with physics. Fig. 3 is a tubular cavity of more irregular form, and is interesting on account of there being two plates of the sapphire projecting into the cavity, so as to nearly divide it into three portions. At the ordinary temperature these partitions prevent the passage of the bubble from one part to the other; but by breathing on the object through a flexible tube, the slight increase of temperature expands the liquid, so as to make the bubble small enough to pass into the next compartment; and a repetition of the process causes it to pass into that at the other end. Such plates projecting into the cavities are very common; and it is requisite to pay attention to this fact, since otherwise they might easily be mistaken for crystals of some other substance included in the cavity, which, if they ever occur, must be extremely rare, since no decided case has come under our notice.

In examining sections of sapphire cut in a plane more or less parallel to the principal axis of the crystal, the double refraction is so strong, that two images of every object lying at any depth below the surface are seen, in such a manner as to make them very confused. This may be avoided by using polarized light without an analyser, and arranging the plane of polarization so as to coincide with one of the axes of the crystal. High powers may then be used with perfect definition; and they show many small cavities, sometimes of most irregular forms, like fig. 4; and very often their sides are so inclined, that they totally reflect transmitted light, and appear black and opake. In some specimens most of the cavities have lost their fluid.

Besides fluid-cavities, there are many small crystals of other minerals included in sapphires, but not so many as in rubies. The most striking are small plate-like crystals, often of triangular form, with one angle very acute. They are very thin, and give the colours of thin plates; so that when viewed by reflected light they look something like the scales from a butterfly. Seen edgewise, they appear as mere black lines, and are arranged parallel to the three principal planes of the sapphire, as shown by fig. 5. These small crystals and the minute fluid-cavities cause many sapphires to appear milky by reflected, and somewhat brown by transmitted light; and being arranged in zones related to the form of the crystal, they often show, as it were, lines of growth.

Rubies.

Though the ruby and the sapphire are of course essentially the same mineral, yet their structure is in many respects as characteristically different as their colour. The number of fluid-cavities in rubies is far less, and the larger cavities are very rare, and only contain what appears to be water or a saline aqueous solution, as is shown by the amount of expansion when the specimen is heated to the temperature of boiling water. Those containing a similar fluid to that included in sapphires do occasionally occur; and when they are minute they are extremely interesting, since they show the spontaneous movement of the bubbles to greater perfection than any mineral that has come under our notice. This is perhaps, to some extent, due to the nature of the liquid, which is more mobile than the saline aqueous solutions contained in the cavities of the quartz of granite and syenite. It is manifestly a molecular movement analogous to that seen in all matter when very minute particles are suspended in a liquid, so as to allow freedom of motion; and the rapidity of the movement is certainly dependent on the size of the particles. It is not seen to advantage if the diameter of the bubbles is more than $\frac{1}{10000}$ of an inch; but when it is about $\frac{1}{50000}$ they move to and fro in the most surprising manner, with such rapidity that the eye can scarcely follow them.

The number of small crystals of other minerals included in rubies is often very great. There must be at least four different kinds; but it would be difficult to determine what minerals they all are. Some are very well characterized octahedrons, variously modified; and, as shown by fig. 5, their planes are very generally arranged parallel to planes of the ruby, and to the small plate-like crystals already mentioned in describing sapphire. These octahedrons have no influence on polarized light, and in general form and character correspond so closely with spinel, that it seems very probable that they are that mineral For some time we thought they were angular fluid-cavities filled with liquid; but when cut across in the sections, they are clearly seen to be solid, though less hard than ruby. Many of the other included crystals are of such very rounded forms that, if it were not for their action on polarized light, they might easily be mistaken for cavities filled with some fluid. Most of these rounded crystals are colourless; but some are of more or less dark orange-red colour, and are certainly not the same mineral as the colourless or the octahedral crystals; and in all probability the thin and flat are a fourth kind. Occasionally alternating plates of ruby with their axes in different positions, gave rise to a beautiful series of coloured stripes when examined with polarized light.

Spinel.

The ruby spinels from Ceylon sometimes contain fluid-cavities which differ in a striking manner from those of any other mineral that has come under our notice. One of these is shown in fig. 7. They are, to a great extent, filled with a yellow substance, indicated by the shading, which seems to be either a solid or a very viscous liquid. It incloses transparent, sometimes well-defined cubic crystals, which have no action on polarized light; transparent, prismatic, or plate-like crystals, which strongly depolarize it; and black opake crystals, either in larger pieces or mere grains. The rest of the cavity is in each case about one-third full of a colourless liquid, which seems to contract on the application of heat, because it passes entirely into vapour, as occured in some of the cavities in topaz described by Brewster. In this change it must expand about six hundred times less than when water passes into steam. Spinel also incloses crystals of several other minerals which we have not yet been able to identify.

Aquamarina.

The most striking peculiarity of this mineral is the occurrence of numbers of fluid-cavities containing two fluids and a vacuity, as shown by fig. 6.

Emerald.

Some of the specimens which we have examined are so full of fluid-cavities that they are only partially transparent. They differ entirely from those already described, and contain only one liquid, which does not sensibly expand when warmed. In all probability this is a strong saline aqueous solution, since the cavities also inclose cubic crystals, as shown by fig. 8, which dissolve on the application of heat, and recrystallize on cooling. On the whole, therefore, these cavities are very similar to those found in the quartz of some granites, and in some of the minerals found in blocks ejected from Vesuvius, as described in Mr. Sorby's paper on the microscopical structure of crystals, already referred to.

Diamond.

Few, if any, of the specimens of diamond that have come under our notice contain objects similar to those which, in the opinion of Göppert*, are evidence of its having been derived from vegetable remains, but we have been able to study to great advantage some facts which do not appear to have presented themselves to either Göppert or Brewster. We have examined twenty-one objects similar to the two described by Brewster, in his paper in the Transactions of the Geological Society†: and this has enabled us to clear up some of the difficulties to which he alludes, and has led us to propose a different explanation. He thought that the black specks, which were surrounded by a black cross, when examined with polarized light, were minute cavities; but at the same time he admitted that they were so small that it was not possible to say whether they contained a fluid or were empty. Judging from what we have seen of such small examples, we consider it impossible to say whether they are cavities or inclosed crystals; but fortunately we have met with several of such a size and character that it was quite easy to see that they were crystals. Fig. 9 is a most excellent example of the fact. The form is clearly that of a crystal, and it depolarizes light very powerfully. Its refractive power must be very much less than that of diamond; for the inclined planes totally reflect the transmitted light, and thus look quite black, as shown in the figure. It is this circumstance which causes many smaller inclosed crystals to appear like mere black specks.

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* "Ueber Einschlüsse im Diamant," Naturkundige Verhandlungen, Haarlem, 1864.

† 2nd series, vol. iii, p. 455.

Brewster has shown that the irregular depolarizing action of diamond is analogous to that of an irregularly hardened gum; and this much interferes with the perfection of the black crosses seen round the inclosed crystals, and sometimes even neutralizes this action. Still, as a general rule, a black cross is seen; and, as described by Brewster, when examined by means of a plate of selenite which gives the blue of the first order, the tints of the sectors in the line of its principal axis are depressed in the same manner as when such a black cross is produced by the compression of glass—thus proving that the inclosed crystals have exerted a pressure on the surrounding diamond. We, however, do not imagine that the crystals have increased in size, but that probably they have prevented the uniform contraction of the diamond, which, as already mentioned, must have been very irregular, even where no such impediment was present. A few of the crystals inclosed in rubies give rise to similar black crosses, as shown by fig. 11; and we are informed by Professor Zirkel that his brother-in-law Professor Vogelsang has prepared a thin section of a specimen of partially devitrified glass, which also shows black crosses round the inclosed crystals.

Brewster suggested that this phenomenon in diamond was due to the elastic force of an inclosed gas or liquid, and compared it with what is seen in the case of some cavities in amber. We, however, find that the optical character of the crosses seen round the undoubted cavities in amber is the very reverse of that in the case of diamond, and cannot be explained by the mere mechanical action of an included elastic substance, but is similar to the change to a crystalline state which has occurred over the whole external surface, and on both sides of cracks passing from it inwards.

The optical properties, however, are not the only evidence of contraction round crystals inclosed in diamond; for actual cracks are often seen to proceed from them. These present the striped appearance shown in fig. 10, owing to more or less perfect total reflection from their waved surface. The same kind of phenomenon may be seen in sapphire, and still better in spinel, as shown by figs. 12 and 13. Sometimes there is a system of radiating cracks nearly in one plane, terminating in a tranverse crack which surrounds the whole, as in fig. 12; and in other cases there are various complicated wavy cracks in different planes, as in fig. 13. There seems to be some connexion between this structure and the natnre of the included minerals; for round some kinds it is very common, but round others very rare or quite absent; and it appears probable that it may be referred to unequal contraction in cooling from a high temperature; and, if so, the results would necessarily depend on a variety of circumstances. Now that attention has been directed to it, it will probably be found to be a very common peculiarity of certain classes of minerals, and serve to throw a good deal of light on their origin.

Crystals surrounded by radiating cracks on a much larger scale have been observed by Mr. David Forbes*, and may, we think, be explained in a similar manner.

The crystals formed in blowpipe beads kept hot for some time over the lamp, also furnish good illustrations of these facts. Phosphate of zirconia is deposited in cubes from a borax bead to which much microcosmic salt has been added; and when examined with the microscope whilst cooling, cracks like those described in diamond and spinel are seen to be formed round many of the crystals, which are evidently due to the crystals contracting less than the surrounding material. On the contrary, the long prisms of borate of baryta deposited from solution in borax are seen to separate from the borax on cooling, and to be filled with transverse cracks, like those in schorl inclosed in quartz, which is clearly owing to their contracting more than the borax.

Fluid-cavities in general.

Before discussing the nature of fluid-cavities in connexion with the origin of the various minerals, we think it best to describe the remarkable properties of the liquid included in the sapphire, and to point out what it seems to be. Brewster, in his paper on the fluid-cavities in topaz†, says that the more expansible liquid contained in them expands one-fourth its size, when heated from 50° to 80° F, or thirty-one and a quarter times as much as water, and, as already stated, he found that the fluid in sapphire expands about one-half when heated to 82° F. Though this amount of expansion is very remarkable, yet, when the relative expansion at various temperatures is examined, it will be seen to be still more remarkable. Very fortunately the tubular cavity in sapphire, shown by fig. 2, is most admirably fitted for experiment. Mere inspection shows that its general diameter is very uniform; and that it is really so can be proved by causing the liquid to pass from one end to the other; for at $17\frac{1}{2}$° C. the length of the column of liquid was $\frac{25}{400}$ of an inch, whether it was at the end A or B. The total effective length of the cavity is $\frac{50}{400}$.

* Ed. New Phil. Journ. July 1857.

† Trans. Roy. Soc. Edin. 1824, vol. x. p. 1.

The specimen enclosing this cavity was fastened to a piece of glass, and this was fixed in a beaker containing water, supported so that the cavity was in the focus of the microscope under a low power. The temperature was raised very slowly, and was maintained for some minutes at each particular degree at which it was thought desirable to measure the volume of the liquid; and this was usually repeated over and over again when the heat was both rising and falling, so as to obtain as accurate a result as possible. In making the measurements with the micrometer, care was taken to allow for the tapering end of the cavity and the curved surface of the liquid. The results are given in degrees Centigrade. Though the expansion below 30° was very great, compared with that of any other known substances except liquid carbonic acid and nitrous oxide, when the temperature rose above 30° it was so very extraordinary that it was not until after having performed the experiment over and over again that Mr. Sorby felt confidence in the results. This will not be thought surprising when we state that from 31° to 32° the apparent expansion of the liquid is no less than one-fourth of the bulk it occupies at 31°; the length of the column increasing for that single degree from $\frac{40}{400}$ to $\frac{50}{400}$ inch. This is about 780 times as great as the expansion of water would be, and even 69 times as much as that of air and permanent gases. It was not possible to ascertain the amount of expansion above 32° C., because the cavity was quite filled at that temperature. If the expansion increase at the same increased rate, the liquid would soon occupy several times as much space; but it seems very probable that before then it would pass into the state of gas. At all events it appears as if this enormous rate of expansion indicated a close approach to a fresh physical condition. The following Table gives the results of the experiments; and it has been found by drawing them as a curve, that their general relations indicate that there cannot be any serious error; but at the same time, considering all the circumstances, they must only be looked upon as tolerably good approximations to the truth.

Temperature.	Volume.
° 0 C	100
17½	109
20	113
25	122
28	130

Temperature.	Volume.
°	
29	139
30	150
31	174
32	217

The apparent expansion of the liquid is doubtless to some extent increased by the condensation of the gas, as the space occupied by it is diminished. When in the highly expanded condition this liquid appears to be remarkably elastic. Berthelot has shown, in his paper on forced dilatation*, that the force with which liquids adhere to the interior of a glass tube is sufficient to prevent their contraction to the normal volume, if they have been heated so as to expand and quite fill the tube, and then cooled to a temperature below that requisite to fill it. This fact must always be borne in mind in studying fluid-cavities, and explains why the bubbles, as it were, hesitate to return, and then make their appearance with a sudden start. Such a forced dilatation is very remarkable in the case described; for though it was requisite to raise the temperature to 32° C. to fill the cavity, no vacuity was formed until it fell to 31°; and therefore it seems as if the force of adhesion were sufficient to stretch it to considerably more than its normal bulk, even perhaps to the extent of one-fifth or one-fourth. Moreover, in the case shewn in fig. 1., the liquid expanded so as to fill the cavity at about 30° C.; and yet it can be heated up to 42° without bursting it, though, even if the expansion did not continue to increase, and were the same for each degree as from 31° to 32°, the normal volume would be about four times that of the cavity,—which in any case seems only to be explained by supposing that its elasticity is most remarkably great, more like that of a gas than of a liquid. There was no decided evidence of its passing into a gaseous state, as does occur when cavities contain a less amount of liquid.

Simmler* has shewn that the physical properties of the liquid in topaz, as observed by Brewster, agree more nearly with those of liquid carbonic acid than with those of any other known substance. Dana, in his 'Mineralogy' (5th edition, 1868, p. 761,) calls it *Brewsterlinite*, and says that its composition is unknown. The facts at Simmler's command were not in all respects satisfactory, since the amount of expansion given by Brewster was from 10° to 26·7°C., whereas that of liquid carbonic acid observed

* Annales de Chimie sér. 3 t. xxx. p. 232.

by Thilorier, was from 0° to 30°, and, as shewn above, the expansion increases so much as the temperature rises that the average rate for 1° is very indefinite. The only reliable method is therefore to compare the expansion between equal degrees of temperature. According to Thilorier * liquid carbonic acid, when heated from 0° to 30°, expands from 100 to 145. One of the experiments described above showed that the liquid in sapphire expands from 100 from 152 ; and the other from 100 to 150, which is the most reliable. This agrees so closely with the expansion of liquid carbonic acid, that the difference might easily be due to a slight error in the thermometers. The expansion of ordinary liquids is not to be compared with it nor is that of liquid sulphurous acid. Dr. Frankland has kindly ascertained this fact, with special reference to the case in question, and found that from 0° to 32° C. the expansion was only from 100 to 104·36 instead of to 217.

According to Andréeff † the expansion of liquid nitrous oxide is not much inferior to that of liquid carbonic acid, being, from 15° to 20°, ·00872 for each degree, which differs decidedly from that of the liquid in sapphires. The occurrence of nitrous oxide in minerals is also so very much more improbable, that, on the whole, it seems as if we should be justified in concluding provisionally that it is liquid carbonic acid, which like water, should therefore be classed amongst natural liquid mineral substances.

Brewster has shown ‡ that when cavities in topaz contain less than one-third of their volume of the expansible liquid, it does not expand when heated, but passes entirely into the state of a compressed vapour. Unfortunately he does not state the temperature at which this occurs, nor does he seem to have tried to ascertain the exact limit of the volume, which must, however, lie between one-half and one-third. Cagniard-Latour § found that when ether and other liquids sealed up in small strong tubes, with a certain space left empty, were heated, they expanded very much, and suddenly passed into the state of vapour. The temperature, pressure, and volume at which this change took place varied very considerably. Ether expanded to nearly double its volume, and passed into vapour at about 200° C., with an elastic force of 37 or 38 atmospheres. Alochol expanded to about three times its volume, and passed into vapour at about

* Gmelin's Handbook of Chemistry, Cavendish Society's Translation, vol. i. p. 225.
† Liebig's Ann. vol. cx. p. 1.
‡ Trans. Roy. Soc. Edin. vol. x. p. 25.
§ Pogg. Ann. vol. cv. p. 460.

260° C., with an elastic force of 119 atmospheres; whereas water appeared to expand to nearly four times its volume, and required a temperature near that at which zinc melts (328° C., Daniel). When in this highly expanded state, the liquids were very mobile, and seemed much more compressible than under other circumstances; for they did not burst the tube, if too much had been sealed up in it, until after their normal volume would have been decidedly greater than its capacity. No one could fail to see that these phenomena have much in common with what occurs at a lower temperature in the case of the liquid inclosed in sapphire, and that they are of great importance in connexion with the origin of fluid-cavities. Since they become full of liquid at a comparatively low temperature, it was not unreasonable to suppose that the minerals in which they occur must have been formed where the heat was scarcely above that of the atmosphere; but these facts seem to show that the occurence of such fluid cavities is quite reconcilable with a very high temperature; for it is obvious that if, at a great depth below the surface, heated, highly compressed *gaseous* carbonic acid were inclosed in growing crystals, it might condense on cooling so as to more or less completely fill the cavities with the *liquid* acid.

If the same principles could be applied in the case of water, we should be led to infer that it could not exist in a liquid state at a higher temperature than that of dull redness, corresponding closely with what Mr. Sorby deduced from the fluid-cavities in some volcanic rocks. In that case, according to Cagniard-Latour, the liquid when condensed would occupy only one-fourth part of the cavity, and it would scarcely be likely to contain any fixed salt in solution; whereas the fluid-cavities in the minerals of ejected blocks are often two-thirds full of what seems to have been a supersaturated solution of alkaline chlorides. The phenomena now under consideration should certainly be borne in mind in studying volcanic action; and it is possible that some cavities now containing water may have been formed by the inclosure of very highly compressed steam. In some cases the requisite pressure would be enormous, and other facts seem to show that it was more generally caught up in a liquid state.

The cavities in emerald are very interesting in connexion with this subject, and also furnish strong evidence against the opinion that the liquid was not present when the crystals were formed, but penetrated into the fluid-cavities at a subsequent period, and either filled vacant spaces or removed and

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* Ann. de Chimie, 1822, t. xxi. pp. 127 & 178; t. xxii. p. 410.

replaced the material of glass-cavities, as suggested by Vogelsang*. In the specimens which we have examined, each of the cavities contains what is no doubt an aqueous saline solution, and, as shown by fig. 8, one or more cubic crystals, probably chloride of potassium, which dissolve on the application of heat, and are deposited again on cooling. These cavities are thus analogous to those met with in the quartz of some granite, and in the minerals of blocks ejected from Vesuvius; and it seems difficult, if not impossible, to explain them except by supposing that a strong saline solution was caught up by the mineral at the time of its formation. In some cases the amount of such saline matter is so great in comparison to the liquid, that a high temperature would be requisite to make it all dissolve. It also seems probable that, if water could penetrate into such crystals, it would soon be lost when they were kept dry. This certainly occurs in some soluble salts, especially those containing combined water, and in some minerals of loose texture; but we have never seen evidence of it when fluid-cavities are completely inclosed in hard and dense substances like quartz or emerald. Though in some instances the size of the bubbles does not bear a uniform relation to that of the cavities, yet in many cases the general proportion is very similar in each specimen; and the exceptions can easily be explained by supposing that occasionally small bubbles of gas were caught up along with the water, or that there was some variation in either temperature or pressure during the growth of the crystal; all of which conditions were discussed in Mr. Sorby's paper already referred to.

We have not had the opportunity of studying many examples of cavities which contain two fluids, probably water and liquid carbonic acid, and therefore forbear to say much abont them. According to Brewster † the temperature at which those in topaz become full, corresponds very closely withwhat we have observed in the case of sapphire, so that the carbonic acid might have been inclosed either as a highly dilated liquid, or as a highly compressed gas; but since the other liquid has deposited crystals which dissolve on the application of heat ‡, it seems most probable that the water was caught up in a liquid state, sometimes perhaps holding a considerable amount of carbonic acid in solution as a gas.

On the whole therefore, the various facts described in this paper seem to

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* Philosophie der Geologie und mikroskopische Gesteinsstudien, (Bonn, 1867) pp. 155, 196.

† Trans. Roy. Soc. Edin. vol. x. p. 1 *et seq.*

‡ See Brewster's paper, Phil. Mag. 1847, vol. xxxi. p. 497.

show that ruby, sapphire, spinel, and emerald were formed at a moderately high temperature, under so great a pressure that water might be present in a liquid state, The whole structure of diamond is so peculiar that it can scarcely be looked upon as positive evidence of a high temperature, though not at all opposed to that supposition. The absence of fluid-cavities containing water or a saline solution does not by any means prove that water was entirely absent, because the fact of its becoming inclosed in crystals depends so much on their nature. At the same time the occurrence of fluid-cavities containing what seems to be merely liquid carbonic acid is scarcely reconcilable with the presence of more than a very little water in either a liquid or a gaseous form. We may here say, that we do not agree with those authors who maintain that the curved or irregular form of the fluid-cavities is proof of the minerals having been in a soft state, since analogous facts are seen in the case of crystals deposited from solution.

EXPLANATION OF PLATE.

Figs. 1 & 2. Fluid-cavities in sapphire; magnified 20 linear.

Fig. 3. Fluid-cavity in sapphire, partially divided by plates of sapphire; mag. 50.

Fig. 4. Branched fluid-cavity in sapphire; mag. 50.

Fig. 5. Crystal of spinel? inclosed in ruby; mag. 50.

Fig. 6. Cavity in aquamarina, with two fluids; mag. 150.

Fig. 7. Cavity in ruby spinel; mag. 100.

Fig. 8. Fluid-cavity in emerald, with soluble crystals; mag. 200.

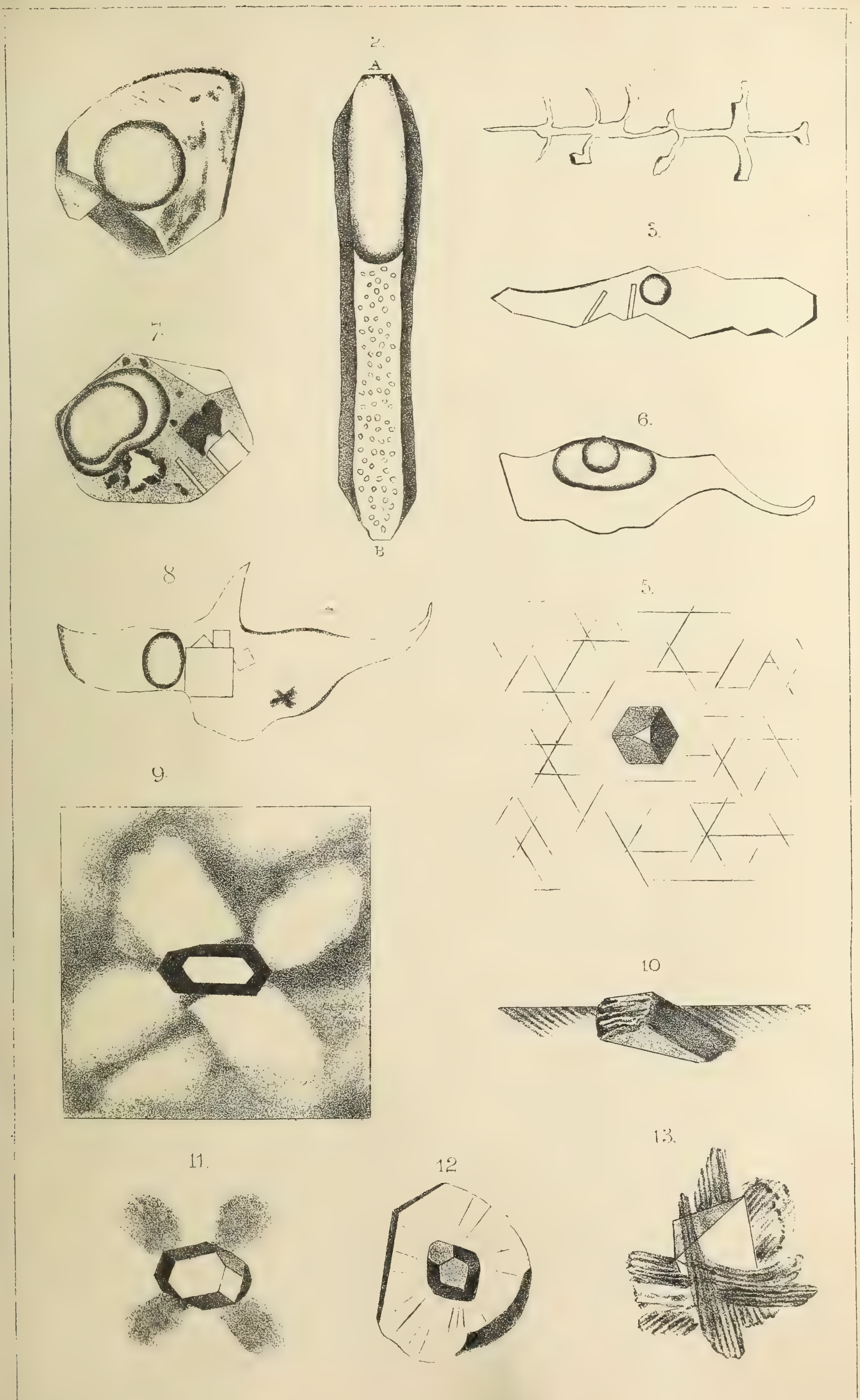
Fig. 9. Crystal inclosed in diamond, surrounded by a black cross, as seen with polarized light; mag. 100.

Fig. 10. Crystal inclosed in diamond, with a crack proceeding from it; mag. 100.

Fig. 11. Crystal inclosed in ruby, surrounded by a black cross, seen by polarized light; mag. 75.

Figs. 12 & 13. Crystals in ruby spinel, surrounded by various cracks; mag. 50.

This paper was illustrated by means of the original specimens kindly lent by Mr Butler for the occasion, and displayed by means of the oxy-hydrogen lamp.



H.C. Sorby del. W.H. Wesley lith. W. West imp.

Fluid cavities and crystals in precious Stones.

SECTIONAL.

ENTOMOLOGICAL SECTION.

The Hon. Secretary reports—

No papers of importance have been read during the autumn. Two excursions were made in the summer to Avonmouth and Brockley.

Several species new to the Bristol district, have been met with by Members of the Section, viz:—

Noctua glareosa, Ephyra trilinearia, Larentia caesiata.

The last named is found abundantly in mountainous districts in Scotland, but I believe has not been previously recorded as occurring so far south.

At a Meeting of the Section held by invitation, on March 8th, at the house of the President, S. Barton, Esq., a box containing a number of silk-producing Canadian species of Lepidoptera, with carded silk and cocoons of each species, was exhibited by Mr. H. Collins of Canada. The silks of several species appeared to be of fine quality and produced in great abundance. A cocoon of one of the species exhibited was nearly four inches in length. Mr. Collins stated that experiments were now going on both in Canada and the United States, with a view to the utilization of the silk of this and other species with every prospect of success.

The following rare species of British Lepidoptera have been exhibited at Meetings of the Section during the year:—

Sesia assiliformis,	Nola cetonalis,	Lythra purpuraria,
Cucullia gnaphalii,	Polia nigrocincta,	Dianthecia Barrettii.

also a new British beetle, Trachyphlaeus myrmecophilus, captured by Mr. Moncreaff of Southsea.

GEOLOGICAL SECTION.

The Geological Section has made three field excursions during the summer months of 1870. On April 27th, a party proceeded to Weston, near Bath, by the Midland railway, where they were met by the Rev. H. H. Winwood, who conducted them to a large and interesting cutting in the lias near that station. The party afterwards visited the Bath museum, to see the magnificent and unique collection of Mr. Charles Moore, and then walked to the Hampton Rocks, where a few fossils from the oolite were obtained.

On Whit Tuesday, June 7th, a party went to Longhope Station and thence to May Hill, visiting several quarries on their way. Mr. Stoddart pointed out the peculiarities of this district, and a large number of fossils from the upper Silurian beds were obtained.

On Saturday, August 27th, a party joined at Cheddar the Exeter

Naturalists' Club, and the united company walked through the pass. At the upper end Mr. Stoddart delivered an address on the Geology of the District, and exhibited a map showing the probable outline of the neighbourhood at the end of the glacial period. The party then returned through the pass and visited Weeks's Cave. Here Mr. Pengelly and Mr. Vivian of Torquay, made a few remarks on the origin of this and similar caverns in the Carboniferous limestone. Before leaving, a number of pieces of magnesium wire (provided by the Hon. Secretary for that purpose) were burnt, by which the interior with its stalactites was rendered distinctly visible.

XI.

Notes on the Geology of Weymouth.

By W. W. Stoddart, F.C.S., F.G.S.

Read at the Sectional Meeting, November 9th, 1870.

Mr. Stoddart read a paper describing the Geological formations in the neighbourhood of Weymouth. This interesting locality abounds with the most instructive strata and fossils, illustrating to the fullest extent the several beds of the lower, middle, and upper oolite. The attention of the Members was first directed to the Oxford clay.

This formation is very well seen in Weymouth harbour, Ham Cliff, Greenhill, near Jordan Cliff, and the western bed of the back water near Radipole. At the last mentioned locality near the bridge, may be picked up a great number of Oxford clay fossils, including twenty-four species of Ammonites, and four species of Belemnites. Very large septaria are often collected which, when polished, are manufactured into table-tops and fancy ornaments. They are composed of clay with veins of Carbonate of lime, coloured with oxide of iron. The lithological appearance of the Oxford clay very much resembles the Kimmeridge, but is distinguished by the prevalence of *Gryphaea dilatata*.

Above the Oxford clay lies the coral rag, between the upper and lower calcareous grits.

The best place for observing the coral rag beds, is between Nothe Point and Sandsfoot Castle. Some of the beds are very fossiliferous with innumerable specimens of *Trigonia clavellata*, vegetable remains, and a long list of Gasteropoda, Conchifera, and Echinodermata. The beds are however so hard that the fossils are extracted with great difficulty. The coral rag beds dip at a very small angle, and as they run for a considerable distance under the sea, form a magnificent habitat for marine Algæ, many of them being exceedingly rare species.

The Kimmeridge clay comes next in succession, and takes its name from a village east of Weymouth, where it attains a thickness of six hundred feet. It may be studied near Sandsfoot Castle, Ringstead Bay, and at Portland Island.

In many places this clay contains so much bituminous matter as to be inflammable, and is called Kimmeridge coal. When distilled the bituminous schist yields one hundred and sixty three gallons of inflammable oil from every fifteen tons. The Kimmeridge clay is very fossiliferous, and may be known wherever it is seen, by the presence of the large *Ostrea deltoidea.* It forms the base of Portland Isle, and may often be examined at its northern extremity.

The upper portion of the Island consists of beds of Portland sand and stone, capped by a freshwater formation called the Purbeck. These are by far the most interesting of all, and by means of the quarries may always be easily examined.

The Portland sand, eighty feet in depth, has a bluish grey colour, from small grains resembling those of the Greensand.

Above the sand are beds of impure cherty limestone, seventy-five feet in thickness. About forty feet from the bottom is an extremely hard siliceous bed, so crowded with casts of shells, especially *Cerithium Portlandicum*, as to be quite unfit for architectural purposes, but it is admirably adapted for quay-walls, breakwaters, &c.

