

THURSDAY, NOVEMBER 27, 1873

THE SOUTHERN UPLANDS OF SCOTLAND *

II.

THE next member of the series of rocks making up the upper Llandeilo series in the Southern Uplands has received from the officers of the Scotch Geological Survey the name of the Lowther group. In its typical area, which is in the N.W. of Dumfriesshire, this group is composed of "fine grey shales and finely laminated felspathic greywackes with occasional grit beds." The estimated thickness of this group amounts to 5,000 feet. It is seen overlying the Haggis rock group in the streams which drain the upper portion of the Lowther hills; with the underlying Haggis Rock group it forms a synclinal trough in which the Lowther hills are contained.

In Wigtonshire the Lowther group rests upon the Dalveen group. The strata here generally correspond with those of Dumfriesshire, but shales are less abundant, and flagstones and grit with shale bands become more developed. In this county, however, the proportion of the fine and coarse rocks of this group varies in different localities. The rocks of the Lowther group in Wigtonshire are best exposed on the shores of the Irish Channel. Here between Morroch Bay and Knockienauk Head, cliffs are seen from 100 to 300 feet high composed of strata often very twisted and broken, belonging to the Lowther group; and in the higher portion of this group, where the flags are well developed, they have been worked for roofing and flooring purposes.

Above the Lowther group, and forming the highest member of the Upper Llandeilo series, as these occur in the Southern Uplands, are strata composed of grey shales with bands of fine-grained blue greywacke and flinty mudstones. Numerous bands of dark anthracitic shales with graptolites interstratify these rocks. These strata, with their associated anthracitic beds, have received the name of the "Upper Black Shale Group." Their estimated thickness is about 3,400 feet. This Upper Black Shale group occurs near the northern limits of the Upper Llandeilo rocks, and is more abundantly developed in Lanarkshire than in Dumfriesshire.

The Upper Black Shale group, in its typical area, has yielded the officers of the Geological Survey a rich graptolitic fauna, no less than 27 species having been obtained from this series of rocks. These species bear a very close resemblance to such as occur in the Moffat Shales, a horizon much below the Upper Black Shale group in position. Two Brachiopods have also been found in connection with these Upper Black Shales, viz., *Siphonotreta micula*, a form also occurring in the Moffat Shales, and likewise in the Upper Llandeilo rocks of Wales, especially in the neighbourhood of Builth; and a *Discina* which has not yet been specially recognised.

The Upper Black Shales group, following the persistent strike of the Upper Llandeilo rocks of the Southern Uplands of Scotland, makes its appearance in Wigtonshire. Two bands of this group lying in a synclinal trough traverse the portion of Wigtonshire contained in Sheet 3. One of these bands is well seen in Morroch Bay, about a

mile and a half south-east of Port Patrick. The other appears south-west of Stranraer, and crossing the moors to the north-east, is seen in the bed of the Luce below Cairnarzean. In Morroch Bay the Upper Black Shale group exhibits a threefold petrological nature. The higher beds consist of thin black shales, having in them lenticular masses and seams of coarse clay, ironstone, and nodular layers of greywacke and pyritous kernals. The strata here are much crumpled, and intrusive masses and veins of felstone have invaded them. It is in this upper portion of the group that graptolites occur, but the number of species obtained from these strata is considerably under what have been found in the Upper Black Shale group of Lanarkshire.

The representatives of the Upper Llandeilo rocks in the Southern Uplands of Scotland attain to a very great thickness. Of the lower portion of the series, the Ardwell group, the Lower or Moffat Black shale group, the Queenberry grit group, the Hartfell group, and the Daer group, the officers of the Geological Survey have not given their thickness in Dumfriesshire. Of the other four groups, the Dalveen, the Haggis Rock, the Lowther and the Upper Black Shales, these have an estimated thickness of 13,000 ft. If to this amount be added the five groups below, we have a development of Upper Llandeilo strata in the south of Scotland which must amount to nearly 20,000 ft. This great thickness of strata much exceeds the same series of rocks developed elsewhere in the British Isles.

