PROCEEDINGS

OF THE

BRISTOL

NATURALISTS' SOCIETY,

(Established 1862,)

FOR THE YEAR 1868.

NEW SERIES.

VOL. III.

Bristol:

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

1868.

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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 years, 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 of 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 (rariden-tata) 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 abscence 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 Jeffery s, 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-established 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 by 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 $3\ (CO^2)+2N+KS^2$, 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.
,, scolioeformis.
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.

④ 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 *Cucullia 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 serpens
,, riparium
Hypnum stellatum
,, fluitans
,, cupressiforme
,, b. filiforme
,, molluscum
,, cuspidatum
,, purum
Hylocomium splendens
,, 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 balance 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.
Length of sternum to ensiform cartilage	8·5
Length of arm and hand ...	30·5
Length of the dorsal border of the scapula	6·5
Breadth of the dorsal border of the scapula	3·9
Length of the axillary border of the scapula	5·2
Length of the clavicle ...	6·2
Length of humerus	13·4
Circumference of humerus at the middle of the shaft ...	2·5
Width of the humerus across the condyles	2·6
Length of radius	9·9
Circumference of radius at the middle of the shaft ..	0·8
Length of Ulna	10·7
Circumference of Ulna at the middle of the shaft	2·1
Length of hand and carpus...	7·2.
Length of phalanges and metacarpus of the middle finger...	6·0
Length of the three phalanges	3.5
Extreme length of leg exclusive of the pelvis	36.2
Length of the pelvis from the labrum ilii to the tuberosity of the ischium ...	9·0
Breadth of the pelvis across the ilii	8.7
Cavity of the pelvis across from the second bone of the sacrum to the pubis, conjugate diameter...	5.2
Circumference of the pelvis round the crista ilii... ...	8.1

Gorilla.

	Inches.
Length of sternum to ensiform cartilage	10·2
Length of arm and hand ...	39·5
Length of the dorsal border of the scapula	10·0
Breadth of the dorsal border of the scapula	7·0
Length of the axillary border of the scapula	8·7
Length of the clavicle ...	5·7
Length of humerus	16·7
Circumference of humerus at the middle of the shaft ...	4·0
Width of the humerus across the condyles	4·0
Length of radius	13·0
Circumference of radius at the middle of the shaft ...	2·7
Length of Ulna	14.5
Circumference of Ulna at the middle of the shaft	3·0
Length of hand and carpus	9·6
Length of phalanges and metacarpus of the middle finger	8·5
Length of the three phalanges	5·0
Extreme length of leg exclusive of the pelvis	28.5
Length of the pelvis from the labrum ilii to the tuberosity of the ischium ...	14.2
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	6.7
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.

Dr.	£ s. d.	Cr.	£ s. d.
1868.		1868.	
To Subscriptions received to April 30, 1868	67 13 0	By Balance due to Treasurer	23 13 0
Sale of Extra Copies of Proceedings	1 13 0	Cash paid—Morris	30 2 0
Donation from Chemical Section ...	1 5 0	,, Morgan	0 11 0
Balance due to Treasurer	9 8 6	,, Sturge	0 9 3
		,, Mardon & Co.	1 4 9
		,, Gratuities, Notices, and other Expenses, per Secretary and Treasurer	23 19 6
	£79 19 6		£79 19 6

Arrears yet unpaid, 1865 ... £1 15 0
,, ,, 1866 ... 7 2 6
,, ,, 1867 ... 15 0 0
£23 17 6

To Balance due to Treasurer ... £9 8 6

LIBRARY FUND.

Dr.	£ s. d.	Cr.	£ s. d.
To Balance in hand	15 6 0	By Cash Paid—Mardon & Co.	0 15 0
Subscriptions and donations to April 30, 1868.	6 11 6	,, Williams ...	0 3 0
Donation from Botanical Section ...	1 1 0	,, Kerslake & Co.	5 19 0
,, Geological Section ...	1 1 0	Balance in hand	17 2 6
	23 19 6		23 19 6

To Balance in hand ... £17 2 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 net-work 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 (¼ or ⅕th) 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 depr essa, 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. *Cn. 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 meéting 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 frame-work 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 Jurassie 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, McÇoy. 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. 65a., 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, 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
Nitzchia sigmoidea
Pinnularia viridis
Onthaseira arenaria
Epithemia
Gomphomena olivaceum
Gomphomena tenellum
Meridion circulare
Himantidium
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:

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

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 grəat 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 ntervals 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 fs 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 organi zation. 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 elevatlon, 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.

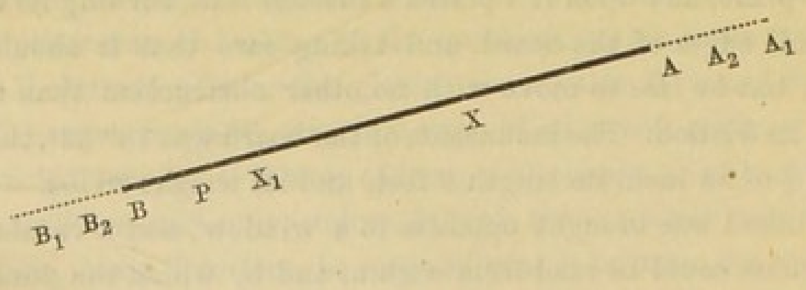
particles of quicksilver may be moved more easily upon one another than those of iron may. The pressure necessary to move a given portion of the surface of a body on any other given portion of the same body is called the force of shearing. A quicksilver glacier would descend because it shears easily, 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 the displacement B B_1 of the extremity B downwards will equal the sum of these 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 61¾ 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.