Above this marine series of deposits commence twenty-five feet of fresh-water beds. They begin with two most singular remains of ancient land, separated from each other by rock called "skull-cap," and themselves named the "dirt-beds." It is, doubtless, the actual soil most wonderfully preserved, and still contains the bases and roots of the old pines and Cycadeæ. The latter resemble gigantic pine-apples, plainly shewing the scars of the leaf-stalks.

The tree-trunks lie prostrate, but the stumps still stand erect in their original position with the roots penetrating the underlying stone. Strangely enough they are almost entirely composed of Silica. The concentric rings of growth, knots, and other markings, are most distinctly preserved. On the opposite side of Weymouth Bay the dirt-bed may again be seen, but dipping at a much greater angle.

The true building stone is soft and white, and when struck with a hammer, rings with a musical note. It is worth in the quarry twenty shillings per ton.

The other beds of the Purbeck formation may be better studied at Lulworth Cone, where the incursions of the sea have made splendid sections.

The paper was illustrated by a numerous suite of fossils, obtained from the several spots described, and a number of diagrams of parts possessing the greatest scientific interest.

XI.

On Fossil Fish.

By W. Sanders, F.R.S., F.G.S.

Read at the Sectional Meeting, December 7th, 1870.

The President, Mr W. Sanders, F.R.S. resumed the subject of Fossil Fishes. After reminding the Members of what he had stated respecting the Placoid division of fishes, he described the characters of the Ganoid division. This contains two sub-orders: first, the Placo-ganoid, so named on account of the large broad plates with which the head and forepart of the body are covered. The two families of the sub-order have heterocercal tails, and retain the notochord. The first of these is illustrated by the Pterichthys and Cephalaspis, and is not known later than the Old Red Sandstone.

The second sub-order, the Lepido-ganoid, in cludesfishes which have the whole body covered with shining enamelled scales. Some of these have an imbricate arrangement of the scales like that of the tiles on a house. They are chiefly heterocercal and belong to palæozoic strata. The Holoptychius is an example of this group.

The remainder have scales of a rhombic form arranged very symmetrically. They are divided into nine families, of which the greater number are heterocercal and retain the notochord. The palæozoic formations furnish remains of these, as the Dipterus, Amblypterus, and Megalichthys. A smaller number are homocercal and these are found in Mesozoic strata. The Dapedius from the lias and the Pycnodus of the oolites, are good illustrative examples.

Dr. S. Martyn then exhibited and described the scale of Holoptychius found by him in the Old Red Sandstone at Portishead. He also shewed a specimen of Trap Rock from Worle Hill, and some large crystals of Celestine, or Sulphate of Strontian, from Wickwar.

ZOOLOGICAL SECTION.

No Meetings have been held in this Section.

BOTANICAL SECTION.

The Botanical Section has been occupied during its monthly evening Meetings in preparing and mounting specimens for the Herbarium.

PROCEEDINGS

OF THE

BRISTOL NATURALISTS' SOCIETY

FOR 1871.

EDITED BY

EDWARD W. CLAYPOLE, B.A., B.Sc.

Hon. Rep. Sec.

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1872.

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Vol. VI.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

JANUARY TO MAY, 1871.

GENERAL.

I.

The Natural History of the German People.

By John Beddoe, M.D., Pr.A.S.L.

Read at the General Meeting, January 4th, 1871.

[Abstract.]

After pointing out with the aid of a boldly drawn sketch-map how largely the migrations and settlements of races have been determined by physical causes, such as rivers and mountains, deserts and coast-lines, Dr. Beddoe entered upon the particular subject of the evening.

In the earliest times of which we can gain any trustworthy account the German-speaking races inhabited nearly the same part of Europe as at the present day. This date is not farther back than the commencement of the Christian era. In some countries it is possible by the aid of history and tradition to trace the changes which have taken place in the population. For instance, in Switzerland the present inhabitants do not belong to the same race as the Helvetii who were Kelts, and dwelt in the country in the time of Julius Cæsar. Whether these Kelts built the lake-dwellings or a yet older race that preceded them has not been ascertained. But in Germany proper the same course of events cannot be traced. Though the names of some of the rivers and mountains seem to afford ground for suspecting the presence of an earlier Keltic population, yet the evidence is insufficient to establish the theory. We learn from Cæsar that in his day the Rhine formed a tolerably accurate boundary between the Gauls and the Germans. During the centuries of their occupation the Romans succeeded in almost completely Romanizing the former and extirpating their mother tongue, so that nearly all the present inhabitants of France except the Bretons employ a Romance language. Near the Rhine are still the descendants of the few Germans who in Cæsar's time had crossed that river and invaded Gaul. Such were the Ubians, in whose territory was founded the Roman city which still retains the name of Colonia (Cologne). All these may probably have been almost completely Latinized, like the Gauls, during the Roman dominion. But towards its close a new and greater immigration began to flow westwards across the Rhine, either extruding or submerging and re-Germanizing these Latinized communities, and carrying the limit of the German blood and language further to the west than it had ever extended. This process was carried on on the Lower Rhine by Frisians and Saxons, who are both included linguistically under the Platt-Deutsch or Low German division; on the Middle Rhine by the Franks, and on the Upper Rhine by the Allemanni or Swabians, who probably contributed the largest share to the ancestry of the present Alsatians. Their presence may be discovered on the map by the names of the towns and districts which they occupied, such as Elsass (Alsace), Lothringen (Lorraine), Strassburg (Strasbourg), and Mulhausen (Mulhouse).

The Allemanni (whence l'Allemagne) entered Switzerland and occupied the eastern part of that country, driving out, destroying, or subjugating the remaining Helvetians. The cantons of this district speak German, except Tessin and part of the Grisons where Italian dialects are current. Another tribe, the Burgundians, seized the western portion of the same country and the adjoining part of France. From some cause or other they came more under the influence of their new neighbours, dropped their own language and adopted that of Gaul, so that French now prevails in the western cantons. Not only westward but southward the Germans pressed and though checked by the mountain fences of Bohemia they skirted along their base.

The German tribes also spread to some extent along the Danube and into Italy, as well as north-westwards into Sleswick. But while thus extending their limits in these directions they were themselves invaded from the east by tribes belonging to the great and widely-spread Sclavonic stock. After the Germans had embraced Christianity and had ceased to migrate towards the west and south where strong governments had grown up, they turned back upon these Sclavonic tribes, and in the course of some centuries succeeded—partly by force, partly by colonization and intermixture of blood, partly through the various influences of superiority in the arts of civilisation—in so far Germanizing their descendants as to make them forget that they were ever other than German.

The same may be said of the descendants of the Borussi or Porussi (Prussians) who were originally a Lithuanic people, somewhat akin to the Sclavonians, and occupying the south-eastern shores of the Baltic. To them also it happened, as is often the case, that in course of time they forgot their Lithuanian origin and lost to a great extent their language, adopting German in its place. So thorough has been the process that a tribe not German at all in its origin has become the foremost and the representative nation of Germany.

Traces, however, may easily be found, especially in the Eastern provinces of Posen and Prussian Poland of the non-German origin of the tribes who seized upon those sandy flats. In Germany at the present day two distinct types of cranial development exist, one a short thick and almost round head, the other longer and narrower, resembling that prevailing in England. The former is more common among the Bavarians, and the latter in Hanover and Friesland. It is impossible at present to say which, or whether either of them preceded the other. Some imagine the round-headed type to be Sclavonic or to belong to some unknown Indo-European race. It is however abundant now in Switzerland whereas we learn from tombs and burial-mounds that it was not so 1800 years ago. In that country it would seem to be a trace of the invasion of the Alemanni; but the long-headed type seems to have existed in Germany in the fifth century in a greater proportion than now. This, the speaker suggested, may be explained if we suppose it to have characterised the ruling, and therefore the military caste, which would naturally suffer more in war than the others. It is worthy of remark that, generally speaking, the German races are Protestant, and that where this is not the case history discloses some record of attempts to secure freedom of thought and worship which have been frustrated. In Catholic Belgium where Teutonic (German) tribes had settled, a desperate effort was made for that purpose, but in vain, against the Duke of Alva and his Spanish dragoons. In Austria too, all attempts to overthrow Popery were thwarted by a persecution long and bitter enough perfectly to accomplish its object.

II.

On the Origin of Species in Zymotic Diseases.

By David Davies, M.R.C.S.

Medical Officer to the Local Board of Health.

Read at the General Meeting, February, 1871.

It is with some hesitation that I venture to bring this subject before this Society, knowing full well that in the present state of our knowledge the usual means of elucidation, viz.:—the test tube, the microscope, and the pocket lens, are inapplicable to our subject; nevertheless, I consider Zymotic diseases a fit subject for the study of Naturalists, presenting as they do, most, if not all, the characteristics of the organic world, among which may be enumerated their power of self-propagation, their portability from place to place, their modification by seasons and years, the regularity of their manifestation, and the family relationship which exists between certain groups of them, indicating, as I take it, the development of certain divisions of them from some common prototype now possibly and most probably extinct; and when we consider the part they have played in the history of our race, the havoc which they have made among the more recently discovered races of mankind,* the desolation and sorrow which they frequently carry into the bosom of our families,† I am quite sure the Members of the Naturalists' Society will excuse an attempt, however feeble, to throw some new light on the subject.

The term Zymotic, derived from the Greek word Zumé, a ferment, was adopted some years ago by the Registrar General, and is applied by him chiefly to seven diseases, which he considers to be the chief members of the class, viz.:—Small Pox, Scarlet Fever, Measles, Whooping Cough, Fever, including Typhus and Typhoid, Diphtheria, and epidemic Diarrhœa. These seven represent but a small number of the whole class; indeed, the outlines of the class are as yet not well defined, and it is the opinion of

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* See the late Dr. George Gregory's Lectures on "The Exanthemata."

† "With regard to Zymotic diseases, it may be stated generally, that from 21 to 26 per cent. of the total number of deaths in Great Britain during a year are due to diseases of this class."—*Aitken's Science and Practice of Medicine, page* 210. *2nd Edition.*

Scarlet fever has, during the present decade, destroyed in three years over 80 thousand lives.—See different annual reports by the Registrar General.

many eminent men that several diseases now regarded as Non-zymotic will have to be added to the list.*

Before entering on the immediate subject of the paper I will mention the following characteristics of the whole class, which to my mind are fully proved.

1. They are never spontaneously developed but propagated from person to person. All the conditions supposed to be favourable to them existed among the red Indians from unknown antiquity, yet these diseases never appeared amongst them until they were communicated to them by the white man.

2. As a rule, they affect an individual but once in life. One attack protects the system against another attack of the same disease, but not uniformly; this protection varies in different individual members of the class. A second attack of Small Pox is rare, whilst a second and a third attack of Typhoid Fever is not uncommon.

3. One species of disease is no protection against another however allied to it in general character. I have known Typhoid, Typhus, and Small Pox, succeed one another at short intervals in the same person. When Typhoid Fever cases are admitted into a ward containing true Typhus, convalescents from the former frequently contract the latter, and so with the whole members of the class.

4. We know the conditions favourable to their development when the germs are present but we know nothing of their absolute origin, we can only trace their history and from their analogies deduce certain conclusions.

At an early period of my professional life I was much struck and puzzled at the resemblance between different diseases showing, as it seemed to me, a strong family relationship. A further acquaintance with the history of diseases proved that I was not alone in this respect, that it had taken mankind centuries to separate and classify certain members of the class, and that two of the most important, viz.—Typhus and Typhoid—had come down to the present decade of the 19th Century without being clearly recognized as distinct species. Accurate observers in England, France, and Scotland, have described the differences for a long period, but it did not strike them that these indicated a difference of species. I have classified some of these diseases according to their supposed affinity. I am not at all satisfied that it is the best classification, but let it suffice if it but serve to illustrate the subject and call forth further enquiry.

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* Pulmonary Phthisis, Cancer, &c.—See Dr. William Budd's paper on the subject, in the "Lancet."

I have put on one Stock the leading Exanthems, or Fevers which are invariably accompanied by a decided eruption on the skin. The oldest in history of this group is Small Pox. Mr. Moore has shown that this disease was known in China and Hindostan a thousand years before the Christian Era, but it is not alluded to by any of the Greek or Roman writers. It was introduced into Europe in 569, the year of the birth of Mohammed, it then swept at intervals like a plague over Europe and at a later period over the new world until the sublime discovery of Jenner checked its ravages, and that discovery having been only partially utilized on account of the ignorance of human nature, the disease again threatens to re-assume its former vigour. To prove its affinity to the rest of the group I may mention that all the early writers in the seventh and eighth centuries, such as the Arabian writers Rhazes and Avicenna, confound the disease with Measles; they accurately and graphically describe the characters of each disease, but consider them only modifications of the same affection; they did nothing towards preventing their spread, believing with many modern Sanitarians that these diseases are simply the result of putrefaction of animal and vegetable matter and not the result of infection from person to person, a doctrine which even now presents the most formidable obstacle to the adoption of true preventive measures.

Dr. Darwin, whose work on the origin of species in animals suggested to me the somewhat bold idea of applying his hypothesis of evolution to these diseases, states that where different species have arisen from the same common prototype, their resemblance to the common type and therefore to one another is greater during the early stages of development. This applies to Small Pox when compared with other members of the group. The early eruption of Small Pox is frequently so precisely similar to that of Measles, especially when it appears first on the arms, that I have been unable te give a definite opinion for 24 hours. The general symptoms are much alike, but as either disease advances the diagnostic symptoms become more pronounced and unmistakeable. Time would fail me to mention in detail other resemblances, but they are such as to induce me to believe that these two diseases, in the unknown past of our race, came from a common origin. Of their absolute origin in time and the mode of that origin science and history as yet know nothing definitely.

Again, take Scarlet Fever and Measles, now known to be distinct species, each having as definite a history as any animal or plant, although the history of Scarlet Fever does not extend beyond two centuries. This disease, probably imported from Italy, made its appearance in London in the year 1689. It was described by Sydenham and Morton. All the early physicians who wrote on the disease considered it to be only a modification of Measles. This confusion prevailed, more or less, down to the end of the last century.

These two diseases show the same general resemblance during their early stages as Measles and Small Pox. I have seen, at an early stage of Scarlet Fever, the eruption on the arms assume the crimson appearance of Measles, and the diagnostic differences have not been pronounced until a late period. But what makes this point intensely interesting is the existence of an important member of the group, which is as a bond of union between the two, showing the very links of development, as it were, which are so often lost in natural history, I allude to a small Exanthem which I have called according to the German writers, Rötheln. It has been described by different writers under the names Morbilli, Roseola, and other names. One of the best and latest textual writers on English medicine describes it very unphysiologically as a hybrid of Measles and Scarlet Fever but it does not protect the system from either of those diseases, nor do *they* in turn afford the least protection against *it*. Describing the disease as it suddenly appeared before me in this city two years ago,--it begins with the general symptoms of Measles, the countenance is suffused and the eyes watery, with the cough so characteristic of that disease an eruption precisely like Measles appears on the face; on the second or third day this fades and a pure scarlatinal eruption appears on the trunk and extremities; so exactly does this resemble scarlatina, that when it appeared in a member of my own family who had previously had scarlatina, I pronounced it to be a modified form of that disease; in this opinion I was confirmed by an experienced member of the profession. The symptoms rapidly vanished leaving not a trace of any evil behind them. Finding a similar affection prevalent in the city a light soon broke on me that I had to do with the German Rötheln. Every case could be traced to infection from another. Now I almost fancy that here we have the prototype still existing alongside of its two gigantic and powerful offsprings, viz., Measles and Scarlet Fever,* compared with

* There are several small Exanthems circulating around Measles and Scarlet Fever as there are known to be three or four around Small Pox. I have taken Rötheln as typical of the former group, and Varicella of the latter. From the exemption of many persons from the infectiousness of Scarlet Fever I surmise that one of the former group is of the same species as, and protective from, Scarlet Fever. The discoverer of this valuable Zymotic Asteroid would acquire the fame of Adams, Leverrier, and Jenner combined. It exists: What is it?

which it is like an old Lion having lost its teeth and claws lying down between two young and powerful cubs. The relationship between them is clear and distinct but the older member seems nearly pushed out of existence by some unknown cause and it will probably soon disappear.

With regard to Measles, a very old member of the family, systematic writers on medicines considered it as a form of Scarlet Fever to a period as late as 1793, and the diagnosis was not made until the issue of the second edition of Dr. Withering's Essay on Scarlet Fever, in that year. Others considered it as a mere form of Small Pox. This is sufficient to prove a family likeness. A further argument which I would advance in favour of my views is the fact that years which (through some not understood conditions) are favourable to the spread of one member of the family, are also similarly favourable to the others. It is a well-known fact that epidemics of Small Pox and Measles prevail generally at the same time, or the one follows in the wake of the other at a very short interval. Many other points might be mentioned to show that they are related to one another in their pre-historic origin.

An objection might be made to my views that I have taken for granted that these diseases are the result of organic entities more or less permanent in their character during historic times. In answer to this I can only say that all sound tradition and written history tend to this conclusion. What Small Pox was in the Chinese and the Hindoo a thousand years before the Christian Era it is in the Cockney of to-day. What Scarlet Fever was in the time of the great and accurate observer Sydenham it is in our day.* There is not a particle of evidence on record which will logically tend to the conclusion that these Zymotic Diseases ever arise from any concatenation of conditions.†

They have as strong a claim to be considered special creations as man himself, but on this I do not propose to speculate. When and in what

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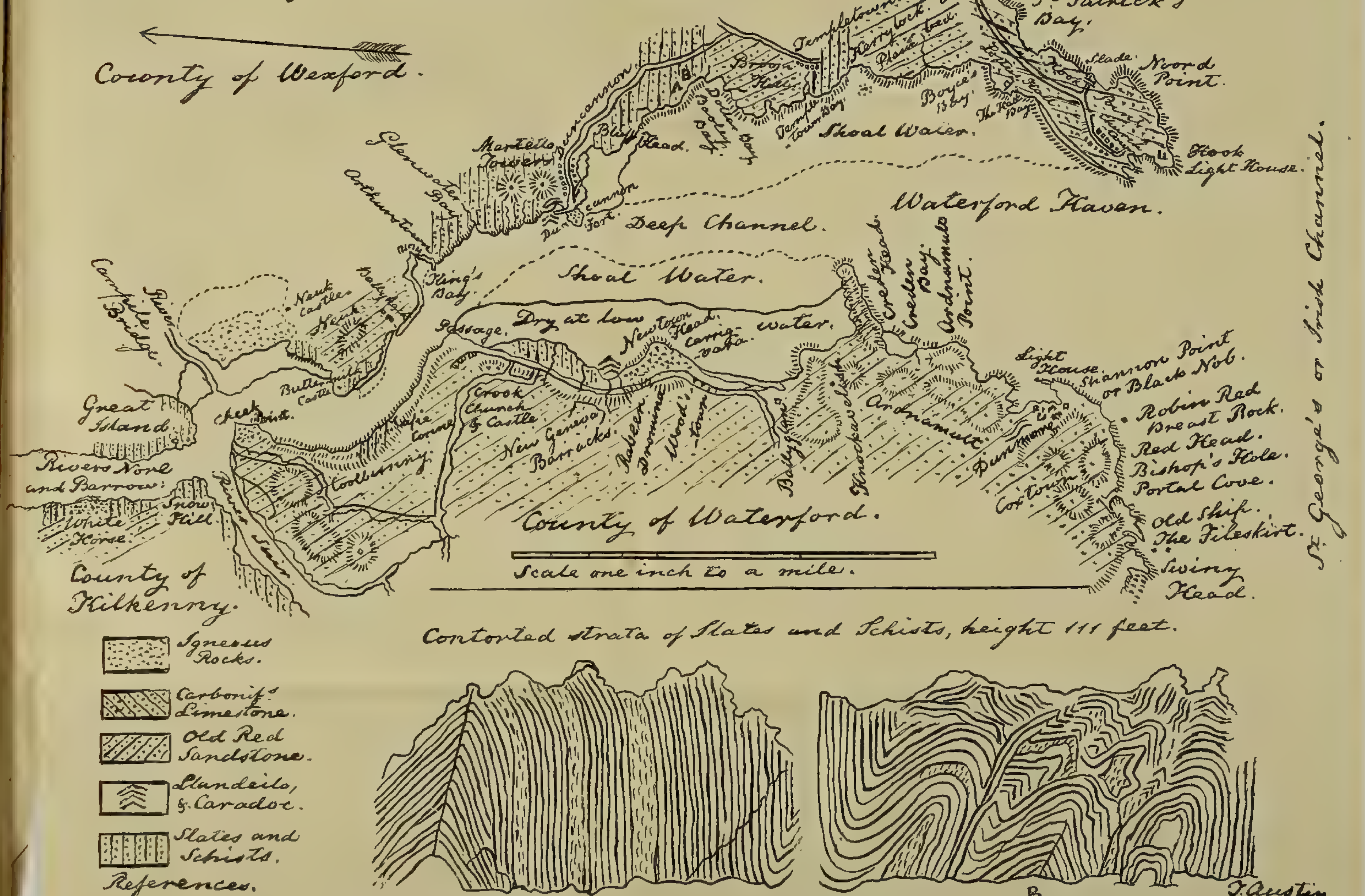
* Where a Zymotic Disease has ever broken out in a new country it has been always traceable to communication from without. For instance, Scarlet Fever, Measles, Small Pox, &c., among newly discovered races, were always traced to the invader. Pulmonary Consumption also was unknown among the South Sea Islanders and the American Red Indians, until the arrival of Europeans. Is it not Zymotic? Evidence points that way.

† Every variety and mixture of filth was found among the Red Indians and South Sea Islanders, yet these never gave birth to any Zymotic Disease known to Europeans. The Pythogenic theory of Fevers, coupled with mere Sanitarianism, have retarded preventive medicine long enough. Dirt is not nice, but, like a certain personage, it may be painted too black.

Map to illustrate Fort Major Austin's Paper on Llandeilo Flags, and Contorted Strata.



On the Eastern or County of Wexford shore of Waterford Haven.

unknown among the South Sea Islanders and the American Red Indians, until the arrival of Europeans. Is it not Zymotic? Evidence points that way.

† Every variety and mixture of filth was found among the Red Indians and South Sea Islanders, yet these never gave birth to any Zymotic Disease known to Europeans. The Pythogenic theory of Fevers, coupled with mere Sanitarianism, have retarded preventive medicine long enough. Dirt is not nice, but, like a certain personage, it may be painted too black.

manner the first breath of life was breathed into the first Zymotic, we know not. I have advanced an hypothesis which, if proved to be true, will show that even the morbid processes of nature observe the same law of development by evolution as is supposed by one of the first Naturalists of the age to apply to the whole of the animal and vegetable kingdoms. Pathological Anatomy and Organic Chemistry are not as yet sufficiently advanced to enable us to demonstrate the organic germs of these affections, and the nature of the subject (which prevents much being done by way of experiment) offers special obstacles. But there is no room for discouragement. Let us all try to throw what light we can, however feeble, on these enemies of our race, and the time may come when they will be as extinct as the Dodo and the Megatherium.*

III.

Personal Experience of the Deep-Sea Dredging Expedition in H.M.S. *Porcupine*, from Falmouth to Lisbon, in July, 1870.

By Wm. Lant Carpenter, B.A., B.Sc., F.C.S.

Read at the General Meeting February 2nd, 1871.

Abstract.

The equipment of the expedition was very nearly the same as in 1869, a few slight additions only being made, which the experience of the previous year had suggested. The *Porcupine* sailed from England on July 6th, under the command of Captain E. K. Calver, the scientific work being under the charge of Mr. J. Gwyn Jeffreys, F.R.S.; the author having been entrusted with the chemical and some of the physical investigations.

The first week was occupied in dredging on the slopes of the plateau on the edge of which Great Britain and Ireland rest, near the northern extremity of the Bay of Biscay, at depths ranging from 400 to 800 fathoms, which past experience had shewn to be usually the most biologically productive. Many forms of animal life were obtained which had been hitherto supposed to be confined to more northern latitudes. On one

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* Note, April 29th.—From observations of cases of Small Pox during the present epidemic I could add many facts in corroboration of the general hypothesis proposed. These would somewhat modify the relation of the zymoses to one another as regards time but instead of invalidating would greatly confirm the views advanced. They would also fully exonerate the early observers from any charge of ignorance.

occasion as many as 45 specimens of the new siliceous sponge *Holtenia* were taken in one haul of the dredge. The *Porcupine* then steamed to the centre and the deepest part—2700 fathoms—of the Bay of Biscay, as it was desirable to obtain, if possible, a cast of the dredge at that depth for the sake of confirming the results obtained at 2435 fathoms in August 1869. The peculiarly favourable conditions of weather necessary for the accomplishment of this object were not fulfilled, and having waited two days in vain the *Porcupine* steamed to Cape Finisterre, and after dredging in its neighbourhood, anchored in the beautiful harbour of Vigo, in company with the Spanish fleet and the ill fated turret ship H.M.S. *Captain*, from whose Commander, Captain Burgoyne, and from Captain Coles, we received every possible kindness and attention. After coaling and refitting, we proceeded to sea again and spent a week in dredging off the Portuguese coast in all depths up to 1100 fathoms; down to the latitude of Lisbon, in which port we anchored on July 23rd, having, on the previous day, noticed a remarkable mirage at sea, which was also observed on the same day at various points on the coast of England and Scotland.

Dredging and sounding off the Portuguese coast were attended with much greater risk to the apparatus employed than at corresponding depths near the British Isles on account of the very rocky character of the bottom, even at great depths. On one or two occasions both instruments and rope were lost, and more accidents would have happened but for the great care and patience displayed by Captain Calver in extricating the apparatus from entanglements in rock. Many forms of Mollusca were obtained which had hitherto not been noticed south of the Shetlands, as well as several more specimens of *Holtenia*. This sponge was also seen by the writer in the Museum at Lisbon, having been quite recently obtained by the shark fishers on the South coast of Portugal. Two extraordinary hauls of the dredge were mentioned: in one, several specimens were obtained of a new living Pentacrinus, about half the size of the West Indian species, which was considered the Zoological gem of the expedition; and on another occasion, the dredge came up full of shells, mostly dead, and consisting of Pteropods, but comprising certain species hitherto regarded as exclusively Northern, and others which Mr. Jeffreys recognised as Sicilian Tertiary fossils, while nearly forty per cent. were undescribed species. Of the total of 186 species, 91 were recent, 24 fossil, and 71 new or undescribed.

It was then stated that all the thermometric observations of the deep sea made on the voyage from Falmouth to Lisbon, fully confirmed the relation of temperature to depth which had been observed in the cruise of 1869 in the North Atlantic basin, the only difference being that the stratum of intermixture between the upper warm and lower cold current was about 150 fathoms deeper off the coast of Portugal than off the coast of Ireland. The investigations in the Mediterranean, however, showed that at no depth in that inland sea, which was cut off from the general system of polar and equatorial oceanic circulation, was there a lower temperature than 55° Fahrenheit.

The author then gave a short account of the experiments conducted by himself. Many analyses of the gases dissolved in sea water had been made, the results of which shewed, (1) that the agitation of the surface water by the steamer's paddles did not, as was at first supposed, tend to aerate the water and replace the excess of carbonic acid by oxygen; (2) that in every other respect the results arrived at in 1869 as to the great excess of carbonic acid and corresponding deficiency in oxygen in "bottom" waters, and the relation of this with the amount of animal life on the sea bottom, were confirmed; and (3) that comparing the waters of Southern latitudes with those of more Northern ones, both bottom and surface waters contained more carbonic acid and less oxygen in the latitude of Portugal than in that of Ireland. One instance was given of water from 1065 fathoms depth, which contained 2.8 volumes of gas in 100 of water, the composition of which was

Carbonic Acid	53 per cent.
Oxygen...	12 „
Nitrogen	35 „

The Author had been specially engaged, however, in determining, according to a method suggested by himself as applicable for use on board ship and also admitting of great accuracy, the amount of chlorine in various specimens of sea water, with a view to compare the North Atlantic basin with the Mediterranean in this respect. 34 samples were examined with the following result expressed in grammes of chlorine per 1000 cubic centimetres of water.

	Surface Water. 12 Samples.	Intermediate Water. 10 Samples.	Bottom Water. 12 Samples.
Average	19.94	19.85	19.75
Maximum ...	20.19	19.94	19.98
Minimum ...	19.81	19.70	19.46

These results appear to shew that there is a slight excess of chlorine, and therefore of salts generally, in the surface water, attributable probably to the constant evaporation from the surface, as is shewn by the following series taken at the same spot:—

Surface...	...	20.013
10 fathoms	...	19.909
25 „	...	19.909
50 „	...	19.909
100 „	...	19.805

Hence it would appear, that the reason this concentrated superficial film does not sink, is that even at the depth of ten fathoms the greater density arising from reduction in temperature exactly balances the greater density arising from excess of salinity.

Mr. Carpenter concluded by stating that the subsequent investigations made in the Mediterranean by Dr. Carpenter, F.R.S., had shewn (1) that the bed of that sea was almost barren of animal life; (2) that its temperature was nowhere lower than 55° Fahrenheit; and (3) that an undercurrent existed in the Straits of Gibraltar flowing outwards from the Mediterranean into the Atlantic.

IV.

On the Strata composing the Shores of Waterford Haven with especial reference to the occurrence of Llandeilo Fossils in that Locality.

By Fort-Major Thomas Austin, F.G.S.

Read before the General Meeting, March 2nd, 1871.

The rocks, in the county of Wexford, of which I am about to speak, extend from the Carboniferous Limestone at the Hook Point in the South, to Buttermilk Castle in the North.* The more ancient portion, slates and schists, tilted, contorted, and dislocated as they are along an extensive line of coast, proved a difficult problem to solve. The Government Surveyors had passed over them but had failed to discover any signs of organic remains, therefore the relative age of these unpromising rocks could not be properly determined, and they were accordingly at one period not included in, or referred to any well defined system of stratified deposits. It was only after I had examined every bed, if only an inch in thickness, along a line

* This castle is situated at the base of an elevated region named Neuk.

of coast between thirty and forty miles in extent, that at length I obtained fossils, and strange to say, these I found, not at a distant point, but within two or three hundred yards of Government House, where I resided. In 1837, when a considerable quantity of stone was removed for the purpose of enlarging and deepening the little harbour of Duncannon, in the county of Wexford, I first discovered the impression of a shell; continuing the search my son obtained two specimens of *Calymene duplicata*, and I found altogether upwards of twelve species of mollusca and several specimens of Chætetes, all of them Llandeilo types. These were all obtained from a black matrix of very limited extent, and which in some portions presented a shining appearance, so much so that it was mistaken for coal, and several of the inhabitants of the adjacent village carried quantities of it away for fuel, but instead of it burning blandly, as they expected, it proved most refractory and flew in their faces with a loud crackling noise. Through this mass ran a vein of rose-coloured quartz studded with yellow pyrites, which so much resembled gold that some of it was sent by a sanguine native to the late Lord Templemore, the owner of the property, who had it analyzed, but with the usual results of such crude speculations. Some very beautiful carbonate of lime was also found. On the opposite side of the estuary, which is here somewhat more than a mile across, I obtained an abundance of fossils which had also wholly escaped the notice of the Geological Surveyors. Papers of mine being read at meetings of the Geological Societies of London and Dublin, attention was directed to these deposits, but even then, in consequence of the upturned edges of the strata being almost flush with the shore, and only visible at half tide, they were not known to the Surveyors until I pointed them out to Sir Henry James.