The Upper Llandeilo rocks of the Southern Uplands of Scotland have a greater uniformity in their mineral nature than is usually common to the series. Greywacke in the form of shales, sandstones, grit, and conglomerates, having in some of their sub-divisions black shales containing graptolites, constitute this great thickness of sedimentary rocks. There is an absence of limestone strata, only nodules occurring occasionally, and the calcareous flags which are so characteristic of this portion of the Lower Silurian in its typical area Llandeilo, have no representatives in the South of Scotland. The rocks in this district have been originally greyish and reddish muds, grey and purple sands, and pebble-beds, with occasionally dark carbonaceous muds, which may have derived their black colour either from decaying sea-weeds or decomposing Hydrozoa. The presence of carbonate of lime seems to have been very rare in the Upper Llandeilo seas of the areas which are now recognised as the Southern Uplands, during the deposition of their strata, and to this great absence of carbonate of lime we may probably attribute the absence of some of the fossils which are so abundant in Wales in this series of rocks. Graptolites are essentially the characteristic fossils of the Upper Llandeilo of the Southern Uplands. The same species seem to run through whole strata from the Moffat Shales to the highest member of the series, having a range of probably 18,000 ft.; and many of these forms of graptolites are common alike to the Upper Llandeilo rocks of Wales and Scotland.

The case is, however, very different when we come to compare the crustacea of the two regions. In Scotland the Upper Llandeilo crustaceans are very few, and almost confined to Phyllopoidea, being *Peltocaris Harknessi*, *P. aptychoides*, and *Disinocaris Brownii*, while in Wales we have a considerable development of trilobitic life. Of the

Continued from p. 24.

latter only one specimen, in the form of a tail, has yet been obtained from the Upper Llandeilo strata of the South of Scotland; and this specimen is too imperfect to admit of its being specifically determined. With reference to molluscs, these are nearly equally rare in the Southern Uplands. Only two Brachiopods have hitherto been recognised, while many forms appertaining to several genera have been obtained from the Welsh Upper Llandeilo strata. Notwithstanding the paucity of varied forms of organic remains in the Upper Llandeilo rocks of the Southern Uplands, their rich graptolitic fauna is at once indicative of their age, and the absence of other forms is most probably referable to want of calcareous strata in connection with these deposits.

The labours of the officers of the Geological Survey among the highly contorted and crumpled rocks of the Southern Uplands have afforded further information, were such required, of the causes from whence *cleavage* results. In a country so subject to flexures and contortions, where anticlinal axes and synclinal folds have been inverted, we should naturally look for abundant evidence of the super-induced structures from which true slates have derived their origin. The great mass of the Upper Llandeilo rocks of the South of Scotland rarely furnishes anything in the form of slates proper; and when we consider the nature of these rocks, which consist for the most part of greywacke sandstones and grits, we cannot fail to discover that the cause of the general absence of cleavage from these rocks has arisen from their petrological nature. The officers of the Survey have, however, in several instances, pointed out the recurrence of cleavage among the finer shales; and this occurrence usually accompanies violent contortions of the strata.

Although rocks of an Upper Llandeilo age enter so largely into the composition of the Southern Uplands, they are not the exclusive representatives of the Lower Silurian rocks in this area; above the Upper Llandeilo strata rocks referable to the Bala or Caradoc age occur. These Caradoc rocks, which occupy a very small area when contrasted with the Upper Llandeilo strata, are marked in the Southern Uplands by a feature which is unknown to their occurrence elsewhere. They are *unconformable* to the underlying Upper Llandeilo beds, a circumstance which Prof. Geikie well describes as "a new feature in the geology of Britain." The Caradoc rocks have not been recognised in Wigtonshire. They are described in connection with Sheet 15. They occur in a trough extending from Wedder Dod N.E. at least as far as the hills on the right bank of the Clyde, below Abington in Lanarkshire.

Here they are seen as greywackes, "passing on the one hand into a crumbling sandstone, and on the other into pebbly grits, with shale partings and with beds of conglomerate found chiefly at their base." In one spot a little concretionary limestone is seen, "the only example of limestone met with in the Lower Silurian rocks in Sheet 15." This limestone has afforded no fossils, but the conglomerates and the pebbly and gritty beds higher up in the series are abundantly fossiliferous. Denudation has probably removed some higher beds from this group. Its total thickness amounts to about 1,700 feet.

From the Caradoc rocks of the Lead Hills the geological surveyors have obtained a good series of fossils.

We miss from their list the whole of the graptolites so abundant in and so characteristic of the Upper Llandeilo strata. In their place we have corals, trilobites, many forms of brachiopods, two lamellibranchiates, several gastropods, and an arthorceras. Most of the species are characteristic Caradoc forms; but they have associated with them some which occur also in the Llandovery series.