But to return to the Llandeilo Beds at Duncannon. It was some years before the Geological Survey would admit that Llandeilo flags occurred in the part of Ireland to which I now refer. Sir Roderick Murchison, in a letter to me, wrote as follows:—

"My dear Sir,—I beg to thank you heartily for your labours in developing the relations and contents of the Silurian rocks in the South-East of Ireland. *All* the Trilobites from that region (Newtown Head, Tramore &c.) belong unquestionably to the *Caradoc formation*, with which Bala is now identified."

It would be unjust to omit saying that Sir Roderick had not seen the fossils from Duncannon when he made these remarks.

Sir Roderick also added the following observations:—

"There is an observation of yours—nay an important discovery—to which I must call the attention of my associates in this age of forward movement. In the Geological Journal, Vol. 3, p. 361 you notice the existence of a human skeleton in the body of a shelly raised beach. This fact is of vast importance now that the intermixture of flint knives and the implements of men have been detected in diluvial accumulations with Mammoth &c.

Yours very truly,

Nov. 5, 1859. RODK. MURCHISON."

After receiving the letter just quoted from Sir Roderick Murchison, I allowed the question relative to the Irish Llandeilo beds to remain at rest for some time, but hearing it repeated that Llandeilo rocks were not known in the South-East of Ireland, I sent a number of the fossils which I had discovered at Duncannon, to Jermyn Street, the head quarters of the Geological Survey. Shortly afterwards the late Mr. Salter, then Government Palæontologist, returned the specimens, all of which he had named in the following list which was headed—

Llandeilo Flags, Duncannon, County of Wexford.

Calymene duplicata...	... ...	2 specimens.
Lingula ovata.	... ...	3 do.
Lingula, not named.	... ...	3 do.
Orthis striatula	... ...	1 do.
——— actoniæ	... ...	2 do.
——— biforata	... ...	1 do.
Leptæna sericea	... ...	2 do.
Chætetes petropolitanus	... ...	2 do.
Stenopora fibrosa	... ...	1 do.

Thus far there can be no doubt that all these specimens from Duncannon are unquestionably Llandeilo Flag fossils. Along with these I sent a set of specimens from Newtown Head, near Woodstown, County of Waterford, and which I had considered as belonging to the Caradoc strata, but Mr. Salter appears to have thought that they might also be included in the Llandeilo series, and he marked the list with a note of interrogation and appended names to the fossils as follows:—

Llandeilo Flags (?), Newtown Head, County of Waterford.

Crania divaricata	... ...	1 specimen	Caradoc species.
Lingula ovata	... ...	1 do.	

Bellerophon perturbatus	... 4 specimens		Llandeilo species.
Calymene Blumenbachii variety brevicapitata	5	do.	Llandeilo chiefly.
Ampyx mammilatus (Sars) ——— Austinii (Portlock)	2	do.	Llandeilo elsewhere,
Trinucleus seticornis...	... 3	do.	Caradoc usually.
Ogygia Portlockii (Salter)	... 3	do.	Most like Llandeilo.
Acidaspis Jamesii ...	... 1	do.	Peculiar to deposit.
Salteria	... 1	do.	

The remarks opposite the names are not mine, but were appended at the Museum of Practical Geology; and the following letter accompanied the list of fossils.

"M. P. Geology, Jermyn Street, Feb. 28, 1862.

Dear Sir,—The list I enclose will show how interesting these Llandeilo localities are. You are quite right. But if any one chose to call them Caradoc he would be justified, for there is a mixture of Llandeilo and Caradoc types which I did not expect. I rather think they are both of the same age, and that *Calymene duplicata*, and the *Ogygia* settle the matter of their age sufficiently. Beds of passage between two such closely related formations could not but be looked for.—Here they are.

I have retained specimen 33, as it seems to have a new form in it which I believe my friend Dr. Thomson has called *Salteria*. Please let me keep it a month; it shall be returned safely. Yours truly,

J. W. Salter."

From Mr. Salter's letter it will be seen that the Duncannon beds are admitted to be true Llandeilo Flags, and that he was also inclined to go further than I had proposed and include the fossiliferous beds at Newtown Head on the Waterford side of the estuary in the Llandeilo series. I was not, and am not now inclined to agree wholly with this view, for although Llandeilo fossils are found mingled with true Caradoc species, yet I cannot consider that we are justified in regarding the Newtown Head, Woodstown, strata as anything more than the passage beds between the two formations, and that during the deposition of the less ancient beds the fauna of the Llandeilo period had not wholly died out, but continued to exist for some time along with true Caradoc types.

The same mixture of Llandeilo and Caradoc fossils has been noticed by Mr. Randall at Cound Brook, a tributary of the Severn, in strata which have always been considered as of undoubted Caradoc age.

To revert to Newtown Head. The Government Surveyors, or rather the recorders of their proceedings, have fallen into an error respecting Newtown Head, which I have in vain endeavoured to rectify. There are two localities of that name, one of them situated near Tramore, and the other close to Woodstown. They are at least eight or ten miles distant from each other and yet those who have written about them jumble the two together or confound one with the other. Even General Portlock, who borrowed my specimens to figure and describe in his Report on Tyrone and Londonderry, has made the same mistake, and although I had previously recommended him to avoid the error he states that I obtained the fossils at Tramore, instead of Woodstown. In fact I did very little at Tramore as Sir Henry James was working the strata there whilst I was plying chisel and hammer among the rocks at Woodstown. But when an error of this kind gets into print it is very difficult to set it right again.

In reference to the human skeleton to which Sir Roderick Murchison alludes in his letter, I will on the present occasion only say that I consider the evidence conclusive as to its having lain at the bottom of the water contemporaneously with the cockles, the shells of which may now be seen by thousands in the raised sea bed at Newtown Head.

If we examine the Carboniferous Limestone at the Hook Point, it will be found that the beds dip at an angle of about 13° South and maintain that inclination with but little variation till they disappear under the sea. Many of the beds are broken and fissured, and there are several caverns which penetrate the more elevated portions, which however never rise more than a few feet above the sea level. Some of the fissures cut through the strata for considerable distances, both along the strike, and in the direction of the dip. This point is classic ground to the palæontologist. Crinoids, corals, mollusca, and fish-remains are most abundant. In fact many of the beds are made up almost entirely of organic remains, others are less calcareous, shaly matter being mixed with carbonate of lime, and these are not so fossiliferous, others again are exceedingly hard and dark coloured, and from their ringing sound when struck with the pick or hammer are locally known as the "Black Bell." When I first visited this point of land it had never been worked by any geologist, so that I was enabled to collect a very great number of beautiful specimens, particularly crinoids, corals, and shells. On my making known the rich harvest of organic remains there, a host of collectors visited the spot and procured many good specimens, among others one of the finest sets of *Orodus* teeth in position hitherto discovered.

Proceeding onward we next come to the Old Red Sandstone at Boyce's Bay, near Porter's Gate, where it dips in perfect conformity under the Limestone of the Point. I believe this to be the original section which gave rise to the opinion that the Old Red Sandstone should be grouped with the carboniferous series of rocks; but I think something more than conformity of dip is required to render such an alteration in the long accepted arrangement desirable. It is true that at this place the upper portion of the Old Red has some few fossils identical with those of the overlying Limestone, but when in other localities we come to the middle and lower beds, we find the types of life, fishes, mollusca, and crinoids, wholly different in character.

At Boyce's Bay, in the upper stratum, I thought I could trace circular spots bearing some resemblance to plants, but the siliceous nature of the bed defied all attempts to remove them. This upper portion is the yellow sandstone of Griffith. In some of the red sandstone strata, more to the west, and close under the limestone, I obtained a few teeth of fishes and detached portions of crinoid columns, similar to those which occur in the incumbent calcareous strata.

From Boyce's Bay to Herrylock, which is situated between the Hook Point and Templetown Bay, an excellent type of the Old Red Sandstone may be seen, where the rock is exposed in the well-defined cliff-section and the base and summit are both clearly visible. Here the thickness is about 450 feet, but this thickness is small as compared with other localities; for instance, in the county of Kilkenny it has been estimated at 1680 feet. In Boyce's Bay the average dip is about 13° South, while that of the underlying grey slates is 60° N.W.

In a grey micaceous flaggy bed of the Old Red I obtained many imperfect specimens of plants and also found several layers of anthracite. Not far from the cliff the apex of a mass of trap protrudes several feet above the beach, probably indicative of a large underlying mass. This trap is so hard and tough that it defied my chisel and hammer and I could only break off a very small portion.

On this beach is also seen a singularly shaped detached mass of Old Red, which may be considered either as a token of extensive but gradual denudation, or of a mighty *débâcle* that broke up and swept the whole of the sandstone from the cliffs above. Such a *débâcle* did probably occur, for in the valley at Taylor's Town, situated several miles to the North-east, massive blocks of the Old Red Sandstone lie scattered in every direction on the alluvial deposit along the river side, proving that a general breaking up of the once wide-spread continuous beds has somehow or other taken place.

In the Herrylock and Boyce's Bay cliff-section, the Old Red and the Carboniferous Limestone were evidently deposited, from the lowest bed to the uppermost, during a period of comparative tranquillity, and were therefore free from any disturbance in position or succession. I may mention that in Ireland there are upwards of one hundred different localities where junctions occur of Old Red with the rocks that lie beneath it. It is quite evident that after the disturbing forces had bent and folded the older stratified slaty rocks, a powerful denuding agency planed down or broke off, and swept away the summits of the anticlinal ridges which rose highest above the undulating surface, leaving the beds tilted as if thrown up on their edges and standing on end, as seen in the part of the section which I shall presently notice. On these upturned strata the conglomerate of the Old Red Sandstone began to lay the first course or foundation stones of a new formation, and this was always the case without reference to the quality of the rocks on which the superstructure was about to be raised, and in which period a new zone of organic life comcommenced to develope itself.

From Herrylock to Templetown Bay the grey slate cliffs gradually increase in height until they are abruptly cut off by the great mass of Old Red Sandstone known as Broom Hill. Against this bold and rugged headland the slate strata dip in the opposite direction to those in the adjoining bay a little more to the south, and appear to rest against the headland as if the ponderous mass of Old Red had shouldered them up from below, but how this could possibly be it is difficult to imagine, unless on the supposition that a succession of downthrows and upward movements had inverted and destroyed the original sequence of position.

A similar but more decided case of inverted strata may be seen at Ballyglan on the opposite side of the estuary, where the Old Red evidently dips under the slates. As this apparent inversion of rock masses, the newer strata seeming to dip under the more ancient formation, is exactly opposite to Broom Hill, in all probability the same movement that produced one inversion occasioned the other.

In Dollar Bay some remarkable foldings are seen, and which are represented in the drawings. Next comes another cliff-section where the strata appear to have been bent and broken in every conceivable way and then squeezed into a pile of confused and fractured beds. But even here we can recognise the shattered slates which serve as an index to the whole line of coast. A little more to the north, this heap of rock ruins is succeeded by a group of vertical strata, which are evidently the base and side of an anticlinal ridge, for still more to the north we can trace the three bands of slate, which are here perpendicular, sloping down from the top of the cliff to the bottom where they are lost to sight as they plunge under the beach. The axis of this anticlinal is so clearly and sharply defined that I consider it about the most instructive section of the kind known. The folding of the strata is so abrupt that in the axis or centre of the fold they are fractured or split in a direct line from the top of the cliff to its base. The height of the vertical strata is, if I recollect rightly, one hundred and eleven feet. Unfortunately the measured section of the whole line of coast has been lost. It is worthy of remark that in the centre of every fold a grey coloured nucleus is seen. The material of this nucleus is now hard but it is probable that when the rocks were bent and folded it was more plastic and yielding than the associated strata that envelope it.

By attending to the position of the three beds of splintery slates we find them alternately appearing and disappearing in repeated folds, and can thus trace them along the cliffs where they sometimes dip under the beach and at no great distance emerge from it until they finally disappear in the low cliff on the border of Duncannon strand. In this section we have a succession of anticlinals and synclinals extending along a line of cliffs for a distance of nearly two miles.

From the evidence presented to our notice in the different contortions along the line of cliffs, and which are represented in the sketches, it would seem that the rock masses at their original horizontal position at the bottom of an ancient ocean must have covered an area more than twice as extensive as that which they now occupy. I have taken some trouble to measure many of the bent strata and find that in several instances they are squeezed into a space less than one-third of that which they occupied in their normal condition, and although my calculations must necessarily be vague owing to the different degrees in which the beds are inclined, yet there can be no doubt as to their former wide-spread distribution as compared with their present more circumscribed position. I had, with my son, made a measured section of the whole line of coast, but unfortunately it has been lost, so that I can now only present to your notice views of detached portions of the cliffs.

The contorted strata near St. Abb's Head, Scotland, have always been considered a marvellous example of such phenomenon. There the rocks in the space of six miles present to view sixteen distinct curves; but in the section now brought to your notice the strata exhibit in the cliffs no less than nineteen curvatures alternately convex upwards and concave downwards in the space of little more than a mile in extent, so that in that limited area the contortions are more numerous and much more acutely defined than in the more extended line of Scotch cliffs.

Along the whole line of coast on the margins of the three rivers, the Suir, the Nore, and the Barrow, whose confluent streams form the fine expanse of water known as Waterford Haven, which separates the counties of Wexford, Waterford, and Kilkenny from each other and extends from the Hook Point to the city of Waterford, igneous agency of remote periods is very conspicuous. Trap rocks are visible at Herrylock, Duncannon Fort, the Neuk, Snow Hill, Newtown Head, Cheek Point, and Cromwell's Rock, all of which are situated on or near the shore.

On the beach of Great Island lenticular-shaped pieces of talcose schist studded with minute common garnets are wedged in between the beds of grey slates, and appear to have been produced by igneous influence or metamorphic action. On the opposite or Kilkenny shore, at Snow Hill, a basaltic dyke rises to an elevation of upwards of 150 feet. This mass of basalt is locally known as the "White Horse," so named by the boatmen on the river from its surface appearing of a dingy white, caused by the decomposition of the felspar which enters largely into its composition. The dyke has cut through the slate rocks which near the junction have become much indurated and studded with cubes of iron pyrites, while the Old Red Sandstone resting on and near the apex of the dyke is more crystalline than the beds at some distance from it.

On "Little Island," near Waterford, portions of the old slates have been baked into porcelain, whilst on the opposite or Waterford side of the King's Channel they also appear to have been acted on by metamorphic influence, and the hard and tough hornblende rock there has evidently been in a semi-liquid state and seems as though it had seethed as in a cauldron until it became twisted into wreaths and rolls of curious forms.

At Duncannon Fort the trap rock when in a liquid state has evidently welled up from below, and this occurred after the slate beds had been tilted and contorted. In the low cliff to the south of the *glacis* portions of the melted trap appear to have run into the concavity formed by a synclinal in the slates, and there become consolidated, while on the sands at a short distance from the fort a detached fragment of slate rock twenty-four feet in length is completely enveloped in the trap, which has also separated some of the layers and forced itself between them.

During these outbursts of igneous activity or subsequently to the cooling down of the trap it is probable that the whole district became elevated to its present position by a gradual upheaval with intervals of rest; these are indicated by the evidence of the upraised sea-margin resting on the north shoulder of Bluff Head where shells such as are now found living on the coast occur, and by the elevated sea-bed at Newtown Head on the opposite side of the estuary where a bed of cockle shells is seen in the cliff, among which I discovered the perfect human skeleton. The shells are also found in the adjacent fields where the action of the plough brings them to the surface and scatters them by thousands along the furrows.

SECTIONAL.

On the Development of the Carboniferous System in the Neighbourhood of Edinburgh.

By E. W. Claypole, B.A., B.Sc.

Read before the Section on January 10th, 1871.

In the Scottish counties of Linlithgow and Mid Lothian the carboniferous system is very fully developed especially in its lower formations, but in many respects it strikingly differs from the same system as familiar to those who have studied it only in the south-western part of England. Before calling attention to these differences it will be necessary to say a few words on the general geology and physical geography of the district. From a very distant date in the history of our earth, somewhere in the interval between the deposition of the lower and upper Old Red Sandstone, the Pentland Hills have existed as a dividing ridge along a line from north-east to south-west. They consist fundamentally of Silurian and lower Devonian rocks, in an almost vertical position. On the upturned edges of these lie in striking unconformity the upper Devonian beds, and above these the carboniferous. Of the original Pentland range but a small fragment remains which with these later deposits and their interbedded felstones composes the present hills. A great gap is thus seen to exist in the series, representing in part at least, the middle Devonian slates and limestones of Plymouth and Ilfracombe. For this reason some have proposed to break up the system and allot its upper part to the carboniferous and the lower to the Silurian. But its continuous development in other localities, as well as the distinctive aspect of its organic remains, is a strong objection against so doing.

The numerous thick sheets and dykes of trap intersecting the upper Old Red Sandstone in all directions afford ample evidence of internal igneous activity during its deposition. These become less frequent in its topmost beds, leading to the belief that the outburst gradually died away towards the time when the lower carboniferous strata were laid down. But the lull was only temporary: ere long the subterranean forces broke out again with all their former energy and the district was for ages subject to the occasional, perhaps the frequent, outpouring of trap, consisting in the earlier times of felstone and in the later of basalt. Even after these outflows ceased on the eastern, they continued on the western side of the chain, and the whole of the period corresponding in date with the age of our mountain limestone was marked in Linlithgowshire by stream after stream of greenstone from some crater of eruption as yet undetected and perhaps long ago destroyed by erosion. In a district so disturbed faults are of course abundant. The Pentland Hills are skirted by two along almost their entire length: one of these passes under the city of Edinburgh, near the Castle, and its throw is estimated at not less than 2500 feet. Others intersect the coal-fields in all directions, and probably if the rest of the locality could be as thoroughly searched they would prove to be equally numerous in every part.

Instead of the eighty feet of red and green shale with coprolite, &c., as in this neighbourhood, the base of the carboniferous system near Edinburgh consists of about 1000 feet of shale and calciferous sandstones with interbedded and intruded trap. Of these strata, dipping at about 30° to the East, the entire hill of Arthur's seat is composed, and the precipice of Salisbury crags is one of the intrusive igneous masses denuded and scarped by erosion. Both kinds of rock have been altered at and near the surface of junction, the sandstones being converted into quartzite and hornstone, and the shales having sometimes acquired a jaspery structure and appearance, while the trap itself has often become soft and friable in texture.

In such a series organic remains are of course not very abundant. Those that occur belong to the lower carboniferous species of the district, Sphenopteris, Spirorbis, Rhizodus, Cypris, &c. I was also enabled through the kindness of C. W. Peach, Esq., F.G.S., the President of the Royal Physical Society of Edinburgh, to obtain some specimens of an organism peculiar, so far as is known at present, to Arthur's seat, and only discovered in 1868. It is an Entomostracon of the Genus Estheria, and occurs in a nodular bed about two inches thick among the calciferous sandstones. The Nodules are hard and brown inside, but weather to a soft mass of a yellow colour, and crumble down to an ochrey powder under the touch. It has been named by Prof. T. Rupert Jones after its discoverer, *E. Peachii.**

The volcanic agency which toward the close of the Old Red Sandstone period had sunk to temporary repose had evidently broken out again during the deposition of these lowest strata of the carboniferous system. Beds of volcanic ash occur containing rounded crystals of felspar in a dark purplish porphyritic paste, and masses of almost basaltic trap with crystals of black augite.

The lower carboniferous series in the neighbourhood of Bristol is completed by about 400 feet of light coloured shales and limestone bands, in which space occurs the well known palate-bed. But in the Scottish area instead of these we find, first,—a considerable thickness of dark shales celebrated for the abundance of fish-remains which they have yielded, consisting of at least nine species:

Amblypterus nemopterus.	Palæoniscus carinatus.
——— punctatus.	Acanthodes sulcatus.
——— striatus.	——— Wardii.
Eurynotus fimbriatus.	Rhizodus Hibberti.
——— crenatus.	

With them are found the usual accompaniments of Sphenopteris, Lepidodendron, &c. Several of the above species also occur in the Coalfield of Lorraine, near the now notorious town of Saarbrück.

Next in ascending order comes an immense thickness of white, clean, thick-bedded sandstone, Scottish freestone, easily worked and withstanding exposure well. Of this the city of Edinburgh has been built, and in perhaps the largest quarry opened for that purpose, the now classical Craigleith, was exposed in 1830 the fossil tree figured by Lyell on page

* Prof. T. R. Jones, F.G.S., has kindly furnished the writer with the following specific description:—"It is of a subquadrate form, boldly ridged, concentrically. Its sculpture is not preserved, and indeed only mere films of the shell itself. Its form however is sufficiently distinct to authorize us to regard it as a new species '*Estheria Peachii.*'" Several of the specimens exhibited are now in the Museum of the Philosophical Institution.

481 of the "Elements." "The total length was 60 feet. Its diameter at the top was 7 inches and at the base 5 feet in one direction and 2 feet in the other. The bark was converted into a thin coating of the finest coal, forming a striking contrast to the white quartzose sandstone in which it lay. The beds were unaltered and undisturbed at the point of junction, showing that they had been tranquilly deposited round the tree. They were composed chiefly of siliceous sandstones in laminæ so thin that from 6 to 14 might be counted in an inch. Some of these contained coaly matter and the lowest were calcareous. The interior of the tree still preserved the woody texture in a perfect state, the petrifying matter being for the most part calcareous."

It has since been quarried away, and at the time of my visit not a fragment of it could be found.

At some distance above lies a bed forming a well-known dividing line in the lower carboniferous shales, and called, from the locality where it was first examined by Dr. Hibbert, the Burdie House limestone. It is not more than 25 feet thick and lies about 3000 feet above the top of the Old Red Sandstone and about 800 feet below the base of the Mountain Limestone. It is worked at the crop near Loanhead and followed for some distance under ground along the dip of about 20°. The blocks of this fine grained limestone are full of Sphenopteris affinis, Lepidodendron with its fruit Lepidostrobus, Calamite stems, and the remains of fish of different species, such as the Ganoids, Eurynotus and Palæoniscus, Rhizodus, and Megalichthys.

At the distance of 3800 feet from the base of the system we reach the bottom of the Mountain Limestone. At this epoch the action of the igneous forces on the east of the Pentland axis ceased altogether while in Linlithgowshire it continued with equal or greater intensity. Taking the Edinburgh or eastern side first, instead of the thick marine deposits and fossil remains of our own middle limestone we find about an equal thickness, 2000 feet, of alternating layers of shale and sandstone, bands of ironstone and seams of coal, with 6 thin bands, not exceeding in all about 40 feet, to represent the typical Mountain Limestone, containing, however, many of the organisms with which in this neighbourhood we are so familiar, such as—

Productus longispinus.	Goniatites.
——— semireticulatus.	Orthoceras.
Chonetes Hardrensis.	Bellerophon.
Encrinites.	

Three of these limestone bands are within 500 feet of the base of the formation, and between these and the fourth lies the great store of Edinburgh coal. In this interval of 1200 feet occur 26 workable seams with a total thickness of 80 feet. Into this subterranean treasure-house the pits that stud the Dalkeith coalfield are sunk. These beds underlie the whole district, cropping out at a high angle on the flank of the Pentlands as the Edge coals of Mid Lothian, and again at a much smaller one about 5 miles to the eastward where they are called for distinction the Flat coals.

Before leaving this part of the subject it may be interesting to add that the district was not disturbed by the subterranean forces for many ages after the close of the carboniferous era. They again broke forth for a time, probably about the date of the beginning of the tertiary deposits, and the top of Arthur's seat was the crater from which issued new streams of lava and showers of ash. Its highest point consists of a plug of basalt filling the pipe and remaining as a proof of the eruption and not less of the enormous erosion that has since taken place.

Very different is the succession of the beds in the same formation on the western side of the chain though only a few miles distant. It consists, in the lowest part, of shale, sandstone, and ironstone, with a few limestone bands corresponding to those in Mid Lothian and several seams of coal of good quality. Above these lies the product of one or more of the ancient eruptions, in the form of a vast sheet of greenstone 150 feet thick through which the pits must be sunk before the coal is won. Above this once lay (for it has now been worked out) the Wester Main coal, one of the most profitable seams in the field, 12 feet thick, and this in turn was covered by an upper greenstone often 250 feet in thickness.

In one pit a deep sinking was made to the Wester Main coal through 150 feet of this greenstone, when a series of shales and sandstones was reached. Greenstone followed and was pierced to a depth of 140 feet when the auger struck a rich seam of coal 9 feet thick. The pit was deepened to this point and the coal worked. Its quality was good, though underlain and covered with greenstone. But it was soon found that the seam formed but a local lenticular patch filling a hollow in the trap, and though mines were driven into the rock in every direction no trace of coal could be found. The boring was therefore resumed, but after passing through an apparently interminable thickness of greenstone at great cost, the pit was abandoned.*

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* Memoir of Survey.

Little metamorphism has taken place in the coal, even where it has been overflowed by the trap. It is sometimes worked with the greenstone for a roof, and the alteration becomes almost imperceptible at the distance of a few inches from the junction. It need hardly be added that this is not the case when the trap has intruded itself through the sedimentary rocks. In such cases the coal is burnt and charred at the surface of junction and for some distance from it. The trap, too, finding less resistance in that direction, has often forced itself along the line of a coal seam, and so impregnated the mineral as to render it over large areas utterly useless for fuel. Nor has the intruding rock escaped reaction, being often itself so altered in appearance as to be nearly unrecognizable.

Following these enormous sheets of trap is a succession of beds of sandstone, shale, and coal, until the thin upper limestone, which occurred at the top of the Edinburgh field, is also met with here. No beds corresponding to our upper shales exist, but the millstone grit immediately succeeds the upper limestone and averages about 400 feet in thickness, interlaminated in some places with shale and fire-clay. As in this neighbourhood, it contains few or no peculiar fossils. The upper coals with their sandstones complete the series and correspond in position to those of our own field.

In conclusion, the marked difference between the aspects of the system exhibited in the two localities seems to imply a difference between their conditions of deposition. From the top of the Old Red Sandstone to the top of the millstone grit there is, in our Avon section, not a trace of igneous action, want of conformity, or of fresh-water deposits, and except one fault, having a throw of about 130 fathoms, no observable dislocation. The whole 4000 feet is a continuous marine formation embedding contemporaneous organisms. On the other hand the same system in Linlithgow and the Lothians exhibits 7400 feet of strata betraying rather fresh-water or fluvio-marine conditions of deposit. The fossil remains from the calciferous sandstones of Arthur's seat, the sandstones of Granton and Craigleith, and the shale beds of the middle limestone, are almost all those of land-plants, or of sauroid fish such as may have infested the brackish water of estuaries.* Only in the few thin limestone bands do true Mountain Limestone fossils occur—shewing that the species inhabited the neighbourhood, and serving to render their absence from the shales and

* The Lepidosteus and Polypterus, the only living Sauroid fish, are both inhabitants of fresh water; the former of the rivers of N. America, and the latter of the Nile and Senegal.—*Buckland's Bridgwater Treatise, p.* 274.

sandstones seemingly inexplicable on any other theory. As a general remark it may be added, that the middle carboniferous formations become less and less marine as they extend northward—the limestones of the south-west giving place to shales and coal seams, and thus showing a marked approach to the Scottish type above described.*

Appendix.

Specimens exhibited in illustration of the Paper.

Rhizodus Hibberti, with large laniary tooth and part of jaw, about 5 inches long, when perfect at least 6 inches.

Coprolites of Rhizodus.	Burntisland.
Megalichthys Hibberti. Scales, head-plates, jaws, and teeth.	"
Palæoniscus. Complete specimen, about 6 inches long.	"
Eurynotus crenatus. Detached scales.	"
Lepidodendron Sternbergii.	"
Lepidostrobus comosus and ornatus.	"
Sigillaria.	"
Stigmaria ficoides.	"
Sphenopteris affinis.	"
Nautilus.	Loanhead.
Anthracomya (Unio).	"
Cypris Scotoburdigalensis.	Burdie House.
Estheria Peachii.	Arthur's Seat.

The Megalichthys was not a fish of large size, as its name might lead one to suppose. The term was coined to designate a fossil now removed and established as a separate genus (Rhizodus). The teeth are of two sizes, as was the case with others among the sauroid ganoidians of that day; and the same is true of the Lepidosteus osseus, a living North American species. The enamelled part of the scale is divided from an unenamelled border by a deep furrow receiving a corresponding ridge on the adjoining scale. They are minutely pitted with here and there a larger and deeper depression.

Rhizodus Hibberti, formerly Holoptychius Hibberti. These genera have been thus distinguished by M'Coy. The species with large, thick, and

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* Since the above was read in January, a paper by Professor Hull, F.G.S., in the "Geological Magazine" for February, 1871, shews that the same change may be traced in the carboniferous limestones of Ireland, the limestones of the south giving place in the north to shales, coal seams, and bands of ironstone.

wrinkled scales and with teeth of uniform size form the genus Holoptychius, while Rhizodus contain those species, mostly carboniferous, having the scales thick and not wrinkled, and with teeth of two different sizes in the same jaw. The great laniary teeth of the latter equal in size those of the largest living crocodile and contrast strangely with the small ones at their side. There are four or five of these in each jaw and they strongly exhibit the peculiarities of the sauroid fish in their deeply fluted base, and the conical hollow at their root Their section is elliptical with a sharp cutting edge in front. The form of the fish is quite unknown, jaws and teeth being the only remains discovered.

II.

On some Gravels in the Valley of the Thames in Berkshire.

By E. W. Claypole, B.A., B.Sc.

Read at the Sectional Meeting, March 7th, 1871.

[Abstract.]

The table land of the Midland counties of England down the gentle eastern slope of which the Thames has cut its channel consists of the soft secondary rocks, the Lias, Oolite, Greensand, and Chalk, in succession. The Thames therefore takes an upward stratigraphical course and flows continually into newer and newer formations. Its tributaries, too, especially the upper ones, the Windrush, Evenlode, Cherwell, and Thame on the left bank, and the Kennet on the right, pursue a similar course and end in strata newer than those in which they rise.

The gravel beds about to be described lie in that part of the Thames valley situated where the river crosses the long narrow belt of chalk which, like the other secondary strata traverses England from north-east to south-west, and in the neighbourhood of the town of Wallingford. This ancient borough stands on the left bank and in the hollow of the chalk along which the river flows. The breadth of the valley in this locality is from one to several miles, measuring from the Chalk Downs on one side to those on the other. The slope is usually gentle on both sides. The tops of the hills consist of the upper white chalk with flints, and their bases of the lower chalk or the chalk marl. The former, a pure carbonate of lime, graduates slowly and imperceptibly down into the latter, less white and more argillaceous, and this again into the underlying chalk marl. As the proportion of clay increases the rock becomes less pervious to water, so that while none at all can be obtained from the upper strata, both the lower are exceedingly retentive. In many of the high-lying farms the whole supply of water for every purpose is obtained from rain stored in tanks at the surface, and, as may be imagined, a hot summer is an exceedingly trying time to the stock and sheep owners of this largely pastoral district, who often lose many out of their flocks in such seasons from want of water. The few wells that have been sunk to the water-bearing strata are sometimes as much as 250 or 300 feet in depth. At a lower level we find the more argillaceous strata turned up by the plough and in some spots retentive enough to afford springs. In the locality now to be described they form a wide terrace on which lies a bed of gravel of considerable thickness. It is the great store-house of road-metal for the neighbouring parishes and as a consequence the quarry now covers many acres of ground. It consists solely of sharp, broken flints, and well rounded flint pebbles, with a red siliceous sand in large proportion. It is not worked to a greater depth than 12 feet and the labour consists solely in screening out the stone from the sand which is then thrown back and often sown with corn.