The Southern Uplands of Scotland have other members of the great Silurian series besides those which have been referred to. These occur along a portion of the south-east flanks of the range, and consist of rocks having a general resemblance to the greywacke strata which form so large a part of the Upper Llandeilo rocks in the South of Scotland. The newer Silurian strata occurring on the south-east margin have, however, a very distinct series of fossils; and associated with their shales are found calcareous concretions frequently affording organic remains; the greywackes flaggy beds also in this higher group often contain fossils, especially graptolites. These graptolites belong to species occupying a much higher horizon than the forms which make their appearance in the Upper Llandeilo rocks; and the organic remains derived from the calcareous nodules also indicate strata higher in position than the Caradoc series. The rocks of an Upper Silurian age are well developed on the shores of the Stewarty of Kirkcudbright, especially on the eastern side of the mouth of the Dee. They occur also in Dumfriesshire, being seen near the southern margin of the Silurians at Dalton Mill, in the parish of Dalton, where the flaggy strata yield the same forms of graptolites which occur near the mouth of the Dee; and they have been extensively recognised in Roxburghshire.

As contrasted with the nearest area where Silurian rocks occur in England, the strata and the organic remains of the Southern Uplands of Scotland show great dissimilarity.

The distance of the nearest portion of the area where Silurian rocks are seen in England from the south-east side of the South of Scotland strata of the same series does not exceed 30 miles; for the northern flank of the Caldbeck range in Cumberland is not greater than this, in distance from the axis of the Lower Silurian rocks in Dumfriesshire where the Ardwell group occurs.

The Lake district of the north of England, occupied principally by Silurian rocks, exhibits strata of a lower position than any of the Silurian deposits of the Southern Uplands. These lower rocks of the Lake district are the Skiddaw slates of Prof. Sedgwick, which in many localities contain graptolites.

The facies of this graptolitic fauna is, however, widely different from that of the graptolitic fauna of the Upper Llandeilo rocks of the south of Scotland. In the Lake district there are no strata which can be paralleled with the Upper Llandeilo rocks. Above the Skiddaw slates of the north-west of England there occur great accumulations of igneous rocks in the form of traps, ashes, trap-tuffs and similar volcanic products. And it is only when the highest of these rocks is reached, which appear to have resulted from sub-aërial volcanic action, that strata occur in which organic remains are met with.

These strata, the Coniston limestones and their associated shales, are prolific in fossils of a nature indicative of the Caradoc age.

It is difficult to conceive how all traces of the vast igneous action which occurred within the distance of 30 miles from the Scottish Silurian area should be absent from the rocks of the Southern Uplands. The unconformability of the Caradoc deposits on the Upper Llandeilo strata in the Southern Uplands may perhaps afford some clue to this difficulty. The Skiddaw slates were probably ancient land in the area now occupied by the Lake district during the period of the deposition of the Upper Llandeilo rocks of the south of Scotland. This ancient land seems to have been subject to violent sub-aërial volcanic action, being the earlier epoch of the Caradoc series. During the later portion of the same epoch this violent volcanic action ceased, the area covered with igneous products again subsided beneath the sea, and allowed of the accumulation of the materials of the Coniston limestone and the succeeding groups.

In the Southern Uplands of Scotland the well-marked break recognised by the officers of the Survey points to a lapse of time between the deposition of the highest of the Upper Llandeilo groups and the conglomerates at the base of the Caradoc rocks. It is probably during this lapse of time that volcanic action was so rife on the other side of what is now the Solway Firth. This lapse of time is still further indicated by the comparative small development of the Caradoc rocks of the South of Scotland, as contrasted with those of the typical Caradoc areas of Shropshire and Wales, and also by their fossil contents, which indicate that only a portion of the group is represented in this area, and that this portion appertains to the upper part of the series.