It is evident from the sharpness of these flints that they have not been moved far from the place where they were broken and there is no room to doubt that they are the remains of thick beds of upper chalk once continuous over the valley. The mass of carbonate of lime removed must have many times surpassed that of the remaining flints, yet the former has entirely disappeared while the sharp edges of the latter have not been rounded. The gravel seems to have no organic remains of its own but some belonging to the chalk are to be met with. The commonest are *Ananchytes ovatus*, and a *Spatangus*, of course silicified. I have several times searched the quarry for flint implements but in vain. Hundreds of chips and flakes may be met with which might easily pass as artificial but I have never found one that I could say was not perfectly natural.

At a rough estimate this, which may be called the upper gravel, lies not less than 200 feet above the river.

At a lower level and on the other side of the Thames, much nearer to the present stream, is exposed in several places another, which may be termed the middle gravel, so different in its composition that the two cannot be confounded. Its composition is various, not uniform, as was that of the preceding. Flint is still the chief, but not the sole constituent, and the fragments are less sharp. Bits of the lower chalk also occur and the same red siliceous sand as before. Besides all these there are found a large number of hard quartzose pebbles of that kind so well known to every worker in new red sandstone districts such as that round Birmingham. Their weight varies from about 10lbs downwards, but a few occur, rounded like the rest, but at least ten times as large. Flint fossils from the upper chalk might be expected here but I have never seen any. Probably they are so ground down as to be unrecognizable, and the gravel seems to contain no organic remains of its own. I have heard that large fossil bones have been met with in this quarry but have not been able to find any sufficient authority for the assertion. It is not improbable, and further enquiry might be more successful. The level of this gravel above the river does not probably exceed an estimated height of about 80 feet.

At a short distance below this is found almost everywhere along the valley, a third, which may be termed the lower gravel. This again, may be at once distinguished from both the others: it is made up of pebbles, generally small, of flint, quartzose stone, lower chalk, sandstone, and other materials, with water-worn shells in large quantity from various formations. This last component always seems to mark it out from either of the others. The fragments are not easily recognized but the following I have been able to identify with tolerable certainty:

Ostrea deltoidea.—Oxford clay.
——— gregarea.—Coral Rag.
Gryphaea globosa.—Lower chalk.
———— conica. ,, ,,
Belemnites.—Lias, &c.

In digging out the ground for the foundation of a new County Lunatic Asylum, near Wallingford, a good opportunity was afforded of examining the gravel. The surface soil, 5 feet thick, was first passed through and next 4 feet of yellow sand full of comminuted shell too small to be recognized but seeming to belong to Paludina, Cyclas, and perhaps Lymnaea. The underlying gravel was removed to the depth of 3 feet, and the foundations then laid. I could not ascertain the exact thickness but the well, 40 feet deep, was sunk quite through it, and some small depth into the lower chalk or chalk marl below. Abundance of water lies at the base of the porous gravel, the well yielding about 2000 gallons an hour.

At a short distance from the spot a trial pit was sunk and in the course of the work a fragment of bone was thrown out consisting apparently of the end of a tarsus of a species of Bos. I also found another small piece among the gravel thrown out of the pit shortly afterwards. Both were so far mineralized as to adhere strongly to the tongue. The foreman of the works told me that at the bottom of the same hole and lying on the surface of the chalk a deer's horn was found which he gave me, saying it was of no use to him. It is a perfect antler of the red Deer and though found below the other specimen, has a very recent appearance. This, however, is not very difficult to explain; the bits of bone may have been brought down from some earlier deposit and laid with the gravel on the top of the horn, which was probably lying at the bottom of the river at the time.

This gravel so closely resembles that in the present river-bed as to be undistinguishable from it except by the absence of recent shells such as Anodon, Unio, Cyclas, and Paludina. If the comminuted shell observed in the sand-bed mentioned above really belongs to these species, even this mark of distinction fails, for such shells would, probably, not be preserved in the gravel-beds even if contemporaneous with them in age. Finally, the flat ground on the margin of the river consists of an alluvial clay or loam in some places perhaps 10 feet thick but generally much less. The stream itself as well as the brooks that enter it in this district all lie upon the gravel—the clay, if it ever occupied this space having been entirely removed.

The above is a short account of a series of deposits remaining like so many ancient monuments to indicate, rather than record, the history of the valley of the Thames. To attempt a full explanation of their origin and position would be premature and could only result in raising a host of serious objections. A few inferences from the facts given may not however be out of place.

There seems to be no evidence of marine action in the valley. The upper and middle gravels could hardly contain the angular and sub-angular flints now found in them had they been formed on a beach and exposed to the wearing action of the waves; they would then be rounded and waterworn. This does not necessarily imply that the sea has had no share in the excavation of the valley. Its beginnings were in all probability the result of marine erosion on an emerging land, and banks of pebble may have been left by the retreating waves; if so, the smooth, well rounded flints may be their only existing relics, the banks themselves having been totally destroyed by subsequent river-action, otherwise these pebbles must have been rounded by being rolled for a distance in the bed of the stream.

The infancy of the Thames must be traced back to the time when it trickled, a tiny rivulet, over the tide-washed fore-shore of the emerging chalk. In so soft a stratum erosion is rapid and on a rising land every ebb is on the whole a little longer than its corresponding flood, and has therefore a slight advantage in carrying out to sea the excavated material. The volume of water increased with the elevation of the ground, and the excavation of the channel would go on rapidly until the velocity of the stream became retarded by its diminished inclination. A brook if left to itself is incessantly leaving its old bed and cutting a new one, as slight observation is sufficient to show. In this way a bank of shingle and sand deposited at one time is often undercut, carried away, and re-laid elsewhere on a lower level, at another. The existing beds, therefore, may be merely the relics of larger ones formed by the river at different times and places along the valley. Nor is it necessary to assume that the volume of water when this took place was very much larger than now. It may have been so, but evidence of the fact is wanting. Large rivers are less effective than smaller ones in moving gravel. A certain velocity in the stream is required which cannot usually be maintained except when the volume of water is small. Moreover, how swift soever the current of a great river may be in the middle and at the surface, yet at the bottom and sides the movement is always sluggish owing to the friction against the bed and the banks. Its carrying power is thus reduced and few rivers of any large size are capable of cutting away and removing anything larger than fine mud. Even a small stream must be watched in flood in order to be convinced of its eroding power, for the amount actually carried down at any other time is quite insignificant.

On this view a regular succession of gravels must have been deposited at varying heights along the valley. These may however have been since then almost entirely removed and consequently the now existing relics may be very different in age from one another. This difference is also indicated by the presence of the quartzose pebbles in the middle gravel and their absence from the upper. The natural inference is that during the interval this kind of stone, a stranger to the district, had been brought in from some foreign source. In reference to this point, the following extract may be of interest:—

"These hills (Bromsgrove Lickey) are the source whence the pebbles met with in far distant places have been drifted. 'They are accumulated,' says Dr. Buckland, 'in immense quantities over the plains of Warwickshire and the Midland counties and are found also on the summits of some hills in the neighbourhood of Oxford and in the valley of the Thames from Oxford downward to its termination below London.'"*

The date therefore of their introduction into the valley must be placed somewhere in the long interval that elapsed between the deposition of the upper and middle gravels, and the means may perhaps be found in the river Cherwell which rises in the district referred to by Dr. Buckland and joins the Thames at Oxford. Beds intermediate in age would most likely be met with on further search which would show that these pebbles occur in increasing numbers and determine more exactly the date of their first appearance The presence in the lower gravel of fossils from the Oxford clay, coral rag, and the lower chalk, and probably also from the lias must be accounted for. Without attempting to offer a decided opinion the writer thinks that the following suggestion may not be quite beside the mark. Assuming that the chalk and green sand were once much more extensive than at present and that they overlapped the formations lying to the west, the beds of the Thames and its tributaries would, when at a higher level, be entirely in that formation.† Consequently only chalk fossils would be met with and most of these being brittle would be destroyed before they had travelled far down the stream. The same would happen to any derived from other systems over which the river passed in its earlier stages. But when, in its eroding process, the river had cut down into the Coral Rag and Oxford clay near Abingdon, the organic remains of those formations would be washed into the stream and might well be found, much worn but not destroyed, at the distance of a few miles only. And in the same way liassic fossils if present may have been brought in by the Evenlode, which has worn its way down to that system along almost its entire course. If this be the true cause of the presence of these shells in the lower gravel, intermediate beds may be looked for by which the date of their introduction may be more exactly determined.

In fine, the alluvial loam without shell may be a result of the slackened current which must at length ensue on the continued erosion of the stream, or, as seems equally if not more probable, it may be the product of the almost annual floods to which this river, like most others, is subject in the winter. At all events there can be no doubt that the carrying power of the Thames for anything larger than silt has long ago dwindled down almost to nothing.

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* "All round the Wrekin."

† There are many facts that tend to prove this: the presence of chalk-flints where now no chalk is found; the projection of these strata to the west in Buckinghamshire; and particularly the outlier of green-sand and flints at Orleigh Court, near Bideford, 43 miles from the nearest corresponding beds at Blackdown.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

MAY TO DECEMBER, 1871.

GENERAL.

I.

Mustard and the Mustard Plant,

By W. W. Stoddart, F.C.S., F.G.S.

Read at the Geueral Meeting on October 5th, 1871.

Perhaps of all the phenomena which come under the daily notice of the student of natural history none is more interesting than the power which certain groups of plants possess of elaborating powerful principles possessing strongly marked effects on the animal economy. Although all feed alike on the same mineral and gaseous elements, yet the products have the strangest variety and opposite properties. Some select sulphur, some nitrogen, some produce the most potent poisons or the most delightful flavours, whilst others only offer the most disgusting odour and repulsive taste. For instance the Solanaceae, the Umbelliferae and the Rubiaceae may all be grown in the same soil and nourished under exactly the same conditions, and yet one will yield the deadly belladonna and the nutritious potato; the second will yield the grateful caraway and the disgusting assafœtida; from the third will be produced the refreshing coffee and the strengthening quinine.

A very remarkable example of the natural selection of chemical principles exists in the group of plants to be noticed this evening, viz.: the Cruciferae or Cressworts. This order comprises the cabbage, mustard, cress, turnip, horse-radish and seacale. No matter where you set them to grow they invariably separate large quantities of sulphur and nitrogen, as may be painfully demonstrated when the plants are decaying, or when the cook is emptying the saucepan in which cabbages have been boiled. None are poisonous and nearly all are in some way or other used as adjuncts to our food, and possess strongly marked antiscorbutic and stimulating qualities.

The order derives its name from the peculiar and constant cruciform type so conspicuous on the flowers. They invariably have a quaternate arrangement. The Corolla has four petals and the Calyx four sepals. Although the stamens are six in number yet only four are long. One of the most useful of the Cressworts is the mustard plant, the seeds of which when powdered form (or ought to form) our table mustard.

No article of food however is more adulterated, and seldom can this condiment be met with at the dinner-table with even a moderately pungent taste. At an examination before the parliamentary committee some of the witnesses plainly admitted that the adulterants used were wheat-flour, turmeric, capsicum, ginger, pepper, potato-starch, plaster of Paris, charlock, pea-flour, radish and rape seeds, linseed meal and yellow ochre. In short, if the microscopist wants a little experience he cannot do better than get a few samples of so-called mustard, such as those on the table and purchased at some of our Bristol shops. Many of these when burnt give from 30 to 50 per cent. of ash while the genuine seeds only yield about 5 per cent. In manufacturing our common flour of mustard the seeds of the black and white mustard are crushed and powdered in mortars and sifted. Four qualities are supplied to the trade, viz.: seconds, fine, superfine, and double superfine; the last is the purest though seldom kept by the grocer.

The black seeds are the principal ones used in the manufacture, but for reasons presently to be stated the white ones are advantageously added. Our housekeeper when mixing the table-mustard little imagines what interesting chemical reactions are taking place in the cup, by which the pungent taste so much admired is developed. For strangely enough the essential oil does not pre-exist in the seeds at all, nor have the seeds the slightest warmth before the addition of water.

Before entering upon and describing what takes place when the mustard pot is filled, it will be better to describe the two species of mustard plants which furnish the seeds in question. The first and most important is the Sinapis nigra (Linn.) or black mustard. The plant occurs frequently in the neighbourhood of Bristol in waste places and on the banks of hedges. In some botanical works it is described under Boissier's genuine name

"Brassica." The black is distinguished from the white by being nearly smooth. The pod too is very different, being destitute of the long flattened beak.

The seeds contain three most important constituents:—a fixed oil, myrosin, and myronate of potassium. When the seeds are subjected to pressure they yield about 23 per cent. of a yellowish brown oil which does not easily turn rancid. Generally the oil is obtained from the dressings. Myrosin is a nitrogenous ferment, and performs the part in mustard that synaptase does in the almond. Like albumen, myrosin is coagulated by heat. The myronate of potassium is a crystalline substance soluble in water. About 90 grains may be obtained from 2 lbs of seed. Now when myronate of potassium is mixed with the myrosin and water added, the essential oil of mustard is instantly developed. We can now readily understand the changes that take place when table-mustard or a poultice is prepared. The water dissolves the myrosin, sets it at liberty to act upon the myronate of potassium, and from its decomposition the essential oil is formed. Acids, alcohol, and heat retard this change, so that the popular notion of preparing mustard for the table or a poultice is a great mistake. Cold or slightly warm water and time are the true and scientific means. When making the French preparation with vinegar, the oil should first be developed with cold water and then the vinegar added, because when the oil is *once formed* acids do not alter its properties.

Black mustard was formerly cultivated very extensively near Durham, where the manufacturers in 1720 gained great fame, in consequence of having found out a method of separating the dark coloured husk from the interior of the seed. It is still grown in Yorkshire, Essex, and Cambridgeshire. The seed is sown in March and the plants gathered in September, In a good year an acre of land will produce between 24 and 28 bushels of seed, the price ranging from ten to twenty shillings per bushel. It is a very exhausting crop and requires a very rich soil.

The white mustard (Sinapis alba Linn.) is found in the same locality but in greater abundance than the black. It is easily known by the pinnatifid leaves and differently shaped pods. The most singular difference however is in its chemical composition. It contains the fixed oil and myrosin, but no myronate of potassium, and therefore cannot in any way produce the essential oil and consequently the pungency which we like with our roast beef. The myrosin or fermentative substance is however much more abundant in the white, and this is the reason why a mixture of the white and black seeds is better for dietetic use than the black alone, viz., by furnishing a more plentiful supply of the myrosin for the decomposition of the myronate of potassium in the black seeds. It may be observed that the white seeds have a slightly sharp taste but this is caused by the action of the myrosin upon another salt called the sulpho-cyanide of sinapin. It is an *acrid* but *not a volatile* principle.

The structure of the white mustard seeds is most interesting under the microscope, and essentially different from that of the black. The seeds have a husk built up with three layers of cells or tunics. The exterior tunic consists of a transparent series of hexagonal cells $\frac{1}{435}$in. broad, and $\frac{1}{320}$in. long, and united to each other by a corrugated cell wall. In the centre of each is an aperture surrounded by an elastic spiral fibre from which a long tube passes from the interior to the exterior. When wetted with water this elastic apparatus springs forward, projecting from the surface like the school-boy's "jack-in-the-box," carrying with it the tube from which flows a thick mucilaginous fluid. It is distinctly different from the well-known spirals of the Collomia, but rather resembles the cushion springs of the upholsterer, covered with an exceedingly fine membrane. It is best seen by the aid of polarized light and a blue selenite stage. This curious compound cell is totally absent in the black mustard seeds. The other two tunics are simply layers of irregular cells. The interior of the seed is composed of cells containing a large quantity of the fixed oil. There is no starch in any part of the seeds, therefore if any effect is produced on Iodine an admixture of wheat or some other flour will be readily detected.

The white mustard is of more recent introduction than the black, and almost any soil is adapted for its growth. An average yield is from 30 to 40 bushels of 50 pounds each per acre, the usual price being nine and sixpence per bushel.

The chemical nature of the essential oil of mustard recalls to our thoughts a singular fact in the history of the human race. Many nations having no connection with each other and having no means of communication have instinctively chosen certain plants as food which although totally differing in outward appearance, all contain a chemical principle identical either in composition or qualities. Thus for instance in the eastern hemisphere the Chinese have their favorite tea and the Arabian his coffee. In the western hemisphere the Brazilian has his holly and the Mexican his cocoa. All these vegetables contain thein, or a similar substance. They, like the modern Australian gold-digger, without knowing the reason why, found out that an infusion containing thein is a better support under physical exertion than beer or fermented beverages. In our own day we have a good example of this natural selection. We can hardly take up a newspaper or magazine, or walk into a shop without seeing Liebig's extract of beef staring us in the face. Most people have used either that or the old fashioned beef tea, and have found it invaluable in times of sickness from its marvellous reviving properties. They have regularly taken it from simple experience, but at the same time without having the slightest knowledge as to how the beef tea does so much good, and the consequence is that almost every one thinks that beef tea is nutritious. It is however not so, for a healthy person would as certainly starve if fed only on that valuable preparation as if he were fed only on arrowroot or isinglass. Just like the tea, holly, coffee and cocoa, it only diminishes the wear and tear of the bodily organs, and we can live a great deal longer without ordinary food with an infusion of these plants containing thein or the extract containing kreatin than we can without.

The same observations apply to our use of mustard. The essential oil of mustard is a chemical combination of sulphur and a base called allyl, and owes its flavour entirely to the last mentioned substance, and it is very remarkable to observe how different nations as distantly separated as those before mentioned have selected the very plants containing allyl for the purpose of giving a favorite relish to food, notwithstanding that the allyl compounds are extremely disagreeable and offensive in the pure state. Indeed in every part of the world the garlic flavour seems to be a general favorite: the Welshman likes his leeks; the Englishman his horse-radish and mustard; the Spaniard his onion and garlic; the Asiatic his assafœtida; the Brazilian his Pitiveria and Sequieria. And all these have compounds of allyl in some form or other. The Israelites of old when leaving Egypt exceedingly regretted the loss of their leeks and onions.

In the onion and garlic the allyl exists as a simple sulphide, and in the mustard and horse-radish as a compound of sulphur and cyanogen. How strange and inexplicable it seems then, that the simple and instinctive preference for a substance like this contained in a minute seed should become the source of an immense trade and give employment to many thousands of the working classes.

II.

The Natural Phenomena and Productions of the Polar Regions,

By C. F. Ravis.

Read at the General Meetings on May 4th and November 2nd, 1871.

[Abstract.]

The discoveries of this century in the Arctic regions began with the voyage of Captain Ross in 1818. With two vessels, the second commanded by Lieutenant Parry, he reached the head of Baffin's Bay and entered Lancaster Sound which was invitingly clear of ice. But after pursuing the course of this great channel for about thirty miles, he too hastily judged the passage impracticable, and abandoned the enterprise. Parry, who happily did not share in the views of his Commander, was the following year appointed to the command of another expedition which following upon the track of the former reached the group of islands named by him "North Georgian Archipelago" but now generally "Parry Islands" and wintered there, having added to the chart of the Arctic regions both shores of Lancaster Sound and the northern part of Prince Regent's Inlet. Unable to penetrate much farther west in the following summer he returned home. The next year Parry and Lyon made another attempt by way of Hudson's Bay. This voyage occupied two years and resulted in several additions to the maps, but the passage remained undiscovered. In May 1824 Parry sailed again with the *Hecla* and *Fury*, attempting the passage by Prince Regent's Inlet, but the *Fury* being wrecked through the pressure of the ice upon a rocky coast he was obliged to return home leaving the stores of the lost ship upon the coast carefully stored and available for any future expedition needing supplies. Thus ended the three memorable voyages of Sir Edward Parry in search of the north-west passage.

Meantime Lieutenant (afterwards Sir John) Franklin in company with Dr. (afterwards Sir John) Richardson reached the shores of the Polar Sea over the American continent, explored its coast a considerable distance and after a most disastrous return journey reached York Factory on Hudson's Bay after an absence of three years, having travelled by land and water 5550 miles. Three years later we find these two great enterprising men again upon their travels. This time they descended the Mackenzie River to its mouth and explored the shores of the Polar Sea westward to longtitude 150° and eastward to the mouth of the Coppermine.

From 1829 to 1833 Captain Ross and his nephew James Clark Ross were shut up in Prince Regent's Inlet. Leaving their little vessel hopelessly fixed in the ice, they made their way by slow degrees along the shore to the northward, living upon the provisions left by Parry from the wreck of the *Fury*. The expedition eventually escaped in an open boat into Barrow's Strait where the crew were picked up by a whaler. In this expedition the shores of Boothia were explored, the Isthmus crossed to the Western Sea, and the position of one of the magnetic poles ascertained. This grand discovery was made by Sir James Clark (then Commander) Ross. The journeys and voyages of Captain Back and of Messrs. Dease and Simpson added much to our knowledge of the northern parts of the American Continent. These explorations and those of Dr. Rae left but a small portion of these coasts undetermined, and paved the way for the great expedition under Sir John Franklin, by demonstrating that the passage between the two oceans must be sought for farther north. The last voyage of this great commander commenced under the brightest auspices but ended in the most calamitous manner possible. Little indeed is known of the details of the voyage or of the movements of the large company of 129 persons who entered the Arctic regions with such high hopes, since not a soul ever returned to tell the tale of their adventures. Such information as we have has been obtained in the course of years from the researches of some of the numerous expeditions which have gone out expressly to endeavour to solve the problem of the fate of the lost ones. Entering Lancaster Sound the *Erebus* and *Terror* passed up Wellington Channel and returned by Crozier Channel to Barrow Strait. Passing their first winter that of 1845-6 at Beechey Island and on the mainland adjoining (where many relics of the missing expedition, including the grave of three seamen were found in 1850) their probable route as ascertained by Sir F. L. McClintock was down a newly-discovered channel between North Somerset and Prince of Wales Island, since named Franklin Channel. This Channel leads directly to the western shores of Boothia, reached previously by Ross, and to the northern and western shores of King William Island, the southern coast of which was reached by Dease and Simpson from the west, and thus the honour of the first discovery of the long-sought-for north-west passage must be assigned to Sir John Franklin's expedition, although in ignorance of the fact it was subsequently bestowed upon Captain McClure, the undoubted discoverer of another of those north-west passages, many of which are now known to exist between the numerous large islands which occupy this part of the Arctic Zone; and the first Arctic explorer who actually passed over the Polar Sea from one ocean to the other, entering the Arctic circle from the Pacific and returning home by the Atlantic, not however accomplishing the passage in his ship but partly over the solid ice.

Beset in September 1846 by ice in about latitude 70° the *Erebus* and *Terror* were abandoned in April 1848 after drifting 19 miles south, Sir John Franklin having died on the 11th June 1847. The crews under Captain Crozier appear to have attempted to reach the American Continent over the ice and to have perished on the way, most probably from hunger. The prolonged absence of this expedition gave rise to many others to ascertain its fate and to these belong the honour of most of the subsequent geographical discoveries in these regions.

The author next proceeded to describe the natural phenomena of the polar regions beginning with Ice.

The polar year consists only of summer and winter, their limits being determined by the breaking up and re-formation of the sea-ice. The breaking up of the winter ice is sometimes accelerated a month or two, or delayed an equal length of time by circumstances the causes of which are unknown. In August 1838 Dease and Simpson found the sea about Coronation Gulf a mass of fixed ice and could only progress on foot along the shore, whilst the following year a month earlier they ran past the same coast with a fresh breeze, a flowing sail, and an open sea. The great mass of the sea-ice does not remain stationary through the winter and melt away in summer but is in constant though slow motion, mostly in the direction of the lower latitudes where it is finally broken up and dispersed. Captain Back in the *Terror* was helplessly borne along amidst the most frightful commotion of the surrounding ice, from Repulse Bay through Hudson Strait, until liberated after many months in Davis Strait. The wonderful drift of the *Fox* down Baffin's Bay from August 1857 to April 1858, by which McClintock was delayed a whole year in his search for the Franklin expedition, was another illustration of the above fact.

The immense floating masses called icebergs consist of fresh water ice formed on the coasts and broken off by the action of the waves. The rocks of ice from which they have been severed are huge glaciers advancing far into the sea. When the buoyant power of the ice overcomes the attraction of cohesion masses break off at the bottom of the sea and rise to the surface in the form of bergs. As they float with only a tenth of their bulk above the water, the rate of movement of the glacier, the distance of its front from the sea, and the depth of the water near the shore have been made the elements to determine the date at which the first berg will be floated off. If this be the true theory of icebergs, their extraordinary abundance in the Antarctic Seas will suggest large tracts of land in the south frigid zone.

The Aurora stands pre-eminent amongst the atmospheric phenomena of the polar regions. Captain Hall alludes to some peculiarities respecting it not generally known. It was attended by the kind of clouds named cirro-cumuli, and the auroral beam illuminated the face of the cloud, proving that it was at play between the cloud and the observer. This writer mentions as the most remarkable feature he ever witnessed the peculiar movement of the clouds overhead, which was by hitches, passing with the wind slowly and then stopping for a few seconds. It seemed as if the clouds were battling with an unseen enemy, but that the former had the greater power and forced their way by steps along the vault above. The observer felt sure the aurora had something to do with it. Dr. Walker, Naturalist to McClintock's expedition, also expresses his conviction that on several occasions the aurora was only a few feet above the vapour rising from the sea.

McClintock, Simpson and Kane all refer to the connexion between the aurora and clouds, and think the former is never seen in a perfectly clear atmosphere. Most observers have negatived the idea of the accompaniment of sound, but Mr. Simpson was convinced of the fact upon what he considered good evidence.

The discovery of the position of a magnetic pole by Sir James Clark Ross claims some notice. Previous calculation had nearly determined its place and it was most interesting to find as the actual place was neared that the horizontal needle ceased to move and the dipping needle became more and more nearly perpendicular until it showed a dip of 89° 59′, only one minute from the vertical. This was in latitude 70° 5′ 17″ N. and longitude 96° 46′ 45″ W. Fifteen years later the same discoverer made the nearest approach ever effected to the place of the south magnetic pole, determining it to be in about 155° E. long. and 75° S. lat.

The phenomena of cold and darkness during the Arctic winter claim attention. The effect of a fall in temperature to —50° or —60° Fahrenheit is shown by the tendency to sleep, and in its worst form exhibits itself in loss of reasoning power, memory and every mental faculty. Dr. Kane narrates several instances of this species of insanity among his men, and was himself to some extent the subject of it. The influence of the long intense darkness is described by the same writer as most depressing. Even the dogs were strangely affected by it and many died, as he thinks from the absence of light as much as from the extreme cold.

The effects of refraction are particularly noticed by Arctic voyagers. The immense amount of evaporation constantly going on during the summer from the melting of the ice, produces an unusually humid condition of the atmosphere on and near the surface, a state of things eminently favorable to the phenomenon of mirage, of which many very interesting instances are on record. Akin to this phenomenon are those of mock suns and moons, both very common in these regions. These in combination with halos are sometimes seen for many hours together and are attributed to the presence in the atmosphere of innumerable spiculæ of ice, forming so many minute points of reflection and refraction. They are most common in the winter months, alternating with dense fogs which for days together conceal every distant object upon the surface of the earth and sea and quite shut out the glories of the heavens.

The question of an open polar sea has been much discussed during the last few years, and many circumstances have contributed to foster the opinion that such an open basin exists in the vicinity of the north pole. Drs. Kane and Hayes succeeded, the former by one of his sledge parties and the latter in his own person, in reaching an open sea perfectly free from ice in latitude 80° and 82½° respectively, whilst their ships were frozen up 300 miles to the south. Subsequent exploration by a German expedition fully confirms this discovery.

The third part of the paper was occupied with a rapid review of the animal life of the Arctic regions. This is by no means so scarce as might be expected, except during the depth of winter. In the summer the seas and lakes, the rivers and plains teem with life. The birds are innumerable, swarming on the sea-cliffs and on the borders of the streams where they arrive in the early summer to hatch and bring up their young, and whence they migrate on the approach of winter to more congenial climes. The marine Mammalia crowd the bays and inlets of the Arctic coasts, and the land quadrupeds wander in immense numbers over the plains, now covered with verdure and bright with summer flowers. The most important members of this order were noticed and their habits briefly described. Of the Whale kind the Balæna mysticetus of the Greenland seas, the *Physeter microps* or Sperm Whale of the Southern Ocean, the White Whale *(Delphinapterus Beluga)* and the Razorback *(Balœna physalis)* were particularly mentioned.

Of all the Cetaceæ, none is more curious than the Narwhal, *(Monodon monoceros)* with its enormous tusk or horn projecting from the snout in a straight line with the body, which has given to the animal its common name of Sea Unicorn. There are in fact two tusks, but that on the right side is usually rudimentary. This appendage belongs to the male animal only. It is from five to ten feet long, tapering to a point and with a spiral twist through its whole length.

The Seal is the most valuable of all Arctic animals to the natives, as it supplies them throughout the winter with food, clothing, light, and fuel. The sagacity of the Seal-hunter is taxed to the utmost in its capture, as its senses of hearing and smell are remarkably acute. The animal is caught either by watching a Seal-hole at which it comes up through the ice to breathe, and by striking it through the head with a spear, or by following the chase upon the open water in the native "Kayak" or skin-canoe. The former process entails great privations upon the hunter, who is frequently out for several days and nights at a time in a temperature of —50° Fahr. The principal species of Seal inhabiting the Arctic regions are the Common Seal *(Phoca vitulina)*, the Rough Seal *(P. fœtida)* and the Great or Bearded Seal *(P. barbata.)* The Seal is carnivorous, feeding on fish, crustaceæ, and water-fowl.

The Walrus or Morse far exceeds in size the largest Seal, being sometimes 20 feet in length. It is gregarious in its habits, large numbers being frequently seen lying in heaps upon floating ice. It uses its tusks to aid its movements in climbing or dragging its unwieldy body from crag to crag. It lives on fish and marine vegetation. The hide of the Walrus supplies the Esquimaux with the best material for their sledge-lines, the flesh forms a large portion of their winter and spring food and the blubber is used for their lamps. Both the Seal and Walrus are known to swallow large quantities of gravel and stones, but what purpose this serves is unknown.

Of quadrupeds the Polar Bear *(Ursus maritimus)* for his great strength, activity, cunning and ferocity is pre-eminent. This animal is the terror of all smaller and less powerful tribes whether terrestrial or aquatic, as he is equally at home on the land, in the water and on the ice Exploring parties suffer much from his attacks upon their caches of provisions, which though constructed with great care and labour generally fall an easy prey to these tigers of the ice. Captain Hall states, on the authority of the natives, that the Bear in his conflicts with the Walrus ascends the cliffs and hurls enormous stones upon the head of his prey, fracturing the skull. Most writers agree that he does not attack man except when provoked or wounded, and McClintock says no instance is known to the contrary.

The Glutton or Wolverine *(Gulo luscus)* is allied to the Bears, Badgers, Otters, and Mustelidæ. Old authors have told wonderful tales of its climbing trees and pouncing upon the backs of Reindeer and Elks as they passed beneath. It is no doubt extremely voracious, but modern travellers assert that its attacks upon the larger animals are chiefly made upon them during their sleep, or upon weak or dying deer or young fawns. It is extremely mischievous, and a great pest to the hunters and trappers of the fur countries by destroying their traps for the sake of the bait. Its strength is prodigious. It has been known to disarrange piles of wood among which were trees that had required two men to lift them.

The Esquimaux Dog *(Canis familiaris. var. Borealis)* is well known. His sagacity in the chase, his patience and perseverance in the sledge-team and his great speed, render him an invaluable possession to the native inhabitant or the more civilized explorer of the northern regions. Though generally treated with harshness by their masters and often half-starved they seldom rebel against human authority. They will attack the Bear and every other animal except the Wolf, to which they have a great antipathy.

The Wolf is one of the tyrants of the northern parts of the world, and is found in both hemispheres. Its great strength, rapidity of movement and savage disposition render it the terror of all animals inferior to itself in these qualities. Its strength and courage even after being wounded are the subject of many interesting anecdotes by writers on northern research and adventure.

The resemblance between the Wolf and the Dog has been noticed by many writers. Cases are on record in which dogs have themselves mistaken wolves for animals of their own species and have fallen victims to the delusion. Dr. Kane says "There is so much of identical character between our Arctic Dogs and Wolves, that I am inclined to agree with Mr. Broderip, who in the 'Zoological Recreations' assigns to them a family origin. Both animals howl in unison alike. Their footprint is the same, at least in Smith's Sound. Dr. Richardson's remark to the contrary made me observe the fact that our northern dogs leave the same 'spread track' of the toes when running, though not perhaps as well-marked as the Wolf's."

The Arctic Fox *(Vulpes lagopus)* is found in both hemispheres. It has a fine fur, bluish gray in summer and pure white in winter. Its habits are gregarious, twenty or thirty burrowing together. It is easily taken in traps and tamed without difficulty. It is said that this little animal hunts with the Bear, and "It is certain," says Dr. Kane, "that they are often found together, the Bear striding on ahead with his prey, the Fox behind gathering in the crumbs as they fall."

Of the few strictly herbivorous animals that inhabit or frequent the Polar regions, the Reindeer *(Cervus tarandus)* takes the foremost place, both from its size, its numbers, and its utility to man. The animal itself as well as its habits are too well known to need description. In their migrations they go in large herds. Franklin states that in a short morning walk near Fort Enterprise in the month of October he saw upwards of two thousand.

The Moose Deer or American Elk *(Alces Americanus)* is the largest animal of the genus. It is higher in the shoulders than the Horse, the neck is short and strong, adapted to bear the large horns which weigh sometimes nearly fifty pounds.

The gait of the animal is a kind of shuffle and the joints crack at each step with a loud noise. It is said to trip occasionally and throw itself down by treading with its hind feet upon its fore hoofs.

The Musk Ox *(Bos moschatus)* which ranges over the barren lands of America north of the parallel of 60° is about the size of one of our Highland cattle. Its horns are of a peculiar form and cover the brow and the whole crown of the head. These animals live on grass and lichens, the country being destitute of wood except some spruce trees on the banks of the larger rivers. They are not found in the eastern hemisphere, nor in Greenland, Spitzbergen, or Lapland. They assemble in herds of 20 or 30 and will sometimes attack a man and endanger his life.

Notwithstanding what has been stated as to the annual migration of the Deer and other Arctic animals, it is nevertheless doubted by many Arctic explorers whether they do migrate at all. It is certain that several expeditions found even in the depth of winter large numbers of Deer in various parts of the frigid zone, and it was the opinion of Parry that only the darkness prevents their being seen all through the winter. What they live on is a mystery, and indeed the animals found at that season are very lean. It seems probable that where migration is easy as on the Continent of North America, it may be the habit of these animals to seek a more genial climate, from the rigours of an Arctic winter, whilst in more isolated situations they may from the force of circumstances remain permanently on the spot.

The remainder of the paper was occupied with a short account of the Birds which frequent or visit the Arctic regions.

III.

Among the Forest Giants of Australia.

Read at the General Meeting on December 7th.

By the Hon. Secretary.

Such is the heading of an article by Theodore Müller in the *Gartenlaube* of November, 1871; and as it is of sufficient interest to the natural historian to deserve being brought before this Society, I take the liberty of giving you a translation of it.

"The bright afternoon sun, towards the end of an Australian summer, was sending its burning rays from a cloudless sky, and we who had been wandering since an early hour in the morning, had had the full benefit of his more than genial warmth. Since our yesterday's encampment we had passed through park-like parts, crossed considerable mountain chains often without any path or track to guide us, and now we had gained the summit of the last mountain ridge before the goal of our journey.

"High gum trees mingled with stately tree ferns surrounded us, whilst the declivity of the mountain before us was robbed of its robe of trees by the axe and by fire. Below in the dale a small clear brook "Olinda Creek," flowed in its winding bed, and farther still a small homely, comfortable-looking settlement, with its orchards and vineyards extended for some distance.

"Scenes like this one were familiar to us, and it was not this which rivetted our gaze; for there below in the valley began the reign of the mighty forest giants.

"From the foot of our mountain extended a verdant meadow, only separated by the brook just mentioned, and on the other side of it towered up like slender masts, tree after tree, each rising high towards the azure blue sky above us. Often and often I had seen during my Australian wanderings many a giant of the forest, but never yet a forest of such gigantic trees.

"We went or rather leapt down the steep forest path and our 'Halloo' and 'Coo-eh'—this latter the usual far-reaching cry of the natives—sounded clear and far into that forest temple opposite to us, under whose deep shadow we soon were walking. Never shall I forget the impression the surroundings made upon me and my companion. These gigantic slender trees, the twilight of the forest, the solemn, awful silence, our almost noiseless walking, produced a feeling such as one can only possess when surrounded by nature in her grand wild garb.

"Suddenly the forest opened and we passed some wood-cutters' huts, which were standing upon a wide, already cleared space. Children and dogs were jumping around us and the contrast was all the greater as scarcely a thousand steps away that high majestic forest was beckoning across to us. On we went up an incline and again we were surrounded by that awful, solemn silence, and high above us, scarcely visible to our sight, rustled the tops of the trees. Now and then the sound of the woodman's axe broke upon our ear; many a slender lofty giant had already fallen to sacrifice its splendid, easily and straight-splitting wood for useful purposes, and the remnants were hindering our progress. Here on this mountain slope the trees towered up to a marvellous height, and the slender tree-ferns whose huge, green fronds waved in the winds, were standing beneath them like playing grandchildren.

"We halted and seated ourselves upon some remnants of a former giant whose life and verdure already belonged to the past. A dear friend of mine, the Photographer Charles Walter, was our guide. This man, a thorough German artist, equipped with perseverance and energy, likes everywhere to steal upon nature and to search out her secrets and sanctuaries in order to preserve for the present generation and for posterity the beauty and grandeur of the wilderness. He had already from this position conjured these forest giants upon his plates, and that by taking their height in three divisions, so that three pictures fitting closely one above the other reproduce a complete and faithful picture of these gigantic trees.

"Our glances sped up the straight smooth stems often to a height of 200 feet and more before the eye could perceive the first branch projecting from the stem. A tree felled in these mountains (Daudenong ranges) measured from the base to the first branch 295 feet, and thence another 70 feet; the continuation and the crown were missing, they had doubtless been used or burned. The entire length of this tree to the point where it was broken off amounted therefore to 365 feet. Imagine then the continuation to the slender summit. A still larger tree, found near Berwick, had a circumference of 81 feet at 4 feet from the ground, the first section was 26 feet in diameter, and at a length of 300 feet it still had a diameter of 6 feet. Another tree felled on the 'Black Spur' measured full 480 feet in length.

"And under such giants we tarried and our eyes grew dizzy in searching for their waving crowns; crowns which could overshadow the highest architectural achievements of the earth, the Pyramid of Cheops and the Minster of

Strassburg. Think also of the time required for the growth of such a living pillar in the temple of nature, of the amount of food requisite to keep the evergreen crown fresh and luxuriant up in the burning sunlight. Often have I discovered at the gold-fields, at a depth of 100 feet, tender spongioles threading their way between slate, quartz and iron ore to the soft, moist, argillaceous veins, in order to obtain nourishment to send upwards to trees flourishing far above. And is this not also a fairy-world? Down there in the dark depths, not dreaming of the glorious world high above and the golden sunlight, work and toil the tender roots, and defiantly force their way through the narrowest chink of the hard rock, ever seeking moisture and food and sending them upwards for the growth and the maintainance of such gigantic monuments of the vegetable world. And does ever the crown rocking herself high up in the air and bathing herself in the glorious sunlight dream of the silent doings and strivings of that hobgoblin world of roots? Scarcely! Proudly she looks down upon everything that is beneath her and scarcely beholds that tiny human being who far below from her gigantic roots looks up awe-struck, to bow then still lower before the glorious works of Almighty power!

"At length we had again reached the height with its view of the wooded ridges of near and distant mountain chains, and I was astonished to meet here with huts and stirring life. Several men, all Germans, were busy lopping off the branches of recently felled trees and cutting them into planks. Gigantic trees were lying on the ground furnishing the necessary material for the building of a house, of which the foundation line was already occupying almost the top of the mountain. The master was a powerful young man whose occupation was likewise that of felling trees and splitting them into shingles. He told us that when the new house with its larger dimensions was ready he should bring home his sweetheart and therefore was he building it so grandly. He pointed across to another mountain ridge and drew our attention to an apparently small bare spot with a bright point: this, he explained to us, was also a settlement, and there also lived a German "Landsmann."

"The sun and the climbing had made us feel warm and we longed for a draught of water. Our fellow-countryman took us about fifty paces down, drew aside the branches of a bush, thickly covered with flowers, and we stood before a splendid spring with ice-cold water, forming a stream that gently murmuring and overshadowed by luxuriant bushes flowed down into the valley beneath.

"The man had chosen his place well. The clearing around him did not allow the fear to arise that by the fall of a forest giant his dwelling might be crushed to pieces, while trees of somewhat less dimensions and therefore easier to be felled were standing about in thousands; above all there were the pure fresh air and the never-failing spring of clear water. He was indeed preparing for himself a home such as many a one in the old Fatherland is longing for. It is true that he would have to work, to work hard perhaps for eight or ten years, but *then* he and his wife would say good bye to the forest giants and descend again to settle in more social quarters in order to spend the remainder of their days in peace and quiet.

"We took leave of our kind fellow-countryman and started with the declining evening sun on our return journey to the settlement mentioned before. Here most hospitably received we rested our weary limbs in order to visit on the morrow a tree fern ravine more than three miles in length. As the description of that grand scenery deserves a special article, I conclude by giving some details about the forest giants.

"The existence of these gigantic trees has only recently been scientifically ascertained by Dr. Ferdinand von Müller, the learned Government Botanist of the Colony of Victoria, and Director of the Botanical Gardens at Melbourne. Having had his attention directed to them, Dr. Müller with his usual zeal for the study and unveiling of Australian nature ordered measurements to be made, which gave most astonishing results and awarded to these forest giants the palm of victory over the Californian Wellingtonias, hitherto considered the highest trees in the world.

"*Eucalyptus amygdalina*, the monarch of the vegetable world is found in the Colonies of Victoria and New South Wales, and also in Tasmania; but only in certain parts, especially at the foot of the Victorian Alps, does it attain the colossal height mentioned before. Dr. Von Müller a short time ago mentioned these trees in a most interesting lecture delivered in the Melbourne Museum, and as he enlarged upon their various uses, I take the liberty of giving some extracts keeping closely to the words of the learned doctor.

"He starts in his calculations with a *Eucalyptus amygdalina* of the colossal height and circumference of that one found near Berwick and says:—

"'If we assume that only *half* the wood which such a tree yields be cut into planks a foot wide and an inch thick, it would give us 426,720 feet running, enough to cover 9½ English acres. If the same quantity of wood be used for railway sleepers each 6 feet long, 8 inches wide and 6 inches thick, the result would be 17,780 sleepers. A vessel of 1000 tons burden or 666 cartloads of $1\frac{1}{2}$ tons each would be required to convey the wood of the trunk, branches and twigs of half the tree. The oils obtainable from the *leaves* of the *whole* tree, might be calculated as 31 hhds., the wood charcoal as 17,950 bushels, the pyroligneous vinegar as 227,269 gallons, the wood tar as 31,150 gallons, and the potash as 51 cwt.

"'But' he exclaims, 'how many a century must have passed before undisturbed nature was able to produce in her slow process of growth, so mighty, so wonderful a structure.

IV.

The Host-Worm, or Larva of Sciaria Militaris.

Read by the Hon. Sec. at the General Meeting, December 7, 1871.

The history of the Host-Worm is not quite 270 years old; yet, like all other histories, it possesses its era of myths: indeed superstition has played by no means an unimportant part in it, but now the science of natural history has put an end to its horrors. That the first appearance of the Host-Worm spread terror through a whole forest need excite no wonder for it was at the beginning of the seventeenth century, at a time when the belief in ghosts, spectres and witches was most flourishing. The altogether singular, mysterious, snake-like gliding of the processions of the Host-Worm; its noiseless, slow and yet uninterrupted advance in the darkness of the forest, and its gradual, trackless disappearance under the leafy covering of the ground could not fail to produce uneasy feelings in most minds, while in those of timid people it awakened fear and horror. Now possessing one, now several heads, it was considered to be intermediate between worm and dragon, and the good folks in Thuringia, the Hartz, and the Riesengebirge called it by such expressive names as "host-snake, war-snake, war-worm, worm-dragon, dragon-snake, snake-worm, etc." By the inhabitants of the Hartz it was also known as "hunger worm," because to them it was a harbinger of a bad harvest if seen ascending the mountains, of a good one if creeping downwards. To the inhabitants of the Thuringian Forest it announced war when ascending, peace when descending; still on the whole it was more feared as a herald of war than greeted as a messenger of peace. Not only was this phenomenon of import as prophesying the fate of whole countries and nations, but even individuals believed themselves able to gather their future destiny from it. Men and women in Thuringia, like the inhabitants of Sweden and Norway, threw their garments, jackets or aprons in the path of the Host-Snake, that it might crawl over them, and considered this, if it happened, as a good omen.

In later times the Host-Worm has often been noticed—almost exclusively in pine and fir forests—in the north-west of the Karpathians, and by the "Gorales" of the Tatra mountains it is looked upon as the harbinger of a good harvest. The country people collect and dry it, have it consecrated in their churches and then strew it about in barns, stables, rooms, on fields, etc., in the belief that bread and luck will follow. An abundant harvest is prophesied for Poland when the Host-Worm passes northwards down the mountains; for Hungary when it glides southwards and upwards towards the Hungarian frontiers. This belief is traced back to the following tale or legend: a woman during a time of dearth went to Hungary to buy bread; returning without success she found in the Tatra a passing Host-Worm and took it on with her in a shawl; arrived at home, she threw her purse to her hungry, starving children comforting them with the assurance that good and fruitful years were coming because the Host-Worm was on its way to Poland. Hence from generation to generation, in the eyes of the people the Host-Worm is a prophet and no one destroys it for all know that it does no harm. In the Babia-Gora, a branch of the Karpathians, when a shepherd finds a Host-Worm he puts it into a new pot and places it amongst his sheep to make them flourish.

The Host-Worm having again shown itself in the splendid beech-forests high in the mountains not far from Stolberg on the Hartz, has enabled the "Forst-meister" Beling at Seesen on the Hartz, to publish an exhaustive article on its history, and to have this article illustrated by drawings. What then is this Host or Snake-Worm? It is not one animal but many, composed often of millions of little grubs which in a manner perhaps unique glide serpent-like through the forests. The first printed notice of it was given in the year 1603 by Casper Schwenkfelt of Liegnitz, in his, now very rare, "Zoological Garden of Silesia." Schwenkfelt named the grub or larva forming the Host-Worm, *Ascarides militaris*, as it somewhat resembled the well-known small white Ascarides, and considered it a true worm, "in summer they crawl, hanging together like chains, forming as it were an army." At the beginning of the eighteenth century Magister Christian Junker, Rector of the School at Schlusingen in the Hartz, in a description of the county of Humberg, mentions the Host-Worm as a peculiar kind of forest worm, which the "Oberforster Hans Christian Ludwig of Ilmenau had observed in his forests; he also states that it was of the breadth of three fingers, plaited like ladies' hair and said to occupy entire mountains attaining sometimes a length of 15-20 fathoms (90-120 feet.)"

This phenomenon had already attracted the attention of men of science, when Professor Dr. Norwické of Krakau observed the Host-Worm in the Karpathians near the village of Kopaling. He bred the midge from its larva and demonstrated the insect to belong to a species until then undescribed; which with its black dress and the yellow line on each side of the female's body was similar to the "Thomas Trauermücke," yet differed from this insect by quite characteristic features and also by its smaller size; this new insect he named "Sciaria militaris." These and simultaneous observations in the Hartz justify the conclusion that all Host-Worms are only formed by the larvæ of Sciaria militaris.

A single grub of the Host-Worm is not quite half an inch long, it is almost white in colour, glistening, and so transparent that the dark brown contents of the intestine which extends nearly the whole length of its body are plainly visible. The wonderful processions happen in the following manner: the little slender grubs being footless crawl with their shining black heads beside, above, and behind one another, exactly in the same direction, and held together by a peculiar stickiness form a rope-like or snake-like body, sometimes 30 feet long and mostly composed of thousands of individuals. This train is usually broadest in front, narrowing gradually until no thicker than pack thread, and formed only of single larvæ. The compactness of the train and the incessant movement of all the closely allied larvæ towards the same goal make it appear as a single individual, while the brownish grey colouring produced by the shining black heads and the contents of the intestines remind one to some extent of the Viper.

The author of a short article on the Host-Worm having received a box containing thousands of these larvæ packed among beech leaves, thus minutely describes the proceedings of the little creatures: "We took two large moistened sheets of paste-board and emptied the contents of the box upon one of the boards, keeping the other in readiness for the procession. The little creatures informed us at once why in their processions or marches thep kept so snugly and cosily together and do not allow themselves to be diverted from their seeming goose-step. We shook them first singly out of the foliage, not putting them together into a heap which naturally would at once have formed a marching column. Thus we saw that each of the many isolated little worms was alone a very helpless creature. Not venturing far from the spot, it incessantly lifted and moved its head in all directions searching for the indispensable neighbourly help; no sooner did two comrades meet or were moved towards each other than they stuck together, and the one crawling over the other lifted its head and looked about, till the second had in his turn crawled so far forward upon him that he was obliged to put down his head. Then he crawled again over the second, and thus the two helped one another on. It is perhaps their bodily constitution which demands this method of progression; for no other means are adopted than this use of the neighbour, even if 300, 400, or 600 are creeping over each other; the upper layers only are in motion, all the crawling ones put down their heads, but no sooner do they come to the front, where they then help to form the head of the column, than they raise their heads but only till the next, previously lower layers, are crawling over them and so on. After a short time, during which we assisted some single individuals to join in the march—many, now longer now shorter, processions in single file were passing along the moist paste-board between the beech leaves, the foremost always seeking in the most lively manner for the proper direction with their heads raised; then began the union of such single lines and thus the formation of threads and strings. The nearer the single lines came to the second sheet of clean paste-board, the more the direction of all became a common one. But this again occurred with various modifications. Whilst lines 5 or 6 deep quickly united into a single band, others, only 1 or 2 deep, continued their march for a long time separately, the one by the side of the other, till they at length joined. Even from the thickest cord, already a finger thick, some portions branched off to the right and left, reconnoitering as it were, and then returned to the great train. The community arrived at the second sheet of paste-board as a fair Host-Worm, representing indeed a small snake. Such a mass of the thickness of an arm, and many feet in length, gliding in the cool, gloomy forest across the footpath, might well furnish an excellent opportunity for horrible adventures, shuddering tales, and stout and sturdy superstition."

To return now to the general history of the Host-Worm. The wanderings, occurring as a rule in the evening and through the whole night till the morning, do not take place, as was long asserted, in any special direction from north to south, but in directions the most various.

Heavy dews or rains favour the locomotion of these larvæ or make it possible; they cannot endure sunshine and even object to bright daylight; but on rainy days they move about on the ground until noon and even longer, then they vanish under the leafy covering of the forest ground. If their line of march be interrupted they as fast as possible try to re-unite themselves. A woman from the Thuringian Forest once saw the Host-Worm creeping across the road like a terrible snake so long that neither head nor tail was visible. She took heart and crushed it in several places with her foot, but to her great terror it soon grew together again. Seized with a sudden fear she took flight and for a long time would not pass that road, for she thought that a crushed snake having power to quickly grow together again could certainly bring misfortune on men and beasts.

If we carefully examine the leafy covering of the forest ground we find that in spring and summer it is never uniform as the fall of the leaves in Autumn formed it, for winds and gales clear away the leaves completely in some places and heap them up higher and higher in ditches, low grounds or otherwise protected situations. We also know further that the amount of moisture in the ground and in the overlying mass of leaves varies much according to the geological formation of the ground, the compactness of the forests, the direction of the slopes of the mountains and the presence of wells, brooks and rivulets. These facts together with the conditions of the weather furnish us with an explanation for the wanderings of the Host-Worm; and although it was formerly considered that the larvæ were in search of decaying animal bodies or offal, it was discovered in 1867 that they live chiefly if not exclusively upon the layer of decaying leaves covering the ground of the forests; consuming only the cellular tissue and sparing even the smallest and most tender veins so that a more or less perfect skeleton of the leaf is left. Continued fine weather makes the layer of leaves under which they live too dry, and an unusual quantity of rain soaks it too much; in the latter case they usually come to the surface and consume the upper softened leaves, but creep down again when these become too dry; thus it is evident that the mass of leaves forms the natural food of these little creatures, and must neither be too dry nor attacked by mould or mildew. Living as they do in great numbers together and requiring as do all insect larvæ a large amount of food, it is not surprising that they must go in search of a new feeding ground as soon as the old one is cleared, resembling in this respect the Caterpillar of the procession spinner: and we are quite justified in drawing the conclusion that this quest is the sole object of the marches.

The strange processions begin perhaps when the larvæ are quite small, and possibly under special circumstances immediately after they emerge from the egg. The observations conducted in the Hartz in the summer of 1868 have shown that the tendency to the formation of processions is inherent in the larvæ from their very birth; for on the 22nd May of that year some grubs were found which were only half a line in length, yet on being placed on some moist dead beech leaves they immediately began to march like adult larvæ. The processions themselves have in Germany been noticed only between the last days of June and the middle of August; this as a rule is the time of the transformation from larvæ to pupæ or chrysalids, which usually takes place beneath the layer of dead leaves in the runs of mice or other hollows. The pupæ lie together in long heaps, without any real silky web, and are only quite loosely united together by single fine threads, cobweb-like, and the shrivelled brown, shining, exuviæ which remain attached to the end of the pupæ. The pupæ are 1½-2½ lines in length, at first milk-white, afterwards brownish-yellow and finally from the head to the end of the wiry sheaths blackish in colour. The pupa of the female has a row of orange-coloured spots along the middle line of the abdomen, and another along the back. The insect remains only 8, 10 or 12 days in the chrysalis state, and the perfect insect, which is scarcely more than 2 inches long, is one of the midges ("Trauermücke" or the mourning-midge of the Germans) a dipterous insect, sluggish in its habits, more addicted to crawling than flying about. Its vital energies are entirely directed towards the maintainence of its kind, and in the forest the midge often does not at all issue forth from under the leaves, its birth-place; but in the same place, where she cast off her pupa-case, she lays her eggs and dies either there and then or soon after, having lived at the most 3 days. Each female lays about 100 eggs, which form a little round heap; they are very small, 15 or 20 together only forming a mass the size of a poppy-seed ellipsoidal in form, transparent, shining, at first milky-white, but assuming after the first 6 or 12 hours a brown colour. They pass the winter under the leafy carpet of the forest. The larvæ escaping from the eggs, perhaps as a rule in the month of May, form as it were separate families or societies, and again have their processions, according as circumstances enforce or permit. In what number and to what extent these Host-Worm processions, and the number of larvæ composing them, do occur, the following cases will illustrate; on the 24th July, 1864, a Host-Worm glided in the Leine Forest near Altenbury, Saxony, as late as six o'clock in the morning in a straight line from S. to N.; it was 52 feet long, and of an average breadth of 3 or 4 inches; 34 feet were of uniform diameter, and 19 feet gradually tapered off towards the tail. This is all the more surprising as the Host-Worm had been discovered already a fortnight previously, and the many observers and lookers-on had carried off not inconsiderable numbers of larvæ.

On the 17th August, 1867, in the forenoon, the sky being cloudy and rain having fallen heavily on the previous day and gently on that morning, 46 Host-Worm processions were noticed upon the wet leaves of a close beech forest not far from Hahausen on the Hartz; they were from one to ten feet long, most of them about a hand's breadth in front and tapering gradually towards the end. The area on which this number was discovered was but 100 paces square, and the processions themselves were directed to nearly all points of the compass. The average length of these 46 trains was at least 5 feet, and their breadth 1 inch; and as on an average every square inch was occupied by about 200 of these travelling larvæ, the total number of individuals in these 46 trains was above 552,000. If united, they would have formed a line 230 feet long and 1 inch broad or nearly 60 feet long and of a hand's breadth.

In Germany the Host-Worm has specially been noticed in the Thuringian Forest and on the Hartz, far more rarely in the plain and almost without exception in beech and oak forests. In consequence of the great attention which its appearance always attracted, the years in which it showed itself have in the science of natural history a more than usual interest and therefore deserve mentioning as far as they have become known.

In the Thuringian Forest it was observed 17 times between 1698 and 1867, for the most part near Eisenach. In the Hartz mountains 21 times in the interval between 1804 and 1871; also near Tilsit in 1845 and 1856; near Hanover in 1853; not far from Hernhut (Saxony) in 1853 and 1854; at Sarquidlen near Rastenburg in 1854; near Buchholz (Saxon Erz-gebirge) in 1860; near Attenbury in 1864; beyond Germany it has been found in Sweden, Norway, Lithuania, Switzerland (1851) and as already noticed in the Tatra and Karpathian mountains.

SECTIONAL.

GEOLOGICAL SECTION.

The first excursion was made, on May 30th, to Ilminster, Moolham, and Barrington. Some good sections of the Upper and Middle Lias were examined and some nodules from the fish-bed obtained, which however contained no fish remains.

On the second excursion, to Henbury, the party were met by Mr. S. G. Percival, under whose guidance several interesting quarries in the Carboniferous Limestone were visited. In some of them seams of white chert traversed the rock, lying between the vertical beds of Limestone. The party afterwards examined Mr. Percival's collection of Corals and other fossils from the neighbourhood, chiefly Carboniferous and Rhætic.

The igneous rocks at Charfield were the object of the third excursion for the season. After visiting them the walk was extended to Wotton-under-Edge, in order to examine some quarries in the Upper Lias and Upper Lias Sands, from which some fossils were obtained.

The fourth excursion, though made as late as October 13, was a pleasant and successful one. Mr. R. V. Sherring met the members at Paulton and conducted them to some interesting quarries in the Middle Lias of that neighbourhood. The sections were described by the Rev. H. H. Winwood, and the party were afterwards hospitably entertained by Mr. Sherring before they returned to Bristol.

At the first meeting for the session, Messrs Sherring and Claypole exhibited a series of Rhætic fossils found by them last July, in a vertical fissure traversing the Carboniferous Limestone beds of the valley between Nunney and Holwell near the the town of Mells, in Somersetshire. The matrix from which they were extracted consists, for the most part, of a yellow loamy deposit occasionally hard and stony, and is full of fragments of the older rocks in the neighbourhood. It is most likely the same fissure as that from which Mr C. Moore, F. G. S., of Bath obtained the magnificent and unique collection in the Museum of that city. Others however appear to exist in the same locality though fossils were not obtained from them by Messrs. Sherring and Claypole. The following list includes the names of the species exhibited.

Gyrolepis tenuistriatus (Alberti)	Acrodus minimus
Saurichthys apicalis	Pholidophorus.
Sargodon tomicus	

Mr. Claypole also exhibited some large crystals of Selenite obtained from the New Red Sandstone near Wickwar.

The President Mr. William Sanders then gave his third Lecture on Fossil Fishes. On the previous evenings he described the Cartilaginous division. The Osseous fishes formed the subject of this Lecture. They compose the 4th, 5th, and 6th Orders. The 4th order, the Acanthopteri, possess fins having the first rays unjointed, the ventral fins being placed before the pectoral. It includes Ctenoid and Cycloid fishes. A very few of these are found in Oolitic and Chalk strata, the greater number are from Tertiary beds. The Semiophorus, Smerdis, and Coelorhyncus are examples. The 5th Order Anacanthini includes Ctenoid and Cycloid fishes. The fin-rays are flexible. The ventral fins are beneath the pectoral. This Order is limited to the Tertiary period and affords as examples the Merlinus and Rhombus. The 6th Order the Malacopteri possess Cycloid scales and abdominal fins. They are found only in Tertiary strata.

The author then made some general remarks on the high type of organization shewn by the fishes of Palæozoic age. The heterocercal tail, ovoviviparous birth, the structure of the heart, the brain, the air-bladder, the great amount of energy—characters prevailing amongst the Placoid and Ganoid groups—mark an approach towards the class of Reptiles; while the Osseous tribes of the Tertiary strata present the truly typical form of the class of fishes.

At the second meeting of the section on the 13th December, the President, Mr. W. Sanders, F.R.S., gave an account of certain bones which had been found in the Rhætic beds at Aust. The first shown was a large vertebra about 7 inches broad which, after close examination and comparison with similar bones at the British Museum, was ascertained to be a cervical vertebra of a very large Ichthyosaurus. Three other bones were then noticed. The largest was 25 inches long and 17 inches in circumference; nearly cylindrical. Both ends of the bone were absent. The next bone had the same thickness, but was only 14 inches in length and also wanted the terminations. This latter was found by Mr. Edward Higgins,

FISHES.

CARTILAGINOUS.

PLACOID.

Order 1. Plagiostomi. *Mouth* transverse, *Gills* with five apertures, no swim bladder. *Ventrals* abdominal. Heterocercal.

Fam. 1.	Cestraciontidæ.	S to C.	Onchus, Ctenacanthus, Cochliodus, Chomatodus, Psammodus, Gyracanthus, Acrodus, Ceratodus, Nemacanthus, Ptychodus.
Fam. 2.	Hybodontidæ.	CL to C.	Cladodus, Orodus, Hybodus.
Fam. 3.	Squalidæ.	O to T.	Notidanus, Corax, Odontaspis, Lamna, Carcharodon.
Fam. 4.	Raiidæ.	CM to T.	Pleuracanthus, Squaloraia, Myliobates, Zygobates, Pristis.

Order 2. Holocephali. *Head* entire; *Gills* with one aperture; *Fins* with spine. *Ventrals* abdominal; Heterocercal.

L to T Chimæra, Ischyodus, Ganodus, Edaphodus, Elasmodus.

GANOID.

Order 3. Ganoidei. (Some Osseous) *Fins* with spine.

Sub-ord. Placoganoidei. *Head* with large plates; Notochordal; Heterocercal.

Fam. 1.	Ostracostei.	S to OR.	Pteraspis, Pterichthys, Cephalaspis, Coccosteus.
Fam. 2.	Sturionidæ.	L to T.	(Edentulous.) Chondrosteus, Acipenser.

Sub-ord. Lepidoganoidei.

Imbricate.

Fam. 1.	Cœlacanthidæ.	Het. Not. / Hom.	OR to C.	Glyptolepis, Phyllolepis, Asterolepis, Cœlacanthus, Macropoma.
Fam. 2.	Holoptychidæ.	Het.	OR to CM.	Holoptychius, Rhizodus, Dendrodus.

Rhombic.