From what has been said it will be apparent that the labours of the officers of the Geological Survey of Scotland have put us in possession of most important information concerning the very difficult series of rocks making up the strata of the bulk of the Southern Uplands. There are other matters amply detailed in the "Explanatory Memoirs" such as the metamorphism which the Silurian rocks have in some places undergone, and the intrusive rocks which are associated with them. The Old Red Sandstones as laid down in Sheet 15 are fully described. The important carboniferous areas of New Cumnock and Guelt, of Lugar and Muirkirk, and of Glespin or Douglas Water, with their thin limestone and low coal, are largely detailed. In relation to Dumfriesshire, the Sanguhar coal-field, made up of strata belonging to the true coal measures, and the carboniferous rocks which underlie it are also fully described. The Permian rocks of a portion of the Nith basin, having porphyries in different beds at their base, and brick-red sandstones with trapecian detritus forming their upper portion, and also rocks of the same age occurring on the shore near Corsewall House, Wightonshire, are subjects treated of in the Memoirs. Igneous rocks of an age posterior to the Permian are also referred to. Superficial deposits in the condition of drift sands, and gravels, brick clays, and erratic blocks, also still more recent products in the form of raised sea beaches, blown sands, peat and alluvium are fully alluded to. Finally the explanations afford information concerning the economic minerals of the several districts, the whole containing a record of an amount of careful observations and inferences such as could only have been arrived at by the labour and experience of such

a staff of officers as that which constitutes the Geological Survey.

ROBERT HARKNESS

LEYBOLD'S EXCURSION TO THE ARGENTINE PAMPAS

Excursion a las Pampas Argentinas: hojas de mi diario: Febrero de 1871: Seguido de tablas de observaciones barométricas, un boceto de la ruta tornaaa. Por Federico Leybold. 8vo, pp. 108. (Santiago, 1873.)

THE publication of a book relating to Natural History in Chili is a rare event, and therefore well worthy of record. Except Philippi and Landbeck's "Catalogo de las Aves Chilenas," and some few papers by the same authors in the "Anales" of the University of Santiago, the present is almost the first that has come before our notice. And these, it must be recollected, are not the productions of native Chilians, but of members of the all-pervading Teutonic race, who have brought their science with them from their distant fatherland.

Herr Leybold, or Don Federico Leybold, as we suppose we must call him, for he writes in Spanish, has been long resident in Santiago, and active in investigating every branch of Natural History in his adopted country. During the last few years, as he tells us in the introductory chapter of the present work, he has sent six expeditions over the Andes to explore the natural riches of the "Argentine Tempe," and finally in the month of February of 1871 was able to make arrangements to proceed himself upon a collecting tour into the same district. The route taken from Santiago was up the valley of the Maipo, to the junction with it of the "Valle del Yeso," and thence up this northern branch to the foot of the "Portillo de los Piuquenes," where the watershed was crossed. But a second and more elevated pass—the "Portillo Mendocino"—succeeds on this route over the main chain, which is, we believe, that usually taken to Mendoza. From the summit the descent was made over the elevated eastern slopes of the Mendocan Andes to an estancia called Vistaflores, situated at the foot of the range, which was made the headquarters of the party while they explored the surrounding country. Rainy weather and drunken servants much hindered operations during the stay at this place, which appears only to have lasted about a week, when it was determined to return to Santiago by the more southern "Paso del Diamante." This pass leads under the volcano of Maipo into the main valley of the Maipo, and thus enabled the travellers to join their former route after about a week's difficult and occasionally dangerous travel amid the snows and storms of the higher Andes.

Herr Leybold's diary of this interesting month's excursion is replete with notes and observations in every branch of Natural History—Zoology, Botany, and Geology. Birds, beetles, and plants appear to have engaged his chief attention—but other objects are not passed unnoticed. Not only are frequent references given to known species observed in the Andes and on the adjacent districts of the Argentine Republic, but descriptions are introduced of species believed to be new to science, and discovered on this occasion. Thus we have characterised

(p. 29) a new Crustacean—*Eglea audina* (pp. 36, 37), two new Violets, *Viola acanthophylla*, and *V. portulacea* (p. 38), a new Pigeon, *Columbina aurisquamata* (p. 45), *Oreosphacus*, a new genus of Menthoidæ; and subsequently two new Snakes, *Bothrops ammodvtoides* and *Pelias trigonatus*.

As regards these and other supposed novelties, it may be remarked that it is not very convenient to scatter such descriptions through the pages of a book of travels, where they are liable to escape notice. Moreover, an isolated worker in a remote part of the earth's surface is in great danger of not knowing what is already known to others, and should take the precaution of consulting some correspondent in the great European centres of scientific activity before publishing what is new to him as new to every one else. Dr. Finsch has already shown that *Leybold's Conurus glaucifrons* is a well-known species of Parrot; and we do not doubt that most of the other supposed novelties will be found to have been previously described elsewhere.