Fam. 3.	Dipteridæ.	Het. Not.	OR.	Dipterus, Diplopterus, Osteolepis.
Fam. 4.	Acanthidæ.	Het. Not.	OR to CL.	(spine imbedded) Cheiracanthus, Diplacanthus.
Fam. 5.	Palæoniscidæ.	Het.	CL to P.	Palæoniscus, Amblypterus.
Fam. 6.	Saurichthyidæ.	Het.	CM to L.	Megalichthys, Saurichthys.
Fam. 7.	Dapedidæ.	Het. / Hom.	L to C.	Dapedius, Aechmodus, Pholidophorus.
Fam. 8.	Pycnodontidæ.	Het. Not. / Hom.	CL to T.	Platysomus, Tetragonolepis, Pycnodus.
Fam. 9.	Caturidæ.	Hom. Not.	L to C.	Caturus, Pachycormus, Saurostomus.
Fam. 10.	Lepidotidæ.	Hom. Oss.	L to T.	(some have *Fin* cleft) Lepidotus, Ophiopsis.
Fam. 11.	Leptolepidæ.	Hom. Oss.	L.	(round scales) Leptolepis.

OSSEOUS.

Order 4. Acanthopteri. *Fins* with first rays unjointed; Ventral before Pectoral.

Sub-ord.	Ctenoidei.	(Perch, Gurnard.)	O to T.	Beryx, Semiophorus, Smerdis, Platax.
Sub-ord.	Cycloidei.	(Mackerel, Swordfish)	C to T.	Cœlorhynchus, Cybium, Cœlopoma.

Order 5. Anacanthini. {Ctenoid / Cycloid} *Rays* flexible; Ventral beneath Pectoral.

Fam. 1.	Gadidæ.	(Cod-fish, Whiting)	T.	Merlinus.
Fam. 2.	Pleuronectidæ.	(Flat-fish)	T.	Rhombus, Solea.

Order 6. Malacopteri. Cycloid. (Carp, Pike, Salmon.) T. (Abdominal or Apodal.) Clupea.

In the Table the following abbreviations are used:—S, *Silurian;* OR, *Old Red Sandstone;* CL, *Carboniferous Limestone;* CM, *Coal Measures;* P, *Permian;* L, *Lias;* O, *Oolite;* C, *Cretaceous;* T, *Tertiary;* Het. *Heterocercal tail;* Hom. *Homocercal tail;* Not. *Notochord permanent.*

in the year 1844, at Aust; and four years later Mr. Alexander Thompson of Aberdeen found the largest bone and presented it to the museum.

The late Mr. Stutchbury supposed it to be Labyrinthoid, but this opinion did not meet with concurrence from eminent persons who had seen it. The author took the three bones to Oxford for the purpose of comparing them with various large bones possessed by the University Museum. Professor Phillips brought the largest into comparison with a femur of the Megalosaurus, and determined it to belong to an animal of that family; but nevertheless an individual much larger than that the remains of which are in the Oxford museum.

Mr. Sanders then gave a brief description of those remains, noticing the large size of the hind limb, of which an outline drawing of the natural size showed it to be nearly six feet in length. The sacral vertebræ are anchylosed together.

The humerus is very much smaller than the femur, so that the hind limbs possessed a large proportion of its muscular power.

A short account was then given of certain huge bones of a Ceteosaurus lately discovered near Oxford. The femur of this Saurian measured six feet in length.

ENTOMOLOGICAL SECTION.

At the Meeting held Nov. 15th, the Hon. Secretary exhibited a number of fine species of Canadian Coleoptera, among which were

Leptura Canadensis	Monohamus confusor and scutellatus
Orthophagus Hecate	Silpha teponica
Aedilis obsoletus	Cicindela repanda
Phyllophagus quercina	Calosoma callidum
Pelidnota punctata	&c., &c.
Buprestris diversicata	

He also exhibited a specimen of Laphygma exigua captured in the Isle of Portland, and remarked that this was a new locality for this rare Noctua.

At the Meeting held on December 12th, Mr. I. W. Clarke exhibited a number of species captured during the autumn on ivy blossoms, including fine specimens of Dasycampa rubiginea, Xanthia aurago, X. citrago, Xylina petrificata, X. semibrunnea, and other species; also a number of species of Brazilian Coleoptera.

Mr. Aldridge exhibited specimens of Deilephila Galii and D. lineata captured by himself at Weston-super-Mare,

Mr. J. B. Butler exhibited a number of rare British Lepidoptera, amongst which were

Lythria purpuraria
Polio nigrocincta.
Leucania vitellina
Sesia asiliformis and
Cucullia Gnaphalii.

Mr. A. E. Hudd exhibited fine specimens of Polyommatus Acis captured by himself in June 1871 in Wales. This exhibition caused some interest, as for many years this butterfly had not been observed in the United Kingdom and was supposed to have become extinct. He also exhibited a species of Bruchus, supposed to be B. pectinicornis, bred from imported beans—a large proportion of the beans imported having been destroyed by this beetle. Some of the beans brought by Mr. Hudd when opened were found to contain from three to six beetles each.

Mr. Barton brought for exhibition some of the Mexican walking seeds, (so called from their having the power of moving along,) and much amusement was caused by the eccentric movements of the seeds. If held to the ear a regular ticking sound similar to that caused by the death-watch beetle could be heard. Each seed appeared to have one or more beetles inside, but though carefully watched, the mode by which they were enabled to move the seeds along could not be discovered.

The Hon. Secretary then read a short paper, being a contribution towards the life-history of Acidalia degeneraria, illustrated by specimens of the imago and larva, the parent moth having been captured July 18th, in the Isle of Portland, the only British locality for this species. The larva was previously unknown.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

JANUARY TO MAY, 1872.

GENERAL.

I.

A Puzzle in Rain, and an Attempt to Solve it.

By George F. Burder, M.D., F.M.S.

Read at the General Meeting, February 1st, 1872.

[Abstract.]

For more than a hundred years it has been known that of two rain-gauges in the same locality, one placed on the ground, the other at an elevation above the ground, the upper will collect less rain than the lower. The upper gauge may be placed on the roof of a house, or it may be elevated on a pole—the result will be substantially the same. Dr. Heberden was the first to notice this curious fact, and his experiments are recorded in the *Philosophical Transactions* for 1769. Some idea of the history of the inquiry from that time to the present may be gathered from the following table, but it should be added that within the last ten years observations have been greatly multiplied.

TABLE I.

DECREASE OF RAIN WITH ELEVATION.

Date.	Authority.	Position of lower gauge.	Position of upper gauge.	Decrease per cent. in upper gauge.
1767	Heberden	Below top of house	Top of house	20
,,	,,	,,	Roof of Westminster Abbey	46
1829	Arago	10 feet	98 feet	15
1834	Phillips	Ground	44 feet	23
,,	,,	,,	213 feet	42
1853-62	W.C.Burder	6 inches	50 feet	12
1864-67	Col. Ward	1 foot	20 feet	6
1870	Glaisher	5 inches	51 feet	38
,,	Chrimes	1 foot	25 feet	13

The results shewn are somewhat discordant, even after allowance has been made for the different conditions under which the experiments were performed, as regards elevation of the gauges. Still, they all point in the same direction, proving beyond dispute that the lower of two gauges collects more rain than the upper.

The ingenuity of meteorologists has been much exercised to explain this phenomenon. Many have tried to explain it away. That is, while admitting that the lower gauge collects more rain than the upper, they contend that the indication is deceptive, and that the true rainfall is the same in both situations.

One theory of this class demands special notice because it has been lately put forward and stoutly defended by some excellent meteorologists. It is not new, for Sir John Herschel in his *Meteorology* notices it, to condemn it as erroneous. It is the theory that the quantity of rain received by a horizontal surface will depend on the angle at which the rain falls. The force of the wind being greater at an elevation, the slant of the rain will also be greater, and the quantity received by a horizontal guage will therefore, it is said, be less. Anyone may draw for himself diagrams which will prove the fallacy of this view. Nevertheless, the question may become complicated through the exercise of superfluous subtlety, and it is surprising, as well as instructive, to note what a quantity of discussion has been required to clear it up. The best excuse that can be made for the advocates of this view—and no doubt the true reason why some of them have been so reluctant to abandon it—is to be found in the fact that the amount of elevation-difference does actually vary in a very consistent manner with the angle at which the rain falls, being large in proportion as the path of the drops deviates from the vertical. This law has been fully proved by careful experiments recorded from time to time in *British Rainfall*, and any theory must be defective which fails to take account of it.

Another view has been lately advanced, according to which the rain-drops in falling approach one another. Hence, it is said, the rain becomes gradually denser in its descent, and the lower gauge will therefore catch more than the upper, although no new formation of rain takes place in the interval. It is not necessary to follow the line of argument by which it is sought to prove this approximation of the drops. It may be granted that all sorts of variations in their relative distribution may occur in the course of their descent, but it seems obvious that any approximation of the drops in one place, so far as it is independent of fresh formation of rain, implies an equivalent separation of the drops in another place, and that, therefore, whatever increase in the quantity of rain at the lower level may be so occasioned in a particular place at a particular time, must be exactly counterbalanced by a decrease at other places, or at the same place in the long run. No explanation of this kind can account for a phenomenon which is constant both in time and place.

Again, it has been urged that there are certain mechanical causes tending to deprive a rain-guage of its proper share of rain—especially eddies of wind formed by the gauge itself, and loss by splashing—and that these causes, being operative in proportion to the exposure, will affect the upper gauge more than the lower. But in a properly constructed gauge the loss by splashing must be inappreciable, and with regard to the assumed eddies of wind, I believe their effect would be the opposite of that which has been supposed—that they would, in fact, tend to concentrate and condense the rain in the funnel of the gauge, and so to increase the quantity, as we see to happen in eddies of snow and of dust. But in any case the effect due to such a cause must be infinitesimal in amount, and quite inadequate as an explanation of the large differences observed.

The greater number of meteorologists have always held that the excess of rain collected in the lower of two gauges is due to an actual formation of rain in the lowest strata of the atmosphere. Indeed this conclusion has been to most minds irresistible, although the mode in which the supplementary formation of rain takes place has been a standing puzzle. We can comprehend pretty well how rain is formed in the clouds. We cannot indeed say certainly what determines the first beginning of a raindrop, nor is it likely that we shall be able, until we know more accurately than at present the intimate constitution of a cloud. But we may be certain that a drop once formed of sufficient size and weight to fall through the cloud, will gather volume as it descends by incorporating with itself not only the minute particles of the cloud, but also all the smaller drops which it may chance to overtake in its course, for the larger the drop the faster it will fall. In this way the large drops that fall in thunderstorms are to be explained. The clouds are then of great vertical depth and each drop that falls represents the amalgamation of many smaller drops. But we cannot in this way account for an increase in the total quantity of rain at the lower level. The cloud being the source whence the rain is derived, the total quantity falling through a given horizontal area should be the same (excluding considerations of evaporation and condensation) at all levels between the cloud and the earth.

But is it right to exclude the effect of condensation? May it not be that the rain-drops falling from the higher, and therefore colder, regions of the atmosphere, act as cold objects towards the comparatively warm and very moist air through which they pass near the earth, thus condensing watery vapour upon their own surface and becoming augmented in volume? This idea was put forward many years ago, and was accepted as an adequate explanation, until it was pointed out by Sir John Herschel that the increase due to such a cause admitted of exact calculation. It could not indeed be predicated of any particular instance what the increase would be, but it might be shown very positively what it could not be. Herschel took as the subject of his calculation the observations of Phillips, and purposely adopting suppositions as to temperature and other matters extravagantly favourable to the condensation theory, he yet found that it would only account for one-seventeenth part of the difference actually observed. The true proportion must be very much less than this.

Thus then the matter stands at present. A notable excess of rain is observed to fall near the ground as compared with a higher level. All attempts to prove this excess illusory have failed. We are bound therefore to believe it real. We are bound to believe that an important proportion of the rain that falls on the earth is generated below the level of the tops of our houses. Yet the only plausible theory hitherto devised to account for this generation is found to be untenable.

Let us meet the difficulty boldly. Rain is formed near the earth. Theory forbids us to believe that it is formed in any considerable degree by the direct condensation of vapour upon the cold drops from above. Then it must be formed by the incorporation of minute watery particles, the condensation of which has been already effected through the operation of some independent influence. And here it is necessary to insist on the distinction between vapour and cloud. The vapour of water is aëriform and invisible. Cloud on the contrary is composed of liquid water in a finely divided state. The quantity of vapour that can be condensed under given circumstances is strictly limited, and admits of exact calculation. The quantity of cloud that can be absorbed by drops of rain falling through it is subject to no such limitation. If therefore we may only suppose the presence of a thin cloud enveloping the earth during rain, the problem is half solved. But it may be fairly objected that we are not at liberty to make this supposition. If cloud were present it would be visible as cloud whereas it is only on rare occasions, in non-mountainous districts, that visible cloud rests on the earth, even during rain. Yet it is conceivabl that the constituent particles of cloud may be formed in abundance in the lower air during rain, being only prevented from assuming the visible form of cloud by reason of their absorption going on *pari passu* with their production. Let some influence be discovered in operation during rain which shall effect a continuous condensation of vapour from the lower strata of the air, and we shall have found a source whence the falling rain-drops may be augmented to an indefinite extent.

Such an influence I believe to be exerted by the earth itself, acting as a cold body towards the comparatively warm and almost saturated air that rests upon it. We know that the air during rain is heavily charged with vapour. We know also that the temperature of the earth's surface is often many degrees below that of the air. We see that when circumstances are specially favourable to the cooling of the ground by radiation, fog forms even in dry weather. In rainy weather, it is true, the circumstances are not favourable to such a cooling process. Still, considering the humidity that then prevails, and remembering that the earth, if previously cooled by radiation, cannot immediately acquire the temperature of the air, we may not unreasonably infer that during rain a process of condensation goes on in the neighbourhood of the earth's surface, the result of which, if it cannot be called actual cloud, may be described as *potential cloud*—a term by which we may conveniently express the idea, that if the process of absorption by the falling rain-drops were intermitted, while the process of condensation still went on, visible cloud would be formed.

It remains to apply such tests as are available to prove the soundness or unsoundness of the view now advanced.

In the first place, it is clear that, if the earth be the cause, the effect should be marked in proportion to the proximity to the earth. Fortunately, the materials are abundant for the application of this test. Subjoined are two tables giving the results of an analysis of two series of observations, the one series by Colonel Ward at Calne, the other by Mr. Chrimes at Rotherham. The observations themselves are published in Symons's *British Rainfall* for 1867 and 1870. They were conducted in both cases with extreme care, and in the Calne observations the ground-level gauge was sunk in a pit, in order to prevent error by splashing from the surrounding soil. The tables show in each case the rate of decrease per cent. in the amount of rain collected at each elevation, calculated on the amount collected at the elevation next below it.

TABLE II.

ANALYSIS OF CALNE OBSERVATIONS.

Elevation.	Decrease per cent.
Between ground-level and 6in.	3·3
,, 6in. ,, 1ft.	1·5
,, ground-level ,, 1ft.	4·8

TABLE III.

ANALYSIS OF ROTHERHAM OBSERVATIONS.

Elevation.	Decrease per cent.
Between 1ft. and 5ft. ...	6·0
,, 5 ,, ,, 10 ,, ...	4·4
,, 10 ,, ,, 15 ,, ...	1·4
,, 15 ,, ,, 20 ,, ...	1·1
,, 20 ,, ,, 25 ,, ...	0·9

It is scarcely possible to conceive a more striking confirmation of theory than is furnished by the above tables. It will be seen that the decrease per cent. in the first six inches from the ground was more than double the decrease in the second six inches, that the total decrease per cent. in the first foot was greater than the decrease in the second five feet, and that the decrease per cent. between 20 and 25 feet was little more than a fourth part of that in the first six inches.

Another test that may be applied has reference to the law already referred to, that the difference due to elevation varies with the obliquity of the rain. To say that the elevation-difference varies with the obliquity of the rain is tantamount to saying that it varies with the force of the wind. Now, a little consideration will show that this is exactly what ought to happen on the theory proposed. By the process of condensation which I have assumed, the air will be continually parting with its vapour, and unless it be as constantly renewed the process must speedily cease. Actually, however, fresh volumes of damp air are continually coming up to take the place of those which have been drained of their superfluous moisture, and in proportion to the rapidity with which this substitution goes on—that is, in proportion to the force of the wind—will be the abundance of condensation of vapour, and therefore of formation of rain.

A third test may be added. It has been noticed by the Rev. F. W. Stow—an indefatigable observer—that the differences are greatest when the rain falls in showers, least when it falls continuously, being in the latter class of cases sometimes *nil.* This again is just what ought to be, if the cause of the difference is the relative coldness of the earth. The cooling of the earth is due in great measure to radiation. Radiation is impeded by clouds, and also by vapour in the air. When rain falls in showers, the intervals of drier air and clearer sky permit freer radiation. On the other hand, when rain is continuous, radiation is reduced to a minimum.

II.

A Walk to the Cotteswolds,

By W. W. Stoddart, F.G.S,, F.C.S.

Read at the General Meeting held on March 7th, 1872.

[Abstract.]

The subject was introduced by a short account of the archæology of the town of Wotton. The old town was destroyed by fire in a distant age, and its site was in a place now known as The Brands, probably from that circumstance. Few camps of Roman origin exist in the neighbourhood, the inhabitants appearing to have submitted without any long or severe resistance to their conquerors. Three Roman roads intersect the district. The history of the church and its various endowments was briefly given. It owes some part of its revenue to the liberality of the great Bristol philanthropist, Edward Colston, who generously increased the value of the living, which previously was small. The speaker then passed on to the geology of the district, which was the chief subject of the evening. During the excursion, an observation was made, which gave the height of Tyndal's monument, near Nibley, as 626 feet above the sea level. In time not geologically distant, and during an age when the land stood considerably lower than now, the sea, there is every reason to believe, flowed far up the vale of Tewkesbury and met the deep inlet projecting southward from the basin of the Ribble. This, which was first pointed out by Sir R. I. Murchison, was called by him the Ancient Straits of

Malvern. The early geological history of Great Britain was then sketched, showing how in very distant days it consisted of patches of the igneous rocks exposed to the wearing action of the Western Sea, which gradually wore them down and deposited the detritus on the eastern side, forming continually newer and newer beds of sand and clay, &c. The various and distinct populations of those ancient seas were described, and specimens shown, such as the Trilobites of Siluria and the armour-plated fish of the Old Red Sandstone and Carboniferous series, with others more minute but not less interesting. The abundant but perhaps monotonous vegetation of the Coal Measures succeeded, indicating estuarine conditions of growth and deposit. The thick deposit of New Red Sandstone follows, nearly unfossiliferous in this locality, but showing a rich fauna in the Austrian Alps. Next is the Rhætic series, with its rich fossil treasures, of which Aust Cliff and Westbury-on-Severn afford abundant supplies. The various beds of the Lias and Oolite were dwelt on, and more in detail, as the district in question is mainly composed of these. Particular attention was drawn to the constant occurrence of one particular fossil in many of these beds, not, of course, alone, but in company with others not peculiar to it. Thus, certain beds of the Trias are characterized by ammonites peculiar to them, and found neither in the beds above nor in those below. In the same way, some of the beds of the Oolite are distinguished by the presence in them of a shell called, from its shape, *Terebratula fimbria*, and so on. The advantage of this means of readily distinguishing strata was shown and the alternatives between which geologists have to choose were pointed out. They must admit either that these creatures were called into being, endured but a short time, and then became extinct, or that the beds in which their remains occur, though often only a few feet in thickness, required for their deposition a long series of ages. For many reasons which could not be set forth at length geologists had unanimously chosen the latter alternative, and hence the great age they were compelled to assign to the crust of the earth and the animal and vegetable tribes upon it. The resemblance and difference between the Cotteswolds and Dundry hill were dwelt on, and the variation in thickness of the same bed in different localities explained. A sketch map was exhibited, showing the contour of the country if sunk to a depth of 500 feet. The Ancient Straits of Malvern would be restored, and the counties of Gloucester, Worcester, Somerset, and Hereford reduced to an archipelago, consisting of the Cotteswolds and of Malvern, &c., separated by deep ocean creeks and channels. The speaker concluded by an allusion to the connection of agriculture with the geology of a district, mentioning the single fact that the common damson will not come to perfection off the Fuller's earth, and therefore grows nowhere so well as in the districts where the subsoil consists of this formation. Natives of those districts regard damsons grown on other soils as worthless, however good they may appear to those who are not familiar with the fruit in its favourite habitat.

III.

The Anthropology of the Lower Danube.

By John Beddoe, M.D., M.A.I.

Read at the General Meeting on April 4th, 1872.

[Abstract.]

The countries in the basin of the Lower Danube are inhabited by people belonging to three or perhaps four races—Germanic, Sclavonic, Magyar, and (doubtful) Roumanian or Wallach. It is not likely that these or any of them, unless the old Dacians were Sclavonic, inhabited the countries they at present occupy 1,800 years ago, when the first fragmentary notices of the districts and their population occur in the classic writers, who, instead of making or recording careful observations upon them, set them all down in a word as barbarians, on account of their ignorance of the Greek and Roman tongues. From Cæsar's Commentaries we learn that Ariovistus was a foreigner in Gaul and had crossed over from the opposite (eastern) bank of the Rhine. But no very long time elapsed before the Germans, following his steps, began to press southward against the Roman Empire. Among others the Gepidæ settled on the Danube and held the passages or ferries of that river, taking toll from the Sclavonic tribes whenever they wished to pass southward for plunder or conquest. But across the Teutonic and Sclavonic wave, advancing from the North, there rolled another from the East. The Avars, a Turkish race, passed from Asia into Europe over the steppes lying north of the Black Sea, and pressed westward, subjugating the Gepidæ, destroying most of them, and meeting the Lombards on their way southwards towards Italy. These Avars possessed skulls naturally of a very peculiar form, and this form was exaggerated by compression until the head had a deformed appearance owing to the

excessive height of the crown. When the Lombards passed into Italy the Avars were left unopposed, and in consequence extended their dominions into Western Hungary during the seventh and eighth centuries, and became a very powerful people. At length, Charlemagne, King of the Franks and Emperor of the West, led an army down the Danube and forced his way through the "Ring," or sevenfold line of fortifications, within which was stored the plunder of centuries. This broke the power of the Avars and at once new movements of population began, as a result of which the Bavarians gained a little, and the Sclavonians so much as to stretch in a compact mass from Bohemia and Moravia to Croatia, Servia, and Bosnia, with some other districts in the same direction. After the destruction of the power of the Avars a new wave of migration set in from the east. A people of Finnish relationship, according to some, calling themselves Magyars, from the neighbourhood of the Volga and the Oural, moved towards Transylvania. They were a nomad, equestrian race, and overran the wide plains of Hungary, south of the Carpathians. They attacked Bavaria and even the eastern parts of France and Italy nor was their course stopped until the siege of Augsburg, about 50 years later, A.D. 955. The tide then turned and the Bavarians have ever since continued to gain ground on the east. Bohemia was occupied for ages by Sclavonic races who in course of time were almost isolated by the constant southward movement of the Germans so as to form a Sclavonic peninsula in the midst of a Teutonic population. Continual advances along the borders have still further reduced this area until now only the middle of Bohemia is held by the Czecks. This is the more remarkable as the Czecks are quite equal to the Germans in intellect and spirit, The Wallachs or Roumanians who once dwelt in the basin of the Danube disappeared from history for centuries, having been, as some supposed, driven into the mountains whence they afterwards redescended. This view derives some confirmation from the fact that, besides the main body of the Wallachs on the Danube, there are several smaller ones to the southward and even as far as the northern part of Greece. They all speak the same language, which is more like the ancient Latin than is any other living dialect, with, however, the addition of not a few Sclavonic words, and others whose origin is unknown, but which might be recognised as Dacian if the Dacian tongue could be recovered. Some ethnologists think they can trace a resemblance between these people and the figures of the Dacians on the Arch of Trajan. Whatever their origin, however, they appear to be rapidly multiplying and ousting the Saxons who settled peacefully as colonists in the south-east of Transylvania about the middle of the thirteenth century. The present inhabitants of Hungary have the reputation of being the handsomest people of Europe but this is only true of the upper classes who have, probably, as in Turkey, been much altered by intermarriages for generations with the native races. The peasants show strong marks of Tartar origin in their short stature, round, pointed heads, rising in a line with the back of the neck, oblique eyes, and straight hair.

IV.

On the Subsidence which has taken place in the South Western Counties of England during the Recent Period. Third Paper.

By E. W. Claypole, B.A., B.Sc.

Read at the Annual Meeting, May 2nd, 1872.

The subject was introduced by a short geological description of Cornwall and West Devon.

These counties cannot be considered as among the most ancient in the Island. They did not emerge from the ocean until toward the close of the Palaeozoic age. The Devonian and Carboniferous beds of which they mainly consist are probably continuous with those in the S.W. of Ireland, the intervening channel being the result of subsequent erosion. About that date, however, either by upheaval or depression or both, a vast synclinal trough was formed the direction of which is nearly East and West, on the north side the slates dip to the south and on the south they dip to the north. Following this by an interval whose length is unknown but occurring somewhere in the vast gap that separates the Carboniferous from the Triassic Rocks came volcanic action in the form of a great intrusion of liquid granite from below. Taking in all probability a line of weakness not exactly parallel to the synclinal axis but rather more inclined to the meridian, it lifted and broke through the overlying beds and now appears at the surface forming the six granite islands of Dartmoor, Liskeard, Hensbarrow or St. Austell, Redruth or Carn Menelez, Land's End and Scilly. To these Lundy may perhaps be an outlier.

If any of the secondary formations were deposited in this county they have all been swept away so completely that their very existence is more than doubtful. Allusion was made to the formation of fissures at different dates, some of which are filled with Elvan (Trap) and others with the ores of tin, copper, zinc and lead. Some of these traverse the fossiliferous as well as the igneous rocks. The subject of the paper was a description of some of the alluvial formations of the county in order to point out their bearing on recent Geological Questions. For this purpose a section given by Mr. J. W. Colenso in the Transactions of the Royal Geological Society of Cornwall, was chosen as typical of many others occurring in various parts of the county. It was exposed at the Happy Union Stream Tin Works at Pentuan, near St. Austell.

At the bottom lying on the rock is found what is termed the "tin ground" and for the sake of reaching which the excavations are made. This consists of the oxide of tin or tinstone in the form of sand, pebbles and boulders and is sometimes as much as 10 feet thick. The mode of its formation has occasioned much controversy on account of its comparative freedom from other ingredients. The various reasons brought forward in support of the different views on this point would be interesting but too lengthy for introduction here. It must suffice to say that the tin ground is most likely the washings of the county during a long series of years. The absence of other material may be rationally accounted for by the great weight of tinstone (Sp. Gr. 7.0), nearly that of Metallic Iron, and its hardness, almost rivalling that of quartz. The former quality would bring it to rest in the bed of the stream where the current was yet strong enough to sweep away all ordinary pebbles, few of which exceed 3.0 Sp. Gr. and the latter would enable it the better to resist the wear and tear to which it was exposed while rolled along by the water.

On the top of the tin ground with their rootlets among the tin stones are found the stumps of oak trees with trunks of the same in such positions that they must have grown and fallen where they now lie. Twelve inches of dark silt follow and on the top of this occurs a layer of leaves, hazel nuts, sticks and moss of equal thickness. In the next bed occur the same relics with the bones and horns of deer and oxen. A piece of oak apparently shaped by the hand of man has also been found here. It was six feet long by two inches wide and half an inch thick. Twenty feet of sea sand follow, omitting some thin layers, with the same organic remains and the addition of some human skulls and the bones of a whale. The top of this bed is just on a level with the present low water mark upon the neighbouring coast. The highest deposit consists of 20 feet of river sand and gravel the accumulation of a period during which the detritus brought down by the stream gained on the depression. The upper part of it, if not more, is most likely the result of ore-washing carried on for centuries higher up the valley. But at the bottom of the bed was found a row of piles probably intended for a foot bridge but their tops being only just on a level with low water mark they would be quite useless for that purpose in the present day. It was formerly supposed, and in this view Sir H. de la Beche concurred in his Geological Survey of Devon and Cornwall, that the stanniferous gravel was the result of some violent and sudden flood that had rushed over the county. The direction of the flood was thought to have been from N.W. to S.E. because the streams on the south were so much richer in stream-tin than those on the North. It is however on the principles of modern geology much more probable that the gravel is the result of the meteoric erosion of the land for a series of ages.

Its greater abundance on the South Side of the county may readily be accounted for by the position of the watershed which lies much nearer to the Northern than the Southern Coast. The latter therefore would receive the washing of a very much larger extent of county.

Further the Stream-tin occurs just where on this supposition it should occur—at the junction of two valleys especially if they meet at a high angle; and at places where the slope of the valley becomes less and the current was consequently slower. Large quantities of stream-tin have been found inland in the Tregoss Moors a kind of basin-shaped depression through which the rapidity of the stream must have been less. In the St. Austell valley the deposit commences where the fall of the valley diminishes to about 45 feet in the mile or about 1 in 120. On this slope the heavy tin ore came to rest with of course a certain proportion of the lighter material the greater part of which however was carried further down by the force of the current. The process was in fact the same as that now adopted for washing the ore after it has been stamped at the mines. During this period the land stood about 50 or 60 feet higher than at present so that the rest of the lighter material was in all probability deposited on ground that now lies under the sea. On the tin thus deposited the oak trees above mentioned seem to have grown until a subsidence of the land set in which brought the sea water over the tin ground. This continued, sea and river wash alternately gaining on each other, until the forest or peat bed had reached the level at which it now lies about 50 feet below high water mark.

From the presence of the remains above mentioned of men, deer, oxen, and the absence of those of the larger mammals such as the Mammoth, Rhinoceros, Hyaena, &c., the further inferences seem to be necessary that the latter had become extinct before the commencement of the subsidence and that their remains would be found, if found at all, in the tin ground or in its contemporaneous gravel. If so the deposit of tin ore must represent the wear and tear of a very long period and the subsequent overlying deposits must be the production of a period comparatively very short. This latter must belong to a late portion of the human era for man is now known to have co-existed with the older fauna of the gravel. Great geological changes must have occurred in the county since he took possession of it, of which this subsidence to the extent of 60 feet seems to have been the latest and to be so recent that it is hardly possible to suppose, as some have done, that since it took place elevation has again set in and that the raised beaches that fringe the coast are more modern than the peat. On the contrary it seems far more likely that they are the older of the two and belong to the age of the formation of the tin ground rather than to that of the ensuing subsidence.

SECTIONAL.

On the Subsidence which has occurred in the South Western Counties of England during the Recent Period. Second Paper.

By E. W. Claypole, B.A., B.Sc., Lond.

Read at the Sectional Meeting, January 12th, 1872.

Two years ago I read a paper before the Geological Section on "Some of the Evidences leading to the belief that Subsidence has occurred in the south-west counties of England during recent times."* In that paper my object was not to prove, what few now doubt, that such subsidence has taken place, but to shew that this subsidence was the last of the movements to which this part of the country has been subject, and that any elevation

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* See Vol. V. Part 1., 1870.

which has also occurred preceded and did not follow it. An abstract of the paper was printed in the proceedings for 1870. My purpose now is to fortify the arguments then adduced by others derived from another part of the same district. The observations then recorded were made in the neighbourhood of Falmouth on the south coast of Cornwall. Those I have to bring forward to-night were made in Bideford or Barnstaple Bay during an excursion of a day or two in the month of July, 1869.

All the headlands along this coast consist of slaty and sandy strata dipping to the S. by W. at a high angle, often 75°. They compose the debatable ground between the Carboniferous and Devonian systems as conformably they dip and form the northern side of the great S.W. Synclinal. The mouth of the river nearly overlies the point which would be called the junction of the two systems. They however most likely shade into one another as gradually as do the corresponding beds in the Avon section at Bristol. After passing under the peat and culm beds of Mid-Devon they re-appear in the south and form the immense thickness of crumbling slate of which the County of Cornwall in great part consists and in which lie the massive limestones of Plymouth and Torbay, The middle of these counties therefore is a trough of Carboniferous rocks lying W. by N. and E. by S. The western part of this trough is drained by the rivers Taw and Torridge emptying themselves by Barnstaple and Bideford into the Bay of the same name. All the bays round the coast are encumbered with sand produced by the wearing action of the waves upon the projecting headlands and thrown up by the prevalence of westerly winds. Near Braunton it has collected in mass sufficient to form Burrows or Sand-dunes covering several square miles of ground and forming one of the most barren and desolate spots that can be found in England. Here and there grows a tuft of the Sand-reed or the Sandwort but these excepted no living plant is seen and the population seems limited to a few rabbits that must find a maintenance with difficulty and not unfrequently leave their bones to whiten on the surface mingled with those of sheep which having wandered too far into the desert could not return, and of birds, perhaps wounded or sick, that lay down here and died.

This blown sand covers the whole district between Saunton Down and the Estuary, but on the other side of the river the country has a very different appearance. Though composed of sand its surface is level and covered with a coarse maritime vegetation just sufficient to support the cattle and geese of the neighbouring cottagers. It is protected from the sea by the pebble ridge, a long high beach of rounded boulders skirting the beach and rising to a height, it may be, of 20 feet. Many of these are large enough to fill a wheel-barrow and they extend for more than two miles along the S.E. shore of the bay. The pebbles have evidently been derived from the Carboniferous beds to the S.W. near Hartland and Clovelly, but why they are piled just here and nowhere else around the coast is at first difficult to explain.

Like the famous Chesil Beach at Portland they have probably been broken away from the Cliffs to the S.W. and rolled along by the united action of tides and currents until the line of shore opposed their farther progress, when they were left piled one on another in a huge bank skirting the beach.

The ridge projects northwards into the Estuary which seems to have been somewhat deflected from its original course by the tendency of the mound of pebbles to extend itself in that direction. The pebbles also underlie the beach for some distance projecting through the sand. They are too large to be moved by ordinary waves but in storm time they are often thrown over from the windward to the leeward side of the bank. They thus mark the limit of the sea during storms and their position seems to be a proof that the land at this spot is either at rest or subsiding. Were elevation taking place they would be gradually lifted out of the reach of the sea and would be found further inland. But fringing the shore as they do they seem to show that with every successive inch of subsidence their line is constantly set back by the advancing waves, or that on a stationary coast they retain an unvarying position.

Evidences of a former lower level of the land may be found in the raised beaches that fringe the coast—relics that have escaped the denuding action of the waves during a period of elevation. One of the best of them may be found on rounding Saunton Down and coming into the bay at the north. It is composed of cemented sand and lies horizontally upon the highly-inclined Carboniferous or Devonian beds. Some parts of it are hard but others being soft it readily weathers away leaving fragments adhering to the older rocks. Pieces of these horizontal beds may be found as much as 30 feet above high water mark. They contain a large proportion of comminuted shell so small as to be scarcely recognizable but apparently belonging to recent species. I could not find any sufficiently large to be identified.

But perhaps the most interesting part of the coast is to be found on the beach itself. In the course of a morning's walk from Appledore over the pebble ridge along the sand I noticed several spots near the water's edge where the smooth surface was broken by the projecting upward of a bed of tenacious blue clay that seemed to underlie a large part of the beach for it could be seen in several places at a distance from one another. On a careful examination I found that this bed of clay was more or less full of different organic remains. In one spot I obtained from it abundance of specimens of the common mud shell *Scrobicularia piperata.* They were in their natural position hinge upward, and with the two valves united, or rather together, the ligament having decayed away. Of this shell Woodward says in his Manual of the Mollusca, "It lives buried in the mud of tidal estuaries five or six inches deep." From this fact it seems likely that a change of conditions must have occurred since these molluscs were living as the shells were found on the open beach far from the mouth of the estuary and where the influence of the land water must be quite unfelt. I found none of the same species on the present beach though the somewhat similar *Mactra stultorum* was abundant, and on the other hand I did not find a single specimen of *Mactra stultorum* in the clay. Another proof that they are not very recent is afforded by their colour. From their long burial in the clay they have acquired the same leaden hue and preserve it even after some years exposure to the air.

While on this part of the subject I may remark that shortly afterwards being at Swansea I made careful search along the shores of the Bay for any deposit at all resembling what I have above described. After some time I found a bed of the same tenacious blue kind of clay and in it were abundance of the *Sc. piper.* as at Bideford Bay in their natural position. The principal point of difference was that they occurred only at or near the top of the clay, whereas in Devon they were often completely buried in it. The part embedded was as before stained of the same colour though less permanently, and after a short exposure to the air regained its natural whiteness. Here however I found nothing besides. The clay seemed to underlie the beach as in North Devon and there was the same distinction between the shells in the one and those in the other.

Not far from the spot first described I found another patch of clay full of roots and rootlets which penetrated it in all directions making it appear to have been the ground on which vegetation must have grown at some past era. Not an inch of it was free from them but I saw no trace of stems or leaves. Among these roots was also a large number of spiral univalves which therefore may most likely be considered land shells. In form however they resemble Rissoa. I have not been able to determine the species with certainty. In order to make a fair comparison I searched the neighbouring cliffs and beach and soon found abundance of the same or an allied species but when set side by side the difference in size is remarkable. The recent shells are at least three or four often six or seven times as large as the sub-fossil forms. If of the same species this variation probably indicates different conditions of life as regards temperature, moisture and food. Their presence would also prove the existence of a land surface with vegetation on which the animals subsisted. It therefore appears that while some parts of the clay were wet enough to be the habitat of *Scrobicularia piperata* others were sufficiently dry, judging from the presence of roots, to support a terrestrial vegetation. In the same clay among the above described shells I found a number of small black glossy bodies which had every appearance of being seeds. They were very abundant in some spots and I was able to obtain a good many specimens though the greater part were broken in clearing them from the matrix. They are of course only shells—all the internal part having disappeared. I have not been able to determine the species, but should think them most likely to belong to some marsh plant. In order to preserve them I am obliged to keep them in water having lost a good many at first by allowing them to become shrivelled and cracked.*

It thus appears evident that this bed of clay with its organic remains is one of those patches of submerged land surface which are met with all round our south-west coast in the sheltered bays and inlets. At Barnstaple Bay it lies where I examined it not below low water mark but at other places it may be met with at much lower levels. In so far it is an evidence that land once dry enough to support terrestrial or estuarine life is now below the tide-level. A change like this may result from either of two causes—subsidence of the land or the removal of some barrier which once kept out the sea. Were this the only instance the latter might be thought a sufficient explanation but occurring as these submerged peat beds do at so many places and over so large an extent of country it is more reasonable to ascribe their position to a general subsidence of the district since the time of their formation.

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* Dr. Hooker, Director of Kew Gardens, at my request very kindly examined these seeds but considers it impossible to determine accurately to what species they belong without better and more numerous specimens than I at present possess. By his suggestion however I am enabled to mention that they closely resemble in outward form the seeds of *Stellaria media* but have not the same crenulated edge. This must not be understood as at all implying that they belonged to that plant but only as supplying a clue to their shape.

From the evidence given in my former paper I inferred that this subsidence at Falmouth had amounted to about 40 feet. A rather less amount would satisfy the demands of the problem presented in Barnstaple Bay. But on the other hand the evidence derived from the raised beaches is stronger in the latter place. They are remarkably distinct and reach a height of 30 feet above high water mark. They therefore indicate elevation to that extent at least since the time of their deposition. It would be an interesting study for any one staying in the locality to make a collection if it were possible of the organic remains in the raised beaches and compare them with those of the clay beds in order to determine which of the two is the older formation. To my own mind the evidence tends to shew that the raised beaches are the more ancient. The crucial test of superposition I have never been able to apply and the arguments in favour of this opinion are mostly derived from other localities. But if this view be the true one it is a necessary consequence that the following changes have taken place in the relative levels of land and sea in Bideford Bay during what may fairly be called quite recent geological times.

(a) As shewn by the raised beaches there was a time when the land lay lower than now by at least 30 or 40 feet. This was the time of their formation from materials derived from the surrounding cliffs.

(b) After the deposition of these beaches followed a time of elevation and reëmergence during which much of the previous deposit was washed away and the remainder lifted out of the reach of the waves to a height of probably 50 or 60 feet that is about 20 feet above its present position. During this period too occurred that growth of peat and wood which afforded the remains brought forward this evening.

(c) Subsidence again ensued by which the land surfaces of the preceeding period were gradually brought down to and below the water level and sand and shingle accumulated above it. This is probably still going on.

A unity is thus given to this interesting series of deposits and the same sequence is found to explain the phenomena presented in other spots around the S.W. coast.

It by no means follows that exactly the same extent of elevation or subsidence must be looked for in all these places. It is not probable that the movement was uniform over any large tract of country nor is it necessary that any gradation should be observed. The break may be quite sudden between a district undergoing upheaval and another and neighbouring one at rest or subsiding, for in this way only can we account for the faults ranging over a large extent of country and shewing such enormous upthrows and downthrows which are met with in almost all parts of the world.

For comparison I have brought some specimens of shells obtained from the deposit of the Avon dug out in making the new Dock entrance and used for filling up the Quarries on Durdham Down. They are mostly land shells but some of them betray a marshy situation. Many seem to be of the same species as those I found in the clay at Bideford Bay and moreover shells now found living on the banks of the Avon are as much larger in proportion than their sub-fossil representatives as are those from N. Devon. The neighbourhood of Bristol may be therefore supposed with reason to have undergone the same changes of level as the shores of North Devon and other parts of the S.W. of England.

II.

The British Fossil Entomostraca.

Read at the Sectional Meeting on February 7th, 1872.

By W. W. Stoddart, F.G.S., F.C.S.

After describing the beauty of form, extraordinary configuration, and complexity of the many pieces forming the exoskeleton, the ancient existence of these curious animals was alluded to and the immense number in which they are found in the different stratified deposits.

The Entomostraca are well adapted for the places in which they are found, some being free swimmers while others are contented with crawling on the mud, or hovering over the surfaces of plants. Some of them in the Palæozoic period attained a considerable size, but most of the genera are minute, not measuring more than the fraction of an inch.

The Entomostraca compose a sub-class of Crustacea ranging between the Cirrhopoda and Xyphosura. The name Entomostracon was first given by Müller in 1785. These animals differ from the ordinary Crustacea by having a carapace or valves under which the whole body and feet move with freedom, and possessing no true gills. Either some or all of the feet are expanded, and subdivided into an immense number of parts, covered with cilia so that a very large surface is exposed to the aerating medium. In a few genera the jaws are extended into a broad plate for the same purpose. This arrangement is beautifully shewn in the common Argulus. The Entomostraca are very cosmopolitan, abounding in fresh, brackish, or salt water. The Artemis inhabits only the Lymington salt-pan, in water holding a solution of 25 per cent. of common salt.

The valves of the Entomostraca are often sculptured with exquisite reticulations, striations, or other designs. They differ from the shell of a Mollusc by the absence of lime, and rather resemble the elytra of beetles by being composed of a substance resembling chitine. When lime is present the carapace effervesces with an acid and reddens by boiling like that of a lobster.

The bivalve carapaces of the Cyprididæ and Cytheridæ are united at the dorsal margin by a ligamentous hinge. The carapaces are always inequivalve, the left valve being always the larger in every species except Bairdia, Siliqua, and Cytherella, where the right valve is the larger one.

The carapace of a Lobster or Crab is formed by the development of the tergal pieces, while that of an Entomostracon is formed by the development of the epimeral pieces. In most fossils the carapace, valves, or tail-spines are the only portion preserved, and of those most frequently the exuviae only.

The author then proceeded to give a general sketch of these fossils and their mode of distribution.

1st. The Cambrian and Silurian periods. These deposits are frequently very rich in specimens, as Hymenocaris from Dolgelly and Tremadoc, while from other places are obtained Pterygotus, Eurypterus, Ceratiocaris, Trilobites, Beyrichia, Leperditia, and Dithyrocaris. The Beyrichia is a very distinctive fossil in the Silurian beds, B. tuberculata marking the Upper Silurian while B. complicata points out the Lower.

The Trilobites having been fully considered at a previous Meeting, Mr. Stoddart passed to

2. The Devonian period, which although less rich in fossil remains yet furnishes very large Pterygoti, Trilobites, and Leperditiæ. The latter chiefly occur in some of the Petherwyn and Marwood beds, which appear to belong more properly to the Carboniferous system.

3. The Carboniferous period saw the last of the Trilobites, but as a compensation the water swarmed with Cyprididæ and Cytheridæ, the former of which inhabit fresh and the latter salt water. After rather minutely describing the anatomical difference between a Cypris and Cythere, specimens were shewn from

4. The Permian and Triassic systems. In the Permian first occurs the genus Bairdia, which has no hinge teeth or crenulated margin to the valves of the carapace. In the Triassic strata abound the little Estheriae.

5. The Jurassic system. These strata have not yet been fully explored, but in many places abound with Estheria and Cythere. In the flinty limestone near Ridgeway in Dorsetshire are collected specimens of Cythereis, a sub-genus of Cythere from which it differs by having three tubercles from which rises a ridge continuing round the edge of the valve.

6. The Cretaceous system is extremely prolific in Ostracoda, as Cytherella, Cythere, Bairdia, Cythereis, Cytherea, and Cytheridea.

7. The Tertiary system. Here we find several sub-genera that have not occurred before, as Cyprideis, Cytherideis, and Candoya. The middle Eocene deposits are so full of their remains that the clay is rendered quite fissile.

Mr. Stoddart concluded his paper by exhibiting specimens of nearly every genus and most of the species, pointing out those localities which he had found most favorable to the collector.

IV.

Rocks: Igneous and Metamorphic.

By W. Sanders, F.R.S., F.G.S.

Read at the Sectional Meeting, March 13th, 1872.

[Abstract.]

Mr. Sanders presented at the outset a sketch of the constituents of the exterior of the earth; the agencies—atmospheric, aqueous, or igneous—which modify the surface of the globe; the general arrangement of the materials; their structure and chemical composition; their division into sedimentary and igneous.

The unstratified igneous rocks were treated under the divisions Plutonic and Volcanic. The Plutonic rocks were shown in two groups, the Felspathic which contain 60 to 80 per cent. of silica, and the Hornblendic or Augitic with only 45 to 55 per cent. of that element. The principal rock of the first group is Granite, a compound of three ingredients, Quartz, Felspar, and Mica; Felspar, containing potash, is called Orthoclase; with soda, it is called Albite; and when both these alkalies are present, the term Oligoclase is used. A mixture of Quartz and Felspar only is called Eurite or Aplite.

Felstone, Claystone, and Pitchstone are respectively compact, earthy or glassy Felspar. Those rocks which enclose large crystals in their general mass are termed Porphyritic.

The Hornblende group comprises the following—Syenite, a variety of Granite, in which Hornblende replaces Mica; and when the Quartz is absent the rock becomes Greenstone. Hypersthenite and Diallage are chiefly Silicates of Iron and Magnesia. Serpentine is a Hydrous Silicate of Magnesia. Diorite, a mixture of Albite and Hornblende, is abundant in Corsica. Melaphyre is chiefly a Silicate of Alumina. Diabase and Aphanite are varieties of Greenstone.

The Volcanic division has similar groups of Felspathic and Hornblendic rocks. Trachyte is the prevalent rock of the Felspathic group. It is composed of Silicate of Alumina with potash and soda. It forms the mass of the Drachenfels. Pearlstone is Trachyte with small globular concretions. Compact soda-felspars are called Clinkstone or Phonolite. Obsidian is glassy Trachyte and Pumice has the same composition but with a cellular structure. The Hornblende group contains Dolerite, a granular mixture of Labradorite and Augite. Basalt is very compact Dolerite. A variety less compact than Basalt is termed Anamesite.

The Metamorphic rocks were then described. Gneiss and Mica-schist were originally sediments of clay and sand, derived probably from Granite. They are of great variety, arising from the prevalence of either quartz or mica or hornblende in the original rock. Clay-slate, when uniform in structure admits of being cleaved into very thin slates. This quality was shown to arise from pressure exerted in a direction perpendicular to the planes of cleavage.

The annexed table is reduced from the larger one which was used to illustrate the paper and is appended for reference.

PLUTONIC ROCKS,

Felspathic — 60 to 80 per cent. of Silica.

Granite { Quartz ... 28, Felspar ... 53, Mica — white or black ... 19 } Silica ... 72, Alumina 15, Potash ... 5, Soda ... 3, Iron, &c. 5

Varieties of Felspar.
Orthoclase—with *Potash*—oblique system — S.E. of Ireland.
Albite-with *Soda*,-anorthic —Mourne Mountains.
Oligoclase,—with *Potash and Soda*, — anorthic — Scandinavia.

Aplite—Quartz and Felspar.
Eurite or Whitestone—the same—fine grain.
Elvanite—Quartz and Felspar, in veins as if from Granite.

Felstone { compact Felspar—80 per cent. Silica—in dykes—sometimes porphyritic,
Claystone—Earthy ditto, ditto.
Pitchstone—glassy.
Porphyry—rock with crystals.

Hornblendic and Augitic — 45 to 55 per cent. of Silica.

Syenite { Quartz. Felspar. Hornblende. }

Silica	46
Magnesia	19
Lime	14
Alumina	12
Protox. Iron ...	7
Fluoric Acid	1.5

Greenstone { Felspar (sometimes Albite.) Hornblende.

Hypersthenite { Labrador Felspar. Hypersthene }

Silica	54
Ox. Iron ...	25
Magnesia ...	14
Lime and Alumina	4

Diallage

Silica	53—50
Magnesia ...	15—17
Lime	19—16
Prot. Iron ...	9—12
Alumina ...	2— 3

Serpentine

Silica	44
Magnesia	43
Water	13

Diorite—Albite and Hornblende. (Corsican Granite.)

Melaphyre

Silica	52
Alumina ...	22
Lime	6
Potash and Soda ...	6
Magnesia ...	4
Iron and Manganese	9

Diabase—Greenstone with Augite.
Aphanite—the same—close grain.

VOLCANIC ROCKS.

Felspathic.

Trachyte	Silica	73	Drachenfels, Auvergne.
	Alumina	15	
	Potash and Soda ...	8	

Pearlstone—same, with globules.

Clinkstone / **Phonolite** } compact Soda Felspar—splits easily.

Obsidian	Silica	71	glassy Trachyte.
	Alumina	14	Ascension Isle.
	Potash	4	Lipari Isles.
	Soda	5	
	Iron, &c.	5	

Pumice—same—cellular.

Hornblendic.

Dolerite	Labradorite	Silica	54	granular.
		Alumina	30	
		Lime	12	
		Soda	5	
	Augite	Silica	53	
		Lime	22	
		Iron	17	
		Magnesia	5	

Basalt—compact Dolerite.

Anamesite—between Dolerite and Basalt.

Note on some Australian Fossils,

By W. W. Stoddart, F.G.S., F.C.S.

Abstract of a Paper read at the Sectional Meeting, on April 10th, 1872.

At the time of the discovery of Gold in Australia the geology of that Continent was almost unknown. In consequence however of the belief that this precious metal was only found in the older sedimentary and the igneous rocks, or in the Tertiary deposits formed by their degradation, an opinion became current that the Australian formations belonged to one or more of those systems, that is that they were either Palæozoic or Tertiary. To this conclusion the Naturalist was compelled to demur because the existing fauna and flora of that country wear a more strikingly Mesozoic aspect than those of any other on the globe. The land animals are very frequently marsupials or those having a pouch in which the young are carried in the earliest stages of their independent existence. In the sea are the Port-Jackson shark—the only living Cestraciont—the Trigonia, and the Terebratula. Among land plants are yet found living the Mesozoic types of Zamia, Cycas and Araucaria. All these exhibit a strong similarity between the Australian fauna and flora and those of the Jurassic period as shewn in a fossil state in Europe. It was therefore a natural inference that Oolitic strata were not likely to be wholly absent, and the conjecture was further hazarded that in Australia may exist the last home of vegetable and animal types once common to the whole globe, but since displaced in every other country by newer forms. Native tradition too has constantly spoken of the mysterious "Bunyip" an alleged inhabitant of the water-holes or lakes, which however was so seldom seen that its existence was considered doubtful. But within the last year the discovery of some bones, apparently those of a gigantic saurian, has given some ground for accepting the story which, if confirmed, will be further suggestive of Oolitic conditions.

In the Geological Journal for 1867, is a paper by the Rev. W. B. Clarke, in which the occurrence of Jurassic fossils is noticed. Specimens were also sent to England for examination.

In 1861 fossils undoubtedly Liassic were sent home by Mr. Gregory.

Upper Liassic and Oolitic fossils were also sent from Western Australia to the Exhibition of 1862.

Specimens were also exhibited at the Meeting which Mr. Stoddart had no hesitation in ascribing to the Greensand.

Another collection in the possession of Mr. Sanford of Nynehead Court, contains among others—

Ammonites Aalensis.
,, varians.
,, Brocchii.
Nautilus semistriatus.
Belemnites canaliculatus.
Gresslya donaciformis.
Cucullaea oblonga.
Pholadomya ovata.
Pecten calvus.
Lima proboscidea.
,, punctata.
Ostraea Marshii.
Rhynchonella variabilis.

All these are familiar to any one who has examined the Jurassic beds of Dundry and the Cotteswold hills.

Other fossils were also exhibited from Van Diemen's Land indicative of the occurrence of Silurian strata in that island.

PROCEEDINGS

OF THE

Bristol Naturalists' Society.

JUNE TO DECEMBER, 1872.

GENERAL.

I.

Recollections of the Brighton (1872) Meeting of the British Association for the Advancement of Science.

By Wm Lant Carpenter, B.A., B.Sc.

Read before the General Meeting, October 3rd, 1872.

[Abstract.]

The speaker commenced by stating that as the City of Bristol had sent an invitation to the Association to hold a meeting there in an early year, (perhaps 1875), it was desirable to spread a knowledge of the Association as widely as possible, in order that interest in it might be excited, and that a successful meeting here might be the result. He proposed therefore to touch briefly upon the History, Objects, and Constitution of the Association, and then to give some account of the recent Brighton Meeting.

I. History. The Association was founded on September 27, 1831, at York, when, at the invitation of Sir D. Brewster, 300 scientific men attended. At the next meeting, in Oxford, 1832, the first of a series of reports on the progress of science was presented,—a series which has maintained its very high character to the present day—and through which the Association has won great prestige. Then followed meetings in Oxford, (1832), Cambridge, (1833), Edinburgh, (1834), and Dublin, (1835), and after these University towns, Bristol was the first to offer a temporary home to the Association, where the first, and as yet the *only* meeting was held here, under the Presidency of the Marquis of Lansdown, and attended by 1350 persons. Since then, meetings have been held yearly, the largest being at Newcastle-on-Tyne, in 1863, attended by 3335 persons, and most of the large towns in England have received the Association two or three times. In 1864, at the Bath meeting, a Pharmaceutical Conference was inaugurated, which has continued to hold yearly meetings, three days before the opening of the Association meeting.

II. Objects. The Association aimed at the advancement of science,—

a. Directly, by pecuniary grants towards the furtherance of original investigation.

b. Indirectly, by the formation of an enlightened public opinion upon scientific matters.

The Association is, probably more than any other body, the recognised representative of national science, and in this capacity is the scientific adviser of the Government. One of the most important public works carried on by it was the maintenance of the Kew Observatory. Several others were also alluded to.

III. Constitution and Organization.

The Association consists of Life Members, Annual Members and Associates. The latter class consists of ladies and gentlemen who join simply for one meeting, and is usually composed of local residents. The Association is essentially peripatetic—never meeting in London—but endeavouring to give a scientific stimulus to the town where it does meet. It is managed by the General Committee, a thoroughly representative body, which elects the Council and Officers of the Association, decides on the place of meeting, the amount of pecuniary grants, &c. The executive power rests with the Council, which meets in London. All local arrangements as to meetings are left to the local committee, organised in each town prior to the visit of the Association. For the more systematic pursuit of each branch of science, seven sections are formed, each with its Officers and Committee.

A. Mathematics and Physics.

B. Chemistry.

C. Geology.

D. Biology, divided into the sub-sections of Zoology and Botany, Anatomy and Physiology, Anthropology.

E. Geography.

F. Economic Science and Statistics.

G. Mechanical Science.

In each of these sections, papers are read and discussed, the reports of Committees of Investigation presented, &c. during the day. The evenings are occupied with the President's address, lectures by distinguished men, and by Soirées, and the last day by excursions to objects of scientific interest in the neighbourhood.

The Brighton Meeting was held from August 15th to 23rd, 1872, under the presidency of Dr. W. B. Carpenter, F.R.S., &c., the tone of whose address was suggested by the spread of materialistic opinions in England. Instead of discoursing on some aspect of nature in her relation to man, he enlarged on man as the interpreter of nature, considering the mental processes by which were formed the fundamental conceptions of Matter and Force, of Cause and Effect, of Law and Order, which furnish the basis of all scientific reasoning. He showed that to the Artist, the Poet, and the Philosopher, nature is to each what he individually sees in her—and he led up to the culminating point of Man's intellectual interpretation of nature, his recognition of the unity of the power of which her phenomena are the diversified manifestations.

The addresses of the Sectional Presidents were then alluded to. In Section A, Mr. Warren de la Rue described the latest improvements in astronomical photography, and their importance in connection with the approaching transit of Venus, since upon a comparison of photographs at different points of the earth, would depend the measurement of the earth's distance from the sun. He concluded by expressing a decided opinion that the time had come for a cultivation of science to be protected and fostered by the State. In Section B, Dr. J. H. Gladstone reviewed the connection of Chemistry with all other sciences, remarked on the advantages of its study, and its introduction into schools, and lamented the small amount of original research in England as compared with the Continent, which he believed was mainly due to its non-recognition by public bodies or the Government.

In section C, Mr. Godwin Austen, who was elected president from his great knowledge of the Wealden formation, made that the subject of his address, reviewing the conditions under which the Oolitic strata were deposited, and tracing the Wealden area in Europe. In section D, Sir J. Lubbock referred to the frequent misunderstanding of Darwin's views, and pointed out how embryology was as good a guide to the study of the organic development of ancient times as a series of fossils was. In the subsection of anthropology, Col. A. L. Fox pointed out how a study of the remarkable analogies between races in the same condition of progress bore on the question of the monogenesis or the polygenesis of man.

In the subsection of Anatomy and Physiology, Dr. Burdon Sanderson showed how much closer physiology now was to the experimental sciences, and what a great need of workers there was. To promote this, however, the first want was a general spread of scientific education—hence the value of popularising science. In section E, Mr. Francis Galton spoke of the geography of the future, when mere exploration was ended, and then developed a scheme for the greater sale of reduced copies of the ordnance maps. In section F., Professor Fawcett, M.P. reviewed the present economic condition, and the probable effect of present economic influences, offering several practical suggestions, and expressing a fear that the tendency of legislation was to hamper industries, by interfering too much with them. In section G, Mr. F. J. Bramwell took coal as his subject. He dilated upon its use and abuse—how other sources of power might be used, as the wind, streams, tide mills, &c., making there a special reference to the tide at Bristol. He pointed out many ways of saving coal, both in domestic and manufacturing use, and in strong terms condemned the so called practical man, as the great obstacle to all improvements.

In conclusion, Mr. Carpenter referred to some of the principal reports, papers, and discussions, that came before the various sections, gave a short account of the excursions, and concluded by hoping that the Bristol Naturalists' Society would do all in its power to render a meeting of the British Association in Bristol, one of the most successful ever held.

II.

Notes on Fossil Botany,

By C. B. Dunn.

Read at the General Meeting, December 5th, 1872.

That most pleasant and interesting science, Botany, may be studied under various divisions, but the most difficult one is undoubtedly Fossil Botany, for this simple reason, that the whole plant may be examined in the study of our Flora of the present day; whereas Fossil specimens are seldom found except piece-meal. In the Coal measures where they most abound, so great has been the pressure of the superincumbent mass of earth, that the vegetable matter has been converted into amorphous pulp before mineralisation took place; and when they have retained their form they are so fragmentary that it is difficult to determine the various portions that belong to the same plant. The root, the stem, the branch, the leaf and the fruit are usually found detached, and so each of these parts have been referred to different genera.

At the present time a very considerable amount of progress is being made in palæontological Botany by the careful comparison of specimens with each other, and the revelations brought to light by the microscope of their minute vegetable structure.

Fossil plants are traced back even to the Silurian System, that is, the oldest of the sedimentary rocks, the Palæchorda, an Alga much like Chorda filum of our times, has been detected in abundance iu the Lower Silurians. In the Old Red Sandstone series of rocks, Fucoids and other Algæ have been found. Cyclopterus Hibernicus occurs in the Yellow Sandstone of the south of Ireland, included in the Old Red period. In the Carboniferous series commencing with the Millstone Grit, Calamites are plentiful, and Stigmaria that is the roots of Sigillaria, whose trunks formed a large portion of that mineralized vegetable matter called Coal. In the Coal Measures vegetation appears to have reigned supreme, for pure Coal is vegetable matter condensed. Sphenopteris, Calamites, and Lepidodendron, were types of plants analogous to the Ferns, Equisetums, and Lycopodiums, of the present day. Lepidodendra were great plants of the Club-moss type, that rose seventy feet high. It was of course an absolute mechanical necessity, that if they were to present, by being tall and large, a wide front to the tempest, they should also be comparatively solid and strong to resist it, and such on examination is found to be the case. In attempting to picture to himself the dense green web of vegetation that covered the face of the earth at the time of these Old Carboniferous deposits, the Palæontologist imagines himself walking in the dark aisles of Nature's Cathedral, where the slim columns were fretted over with arabesque tracery, and at some sixty or seventy feet branching off into an elegant network of filagree, or headed with a capital of feathery foliage like the palm trees of the tropics of the present day, or darkening with their clouds of cone-like fruits the already misty and vapoury face of the earth.

In the Oolitic formation a new feature of vegetation presents itself in the form of Zamia, allied to the Cycads of the present time.

The whole of the foregoing Fossils are included in the classes of Acrogens and Gymnogens, and almost the whole of known fossils belong to the natural order Filices, Lycopodiacæ. Equisetaceæ, Cycadaceæ, or Coniferæ. Among the more recent discoveries made in this department of science, those made by Mr. William Carruthers, of the British Museum, are most important. Of the Genus Lepidodendron he says, "That they are numerous in species, and very numerous in individuals, any one who has cursorily examined a coal-pit, or the fossils in any public museum, must be convinced. The axis of the stem cannot be considered as a true medulla or pith, inasmuch as it is composed not of simple cells, but of elongated utricles of various sizes, irregularly arranged, and having thin walls marked with scalariform bars. The tissue of the wooden cylinder consists of long scalariform vessels, which increase in size from the inner margin to the outer, this increase being sufficient to meet the requirements of the enlarged circumference. with the help of only a few additional series of vessels. As there is no true medullary cellular tissue in the axis so there are no medullary rays passing through this cylinder. In radial sections an appearance is seen singularly resembling, to the naked eye, the "silver grain," produced in dicotyledonous woods by the medullary rays; but this arises from a very different cause. The woody cylinder is surrounded by a great thickness of cellular tissue, which extends to the exterior of the stem, and is composed of three distinct and separable zones. The cell walls of all the three zones are without markings of any kind. These zones are traversed by the vascular bundles, which rise from the outside of the interior wood cylinders and pass to the leaves and branches. Each bundle consists of fine scalariform vessels and terminate in the points seen in the areoles of the stem, which are the scars of the leaves."

Stigmarioid Roots have been determined to belong to Lepidodendron as well as to Sigillaria, and their whole structure supports this determination. The roots of Lepidodendron must have presented in their crowded and long rootlets an immense surface for the absorption of moisture; and in their great abundance of lax cellular tissue possessed the means of containing this moisture, and transmitting it to the foliage. The leaves were simple, lanceolate, acute, and sessile. They had a single medial nerve, and when found separated from the branches, are called Lepidophylla. The younger branches were densely covered with leaves; the scars left on the trunk after they perished give the numerous beautiful markings by which the species have been distinguished. The fruit was a strobilus formed from a shortened branch, the leaves of which are converted into scales, that support on their upper surface a single large sporangium, or perhaps as in the Flemingites several small ones. There appear to be both macrospores and microspores in the same sporangium. Specimens of Lepidostrobus, as the fruit is called, have been found attached to the branches of Lepidodendron. In tracing the affinities of this genus we have the safest guide in the organs of fructification. The sporiferous strobilus shows that it is a true cryptogam; and in general appearance and arrangement of parts the strobilus can scarcely be distinguished from that of some living Lycopodia, except in the difference of size.

Respecting Calamites, Mr. Carruthers says, "Few fossils have been more misunderstood than the set of plants to which the name of Calamites is given. One of the least errors regarding them was that which placed the stem upside down, and made the cylindrical roots its leaves. The branchlets and foliage have been referred to the genus Asterophyllites, supposed to be independent aquatic plants, and the fruits form the genus Volkmannia. Calamites usually exhibit an apparently furrowed and jointed stem, somewhat resembling the recent Equisetaceæ. The few specimens that have been found with the internal organisation of the stems preserved, show a structure differing from what had been assumed to be that of Calamites, and have been constituted into the genus Calamodendron. The stem of Calamites was formed on a different plan from that of Lepidodendron. The axis consists of a considerable mass of cellular tissue. This is surrounded by a solid cylinder of wood, formed entirely of scalariform vessels, these formed constrictions at regular intervals; beyond the woody cylinder there was an epidermal layer of parenchyma, which is less seldom preserved even than that of the interior. When the stems were thrown down the cellular portions were generally completely destroyed, and the space occupied by the axis was filled by the clay or sand in which the plant finally rested. In this way a cast of the interior was made, which in time became harder than the vascular tissue of the stem, and the pressure of the superincumbent deposits flattened and compressed the woody cylinder, producing on its upper surface a counterpart of the internal cast with its furrows and constrictions. The stem somewhat rapidly contracted at the base, the nodes shortening and giving off cylindrical roots which spread laterally through the soil. The main stem was simple, but at intervals gave off whorls of slender branches, and these again bore branches or leaves also arranged in whorls, each whorl containing from ten to twenty leaves of a linear acuminate form. The fruit was composed of whorls of scales alternating with, and protecting whorls of sporangium-bearing spines. It was borne at the end of the primary branches, or in whorls around them and was composed of a shortened axis, with the leaves specially developed. The strobilus consists of protecting scales fifteen in a whorl, the scales of each whorl being opposite to those in the others: between the scales is a whorl of five short spines, each supporting four flask-shaped sporangia arranged perpendicularly on the axis, the one directly over the other."

There are several varieties of Equisetums which bear their fruit on the end of the branchlets, in this they resemble Calamites, although the general arrangement in Equiseta is to bear the fruit at the termination of the main stem,

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III.

A Letter from Boston, U.S.,

By E. W. Claypole, B.A., B. Sc., Corresponding Member.

Read at the General Meeting, Dec. 5th, 1872.

[Abstract.]

" Boston like Bristol is laid out anyhow," (New York is laid out on the the square).........Building stone is dear in Boston. The neighbourhood affords none suitable for the purpose, the only kind occurring near the city being a very coarse red sandstone or conglomerate full of pebbles of red and greenish quartzy rock. It is used for foundations and other rough work, but cannot of course be tooled. A fine brown sandstone comes from Connecticut, and has been much used for frontages; a yet finer kind is now being introduced from New Brunswick. Granite, the common black and white kind is largely used for foundations and doorsteps, but is too expensive in working to be employed for building houses. It is chiefly brought from Maine. The best and most beautiful, and at the same time not very expensive material, is the white and veined marble from Vermont. This is largely used for fronts, being put on over brick, as the Bath Oolite in Bristol, and sometimes polished. Not unfrequently it is used solid, and the blocks of white houses and public buildings have a very tasteful and clean appearance. They preserve their purity and brightness even in the heart of the city, because the almost exclusive use of anthracite coal completely prevents the cloud of smoke that hangs over every English city of the same size, and also over the great manufacturing centres of the middle and Southern States where the bituminous coal is burnt. (It may be worth mentioning that the latter occurs chiefly on the Western and the former on the Eastern side of the Alleghany Mountains.) As a consequence of its comparative abundance, marble is much more commonly used here than in England for furniture and other common purposes.

The ground on which the City stands is very flat and the soil is sandy. A very large part of it has been reclaimed from the sea, and the same

process is still going on. During the last 16 years hundreds of acres have been thus reclaimed and filled up to grade with millions of tons of gravel brought in by the different railways, and a plan is now being carried out by which 800 acres more will be obtained. To secure the foundation, piles are driven into a bed of clay, underlying the sand and cut off below low water mark, so that much of the newer part of the city consisting of brick and stone houses, often five storeys high, really rests on timber. At the back of the city crops out the coarse carboniferous conglomerate above alluded to, dipping to the N.W. and forming a good soil for the growth of trees Robury and other suburbs of Boston are situated on this formation and are remarkable for the beauty of their woods. The surface has been severely glaciated, if I mistake not, A cursory walk over the district revealed great bosses of rounded rock *(roches moutonnées)* in every direction, but I did not observe any striations. Many of the hills exhibit the "crag and tail" formation, the crag being at the western or north-western end.

The Boston Library is supported entirely by the city, and open to all persons living or staying there without charge. Should any resident apply for a book which is not in the catalogue he need only write the title on a slip of paper, provided for the purpose, and hand it in to the Librarian, when the book is immediately ordered. On its arrival he is informed and allowed the first use of the book for perusal. The sum of 15,000 dollars is I believe, annually voted by the city for the support of this Institution.

In the last paper which I read before the Geological Section and which appeared in the "Proceedings" I gave an account of the beach at Barnstaple Bay. Among the specimens I then showed, as the hon. sec. will recollect since he was good enough to mount one of them for me, were some fossil seeds, which I could not identify. I was obliged to leave the point open. A foot note to that paper showed the difficulty of recognising such objects with certainty.* It was therefore not a little interesting to me on my first walk out in the neighbourhood of Boston to accomplish what had previously baffled me. Crossing a salt marsh near the town I picked up a few specimens of a small plant growing there, and while examining it, some of the ripe seed dropped out into my hand, when I immediately recognised them as the very same with my unknown species from Devon shire, having the same form, colour and size. On referring to books I found it to be Atriplax patula, which is I believe a common English plant.

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* See Vol. VII, pt. 2, p. 18.

The Boston Natural History Society is like our own, the occupant of a new building. The collection is far from complete at present. Its members hold two general meetings in the month, and there are sections for Microscopy and Entomology. but none for Geology, which does not seem so favourite a study as at Bristol, probably on account of the nature of the formations occurring in the district, these are all Palæozoic, and most of them unfossiliferous.

I learn that there are 13 distinct species of Oak in Massachusetts alone, none of which can be identified with our English Oak. Many of the English trees are very common here, probably all introduced, but there are many more that are unknown in our country, quite enough to take away much from the feeling of familiarity, and sometimes sufficient to cause one of strangeness. Among familiar English plants, I have already noticed the following:

The Common Barberry,	The Blackberry,
,, ,, Elder	,, Great Mullein
,, ,, Privet	,, Tansey
,, Burdock	,, Common Polypody
,, Stinging Nettle	,, ,, Yellow Toadflax

IV.

Twenty Years' Rainfall at Clifton,

By George F. Burder, M. D., F. M. S.

The year 1872 completes an unbroken series of twenty years, during which rainfall observations have been taken at No. 7, South Parade, Clifton, either by my late brother, William C. Burder, or by myself. The rain-gauge employed has been throughout of the form known as "Glaisher's," the receiving surface having a diameter of eight inches. The cylinder of the gauge is partly sunk in the ground, and the receiving surface is six inches above the ground. The height above the mean sea level is 192 feet. The position of the gauge has been changed once only, a movement of a few feet having been rendered necessary by the growth of trees. As a rule, the gauge has been emptied daily when rain has fallen.

TABLE I.

RAINFALL AT CLIFTON IN TWENTY YEARS.

Year.	Jan.	Feb.	March.	April.	May.	June.	July.	August.	Sept.	October.	Nov.	Dec.	Year.
	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.	Inches.
1853	2·994	0·733	0·544	3·125	2·335	4·385	4·787	4·486	3·324	3·934	2·946	0·607	34·200
1854	3·206	1·013	0·670	0·022	3·398	3·069	2·534	1·338	1·089	3·340	1·988	1·996	23·663
1855	0·311	1·462	2·166	0·429	2·188	3·628	3·490	2·789	0·849	6·060	0·541	0·992	24·905
1856	3·455	1·868	1·193	3·666	3·142	1·669	1·737	4·694	5·240	2·730	0·720	2·465	32·579
1857	2·707	1·552	1·883	2·857	2·074	2·108	2·501	3·968	2·215	3·275	1·668	1·071	27·879
1858	1·201	1·165	1·073	2·904	2·468	2·006	1·911	2·062	3·270	2·673	1·503	2·884	25·120
1859	1·995	1·654	4·747	2·955	2·390	1·929	3·938	3·950	4·185	2·224	3·045	3·861	36·873
1860	4·943	0·994	2·915	1·688	3·539	7·104	1·869	5·682	2·434	3·027	2·828	3·775	40·798
1861	1·033	2·751	2·935	0·305	1·385	3·339	4·534	2·568	3·860	2·283	4·860	1·459	31·312
1862	3·203	0·413	4·496	3·135	3·358	2·728	2·536	1·447	2·389	5·717	1·469	1·982	32·873
1863	4·087	0·809	0·832	1·894	2·252	4·645	0·509	3·879	3·584	5·203	2·903	1·666	32·263
1864	1·564	1·881	2·623	1·395	0·865	2·123	1·002	1·121	3·356	1·895	2·945	1·976	22·746
1865	3·764	2·879	1·157	0·729	1·986	1·578	4·233	8·508	0·022	4·969	3·253	3·426	36·504
1866	4·217	4·801	2·090	1·684	1·115	3·622	2·663	3·254	7·404	1·919	2·394	4·945	40·108
1867	4·867	2·712	4·865	3·410	2·520	2·069	2·728	2·046	1·338	3·643	2·200	1·570	33·968
1868	5·898	1·970	1·790	2·306	1·764	0·639	0·882	5·761	2·995	2·755	1·673	5·672	34·105
1869	5·368	3·882	1·203	1·126	6·304	1·026	0·957	1·396	5·775	2·439	2·399	4·296	36·171
1870	2·477	1·400	1·576	0·566	1·545	0·619	1·472	2·000	1·770	5·333	2·741	1·930	23·429
1871	2·118	1·560	1·495	3·759	1·206	1·447	5·114	1·865	5·239	2·430	0·626	2·238	29·097
1872	6·416	4·187	2·202	2·750	2·651	3·418	3·724	2·178	2·207	4·124	4·326	4·183	42·366
Mean of the 20 yrs.	3·291	1·984	2·123	2·035	2·424	2·658	2·656	3·250	3·127	3·499	2·351	2·650	32·048

TABLE II.

EXTREMES AND MEANS OF MONTHLY AND ANNUAL RAINFALL AT CLIFTON, 1853—1872.

	Least Fall	Greatest Fall	Mean of 1st 10 years	Mean of 2nd 10 years	Mean of the 20 years
	Inches	Inches	Inches	Inches	Inches
January ...	0·311	6·416	2·505	4·078	3·291
February ...	0·413	4·301	1·360	2·608	1·984
March	0·544	4·865	2·262	1·983	2·123
April	0·022	3·759	2·109	1·962	2·035
May	0·865	6·304	2·628	2·221	2·424
June	0·619	7·104	3·197	2·119	2·658
July	0·509	5·114	2·984	2·328	2·656
August	1·121	8·508	3·298	3·201	3·250
September...	0·022	7·404	2·885	3·369	3·127
October......	1·895	6·060	3·526	3·471	3·499
November...	0·541	4·860	2·157	2·546	2·351
December ...	0·607	5·672	2·109	3·190	2·650
Year	22·746	42·366	31·020	33·076	32·048

In Table I. are given the quantites of rain (including melted snow and hail) collected in each of the 240 months over which the observations extend; also the annual totals, and the monthly and annual means. It will be seen that the three driest years were 1854, 1864, and 1870; the three wettest, 1860, 1866, and 1872. The driest of all was 1864, the wettest of all, 1872. In 1864 the fall was only 22·746 inches; in 1872 it amounted to 42·366 inches. No month was entirely without rain, but in April, 1854, and again in September, 1865, the quantity barely exceeded the fiftieth of an inch. The exact amount was in each of those months, 0·022 inch. The heaviest monthly falls were—in June, 1860, 7·104 inches; in August, 1865, 8·508 inches; and in September, 1866, 7·404 inches. The wettest month of the whole period, and one of the two driest months occurred consecutively.

Table II. has been compiled partly to show the extremes in either direction to which the rainfall of each month is liable, and partly to give an idea of the length of time necessary for the deduction of trustworthy averages. For this latter purpose the period of twenty years has been divided into two periods of ten years each, and the monthly and annual averages have been calculated for each of these. In this way there comes out even in the annual averages a discrepancy of more than an inch, while the differences between the monthly results are in some cases surprisingly large. Thus the mean rainfall of January, which, deduced from the first ten years, is a trifle over two and a half inches, deduced from the second ten years is upwards of four inches; and the mean of February, which in the first period, is not much more than an inch and a third, becomes in the second period two inches and six tenths. Clearly, therefore, ten years is too short a period for obtaining even approximately the average rainfall of a particular month, while even for a whole year the possible error of a ten years' average is not unimportant; it may indeed be greater than appears by the table, for it is possible to select two decennial periods of which one (1855–1864) shall give an annual average of 30·735 inches, the other (1859—1868) an average of 34·155 inches. Results showing an even greater discordance than this would be obtained if the calculations were based upon the two eleven-yearly periods 1854 to 1864, and 1859 to 1869. The averages drawn from these two periods are 30·092 inches and 34·338 inches respectively. Hence it follows that two observers might have recorded the rainfall of Clifton with perfect accuracy for eleven years each, and yet their annual averages should differ by more than four inches,—a consideration which must certainly enhance the value of a connected series of observations such as that now submitted.

Assuming then a twenty years' average to be fairly true, it may be said that the mean annual rainfall at Clifton is 32 inches, the range extending from less than 23 to more than 42 inches. The three driest months on an average are February, March, and April. In the table it appears as if February were the driest of all, but when allowance is made for the different lengths of the months, it turns out that the driest, on an average of twenty years, is the proverbially "showery" month of April. The three wettest months of the year are, in the order of their wetness, October, January, and August. Looking at this matter from a more general point of view, it is worthy of note that the three driest months occur consecutively at the time of year when winter is gradually yielding to spring; and that the wettest three-monthly period is that which includes the transition from summer into autumn. The difference between these two periods is striking. In the three months of which the early spring is the centre, namely, February, March, and April, the average aggregate rainfall is 6·142 inches. In the three months of which the early autumn is the centre, namely, August, September, and October, the average is 9·876 inches.

SECTIONAL.

On the occurrence of Zoophycos scoparius (Thioll :) in the Inferior Oolite of Dundry.

By E. B. Tawney, Assoc. R. Sch. of Mines, F.G.S.,

Read before the Geological Section, December 11th, 1872.

In the summer of 1872, in fact on one of the excursions made by this Society to Dundry Hill, I found the above fossil.

It is an Alga, a remarkable one too of its kind, and it has the additional interest of being, as far as I know, new to English Geology. At least I can find no mention of its having been recognised here before, though it is well known in parts of the continent.

Genus *Zoophycos* Massolongo, 1851.
Chondrites (Thiolliere)
Taonurus (Fischer-Ooster)
Cancellophycos (Count Saporta, 1872*)

The genus Zoophycos was instituted by Prof. Massolongo in 1851, to include certain fan-shaped Algæ found in North Italy, but whose nature was till then so little understood that they had been ranged at different times under the genera Fucoides, Zonarites, Pterocarpus, and even Gorgonia.

Zoophycos scoparius (Thiolliere sp :), Our fossil from Dundry is a plume-shaped Alga, corresponding precisely with continental specimens, so abundant in certain spots in the Alps and South of France.

The characteristic of the genus is a frond, in shape something like an ostrich-plume, set on a wide stalk, and disposed perhaps in whorls or close spirals. The distinctions of the species depend on the frond being radiate, infundibuliform, &c.

The present species is strongly arched or bow-shaped, but not divided into crescent, or horse-shoe shaped segments.

Zoophycos scoparius is extremely characteristic of the Inferior Oolite in the Alps of the Canton de Vaud, being sometimes almost the only fossil to be found in those beds.

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* As Count Saporta has not published yet the description of the plate in which this new generic name is given, we do not feel entitled to adopt it.

We may look upon it perhaps as the Laminaria of the period.

Its presence is therefore important when it enables us to determine horizons in the Jurassic Series which we might otherwise have difficulty in doing.

On Mont Cray above Chateau d' Oex (Canton de Vaud) I have seen it covering the surfaces of the dark grey limestones and shales, for the space of many square yards; its graceful plumes overlapping one another, so thickly were they crowded together: at other places in the same formation perhaps scarcely a trace of it is to be seen, and yet other fossils seemed to me very much more scarce.

It not only occurs in he Alps, but seems to be characteristic of the Inferior Oolite (Bajocien) in the South of France.

M. Bleicher (Revue Scientifique 26th October, 1872,) describes it as occurring in the Basses Cevennes, in rocks where other fossils seem locally very scarce.

Our specimen was found at Rakledown quarry, Dundry, in the Inferior Oolite. I have presented it to our local Museum.

The species which have been hitherto described are, as far as I knew the following.—

Z. Caput Medusæ (Massolongo) from the Eocene of Monte Bolca.

Z. Villoe (Mass:) from the Upper Cretaceous beds of Mid-Italy.

Z. Brianteus (Villa sp:) from the Upper Cretaceous of Italy.
Fucoides Brianteus (Villa
And Gorgonia? Targioni (Savi and Menegh:)

Z. Scarabellii (Mass:) from Miocene beds of Sassotello (near Bologna.)

Z. ferro-equinum (Heer) from I. Oolite of Canton de Vaud.

Z. procerus (Heer) from I. Oolite of Canton de Vaud.

Z. scoparius (Thioll: sp.)
Chondrites scoparius (Thiolliere) from I. Ool. of Canton de Vaud, S. France, &c.

VI.

On the Collection of Upper Greensand Fossils in the Bristol Museum.

By E. Tawney, F.G.S.

Read before the Geological Section, Dec. 11th, 1872.

[Abstract.]

The author of this paper after alluding to these fossils, which are nearly all from the Blackdown Hills, as one of the treasures of the Geological collection, proceeded to add that they were valuable from comprising so large a number of type specimens.

These were described and figured by Sowerby, in an appendix to the classical monograph of Dr. Fitton, on the "Strata below the Chalk."

(Dr. Fitton's paper bears the date of 1836, though it had been read to the Geological Society in 1827.)

This collection of Blackdown fossils was formed by the late Mr. Miller, but on his decease, it was acquired by the Bristol Philosophical Institution, and then lent by the Managers to Dr. Fitton, for the sake of being named by Sowerby.

In arranging the fossils of the Museum, the author of the present paper said that he regretted to find that they had been so indifferently catalogued, that many of them bore erroneous names, while others had not been named at all, and on compiling a list it was found that some had been lost.

The results of his catalogueing are the following:—

Out of a total of 144 species (being 137 named and 7 un-named) mentioned by Dr. Fitton, there were described and figured, 57 as new species: a few of these have however since been degraded from the rank of species.

Of these 57 types, there are at present in the Museum 49, so that 8 have been mislaid, viz.

Astarte multistriata. Phasianella pusilla.
Nassa lineata. Pollicipes lœvis.
Natica granosa Psammobia gracilis.
Petricola nuciformis. Terebratula dilatata.

Besides the 57 types of new species, there were figured 6 others, but not for the first time: none of these are mislaid.

There remain then out of a total of 144, still 81: these were not figured, but simply cited as existing in the Miller Collection: again of these 6 are missing, viz.

Corbula sp.
—— sp.
Cytherea parva.
Solarium conoideum.
Terebratula pisum.
Ammonites dentatus.

The Paleontological evidence of the Blackdown deposit was next discussed.

First was remarked, that of the Ammonites all except 3 occurred in the Gault, but none is the Neocomian: so that the important group of Ammonites go to prove that these beds have much nearer relation to the Gault than to any other deposit.

Of other fossils it was shown that more occurred in the Gault than in the Neocomian, though the difference is not so great as in the case of the Ammonites.

It was added that Professor Renevier has shown that 23 Blackdown species occur in one locality (Cheville) in the middle Gault of the Alps, and 10 in the Lower Gault of the same locality: while out of a total of 239 species in the L. and M. Gault of Cheville, only 9 occur in the Swiss "Aptien," or top beds of the Neocomian.

VI.

Notes on some Melville Island Flowers,

By A. E. Hudd.

Read before the Botanical Section, December 19, 1872.

Melville Island, the largest of the group now known as the "Parry Islands," is situated between the 74th and 77th parallel of N. latitude, and between 105° and 115° 30′ west longtitude. With the exception of Spitzbergen and the northern portion of the continent of Greenland, these islands, were until comparatively recent voyages, the nearest land known to exist in the direction of the North Pole. A short account of some of their natural productions may therefore be of interest, especially as I am enabled this evening to exhibit a small collection of plants from Melville Island, which were collected rather more than fifty years since, by an officer who accompanied Captain Parry in his celebrated voyages of discovery in the "Arctic Regions." "Winter Harbour," a bay on the South coast of Melville Island, was, as its name implies, the locality chosen by Parry and other Arctic explorers, for passing the long, dreary, sunless winters of these frigid climes. It was probably in the immediate vicinity of this harbour that most of my botanical specimens were gathered; this portion of the island being protected from the north by a range of hills.

A few remarks on the geological features of the island may be acceptable before considering its botanical productions. The Rev. S. Haughton, of Dublin, in the appendix to McClintock's "Voyage of the Fox," says:

"There is abundant evidence to show that the Arctic Archipelago was submerged at comparatively recent geological periods, many species of shells, etc., now living in the neighbouring seas being found, at considerable heights, throughout the whole group of islands. But this submersion must have occurred anterior to the period when pine forests clothed the sandy shores, remains of such forests now occupying positions at least 100 feet above the level of high tide." According to the geological map of the Arctic Regions published in the same work, the Northern portion of Melville Island above latitude 76° consists of carboniferous limestone, and the remainder of the island of carboniferous sandstone with beds of coal. Iron-stone, coal, and brown hematite were found along the south coast by McClintock.

As the ground in these high latitudes is seldom without a covering of snow, and the sun is absent from the sky for a period of nearly 100 days every winter, it might naturally be expected that a very small number of flowering plants could exist under such unfavourable circumstances. I was therefore rather surprised to find that nearly sixty species have been brought home from Melville Island alone, and that including mosses, lichens, &c., the number is increased to upwards of one hundred. My collection, which consists exclusively of *Dicotyledonous* plants, contains forty-three species, viz.:

Ranunculus nivalis, Lin.
,, var sulphureus, Soland
Papaver nudicaule Lin.
Draba alpina Lin.
,, androsacea Wahlbg.
Cochlearia fenestrata, Brown.
Parraya arctica, Brown
Cardamine, sp. ?
Lychnis apetala, Lin.
*Silene acaulis, Lin.
*Cerastium alpinum, Lin.
Stellaria Edwardsii, Brown
*Arenaria rubella, Wahl.
A Rossii, Brown
*Saxifraga oppositifolia, Lin.
* ,, Hirculus, Lin. (?)
,, flagellaris, St.
,, tricuspidata, Rottb.
* ,, rivularis, Lin.
* ,, cæspitosa, Lin.
* ,, nivalis, Lin.
,, Sp. ?
*Saxifraga cernua Lin.
*Chrysosplenium alternifolium Lin.
Dryas integrifolia Br.
Potentilla pulchella Br.
,, nivea Lin.
*Astragalus alpinus, Lin.
Oxytropis arctica, Br.
Epilobium latifolium, Lin.
Cineraria congesta, Br.
Antennaria alpina, Br.
Erigeron uniflorum, Lin.
Pyrethrum alpinum.
Campanula uniflora, Lin. (?)
Andromeda tetragona, Lin.
Ledum palustre, Lin.
*Loisleuria procumbeus, Des.
Pedicularis arctica, Br.
Armeria maritima, Lin.
*Polygonum viviparum, Lin.
*Oxyria digyna, Cas.
Salix arctica, Lin.
Onosma micrantha (?)

It will be observed that most of the genera named in the above list, are represented in Great Britain; and that nearly one third of the species (the fourteen marked *) are included in our lists; being now met with principally on the summits of some of the higher English and Scotch mountains. These are I think very interesting facts, as there can be doubt but these British specimens are descendants of plants which flourished in our islands thousands of years since, during the glacial period; being probably our sole living representatives of that far distant epoch. Some few British plants that are also met with in the Arctic Regions are not given in my list as there are no specimens of them in my collection. For instance *Leontodon palustre* Sm., which in some parts of Scotland is the most common species of "dandelion" was found in Melville Island and other places during Parry's voyages.

Though both Hooker and Brown remark on the great difficulty they experienced in determining some of the Arctic species owing to their extremely variable nature, my specimens appear to differ from British ones only in their smaller size, and greater tendency to pubescence. As a rule, the farther north a species occurs, the more stunted becomes its growth. Thus the pretty little poppy *Papaver nudicaule*, which grows in some places to a height of from seven to nine inches, does not exceed half that size in its most northern stations. This is said to be the most hardy plant of the Polar regions, resisting the first frosts, and remaining the last in flower. It probably extends to the farthest limits of vegetation. Captain Sherard Osborne and others remark on the familiar look of the Arctic flowers reminding them of home. Buttercups, poppies, saxifrages, knot-grass, sorrel, and dandelions grow in many sheltered localities within the Arctic circle.

All the Melville Island plants are quite small, my largest specimens measuring only from five to six inches. Of course no trees were found there, the tree-limit being far to the south. Though there is a faint twilight each day for some hours, during the long interval of more than three months that the sun is absent from these high latitudes, there is at no time sufficient light for out door explorations. Thus July, August, and September are the only months in which botanical specimens can be collected in Melville Island.

BOTANICAL SECTION.

January 18th. Annual Meeting. Mr E. Halsall, in the chair. The accounts for the previous year were audited and the sum of one Guinea voted to the Library Fund. Mr. Leipner was re-elected President, and Mr. Yabbicom, Honorary Secretary, with thanks for their past services. Mr. J. W. Clarke exhibited a collection of Mosses and Lichens, taken in the Bristol district.

February 15th. Mr. S. Barton exhibited a specimen of the flower of a species of Banksia, from the colony of Victoria, commonly called the swamp honeysuckle.

It was noticed that a Habitat for Petasites fragrans had been found in this district where the plant was noticed in considerable quantity, apparently wild.

March 21st. The evening was spent in the examination of a fine collection of British Lichens, sent for exhibition by Mr. S. Derham.

October 17th. Mr. Dunn read a paper on Welwitschia mirabilis; Nat. Ord. Coniferæ, which he stated was discovered by Dr. Welwitsch, in South-western Africa, about half way between the Equator and the Cape of Good Hope in 1859. It was a dwarf tree seldom rising more than a few inches from the ground, with a diameter of several feet, and a single pair of leathery leaves, usually torn to ribbons, springing from the margin of the trunk and remaining through the lifetime of the plant which was about 100 years. The fruit was a cone, growing in clusters on the edges of the stem. The plant was remarkable as presenting the simplest type of structure, with a complex form of flowers. Living plants had not yet been introduced into this country, but dried specimens might be seen at Kew.

Mr. Dunn also made a communication on Rafflesia Arnoldi, which was discovered by Dr. J. Arnold when accompanying Sir Stamford Raffles into the interior of Sumatra, in 1818. The plant was described as parasitic on Cissus, the whole consisting simply of a flower growing close to the ground, of a thick substance and very succulent. It measured a full yard across, the petals being twelve inches from base to apex, and the nectarium was capable of holding twelve pints. The weight of the flower was calculated at fifteen pounds.

Nov. 21st. Rev. W. Hargrave exhibited an interesting collection of Fungi, collected in the Bristol district, and dried so as to show as much as possible the natural form.

Mr. Clarke mentioned a remarkable case of the introduction of a fungus into a stove greenhouse by means of horse manure, by the spores of which the leaves of evey plant in the house became spotted within two days.

Dec. 19th. Mr. H. E. Hudd read a paper "on some Melville Island Flowers," which has appeared above. This paper was illustrated by a collection of dried specimens.

GEOLOGICAL SECTION.

The excursions made by the Members of the Geological Section, during the summer, were the following:—

May 20th, (Whit Monday.) The party proceeded to Frocester, thence to Long Down and Dursley.

June 19th. An afternoon was spent in a drive to Dundry with a visit to the chief quarries there. The Inferior Oolite Sections were not in a very good state; no very interesting fossils were found with the exception of Zoophycos scoparius, which has been noticed above.

September 3rd. By train to Charfield and thence on foot to Damory Bridge. The Llandovery beds found to be very fossiliferous though there was no good section. The party were unsuccessful in their search for Prehnite which is said to occur in the Trap near the Bridge. The road taken in returning was through Tortworth. Many stopped to examine the old chesnut tree near the church.

October 11th. A pleasant afternoon was spent in visiting the Banwell Caves. One is a deep fissure, the descent being at a very steep angle: the other where the rich collection of fossil bones was found is more easily examined. The marks of the dissolving action of water are well seen: it apparently owes its origin to the widening of joints by the solvent action of water; these joints as usual being mainly in two directions and so accounting for the different branches of the cavern. The cave-earth is still seen *in situ* in places.

The first evening meeting of the Section was held at the Museum, December 11th. A notice has appeared above of the papers read.

ENTOMOLOGICAL SECTION.

During the summer excursions were taken by the Section to Brockley, Portbury, and Brean Down near Weston-super-Mare.

At the November meeting of the Section Mr. J. W. Clarke exhibited a fine specimem of Vanessa Antiopa, (the Camberwell Beauty Butterfly) captured on Durdham Down in September, and an interesting discussion arose respecting the different appearances of this fine species in the United Kingdom.

A number of interesting exhibitions were also made including Nola Abulalis, D. rubiginea, P. monticolana, and Incurvaria pectinicornis.

At the December meeting, Mr. Griffiths exhibited several boxes containing European and Exotic Lepidoptera including some interesting species.

Mr. Hudd exhibited the rare Pachetra leucophea W. V. captured near Ashford, Kent, and Toxocampa Craccœ a fine pair taken in South Devon in 1871.

The Hon. Sec. then read some notes on the genus Eupithecia with more special reference to the thirty-two species that had been met with in the Bristol District, and exhibited a box containing forty-five of the forty-seven species that have been met with in the United Kingdom.

47 Hampton Park, Clifton
Bristol. Aug. 5th/84

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