P. L. S.

A HEALTHY HOUSE

What a House should be, versus Death in the House. By William Bardwell, Architect and Sanitary Engineer. (London: Dean and Son.)

THE author of this work is evidently an enthusiast in sanitary matters, but there is much in it worth the attention of the professional architect and builder, as also of the house-owner and occupier. It will be some time before the precepts of hygienic architecture can be expected to pervade all classes of the community; but reforms in this direction must commence from above, and will gradually be accepted by the poorer classes: this work will assist the dissemination of wholesome rules.

The subject of drainage, which necessarily occupies much of the work, has been forced into prominence by the dangerous illness of the Prince of Wales, in the Autumn of 1871; and this work meets to some extent the demand for further and better information on the subject. Our author is not new to the task, having so long ago as 1828 turned his attention to the sanitary conditions of buildings, and has published several treatises on cognate subjects. The work before us, however, is suggestive rather than profound, and we find a tendency in it to describe very prosaic details in stilted language. There is also a general want of references, so that many of the statements cannot be easily verified—such, for instance, as this, p. 6, art. 10:—"We have progressed some little since 1828, when my first essays on health were published, and public attention has been directed to the subject; but still, one half of the children born in London and other large towns, die before they are three years old; while at a parish in Norfolk, where the principles here set forth are rigidly enforced by the excellent rector, a child is never known to die." After making, however, every abatement—as we are bound to do—the work will not fail to prove very useful, and will assist in leading people to better sanatory arrangements.

In p. 8 he justly animadverts on many modern cottages, which "from admiration of mediæval architecture are irregular in plan, and irregular in outline from an idea of being picturesque; and hence the chimneys are outside,

involving loss of heat, the roof all hips and valleys, and dormer windows requiring constant repairs, and exhibiting an utter ignorance of the very first principles of a healthy home." Some fallacy seems, however, involved in the passage which follows, and which describes the effect of asphalted ground floors in some Essex cottages. The inhabitants suffered from rheumatism until the asphalt was covered with boards—"because the boards were conductors of damp, whilst the asphalt was a non-conductor of moisture." It must have been the conduction of temperature, and not of moisture, that led to the inconvenience.

Chapter ii. is on bad drainage, and opens sensibly thus:—"The use of water in cabinets in disobedience to God's command to the Israelites to bury excreta in the earth is unquestionably the cause of those alarming modern diseases—the something in the air—with which the whole country is affected." It may be impossible to return to the more primitive practice, but the fact remains that even the old cesspool system was less unhealthy than the modern more artificial one. Some valuable hints are given in pages 12—13, for discovering the inlets of sewer gases into houses. The closet soil-pipe is often the origin of these irruptions; for the inclosed gases decompose the soldered joints of the lead pipe in a few years' time, if the pipe is not ventilated, as indeed it seldom is, and the junction of the lead-pipe with the drain is often defective. Every sink, too, which modern luxury has introduced to save the old-fashioned labour of throwing slops away out of doors, opens a pathway for the poisonous gases, of which one part in 260 mixed with common air is fatal to life, and of which no sensible proportion can long be breathed with impunity.

There is also a moral aspect to the question. The following passage is introduced as a quotation, but it does not appear from what author, p. 19:—

"A clean, fresh, and well-ordered house exercises over its inmates a moral no less than a physical influence, and has a direct tendency to make the members of the family sober, peaceable, and considerate of the feelings and happiness of each other."

In chap. iii. are some valuable remarks about drains, stink-traps, and rain-water pipes. Water-closets, it is said in p. 29, should never be in a basement—for if so, the house is liable to draw its supply of air through them—but always in a back-yard. Those that are wanted to be in immediate connection with the house should be in the upper floors only, and, whenever practicable, approached through a greenhouse.

At p. 33 are some remarks on the necessity of pure, untainted water; and, in p. 34, on the danger of lead-poisoning. The pipes made by Messrs. Walker, Campbell & Co., of Liverpool—lead-cased block-tin pipes—are recommended in those cases where the water acts upon lead. A caution as to the use of these pipes should, however, have been added, as very great care and peculiar arrangements are required in jointing them; otherwise, the combination of the two metals becomes exposed to the action of the water at the joints, when decomposition will take place, and the water will still be affected with lead.

In p. 41 the importance of a dry basement is inculcated, and with a well-merited encomium on Mr. John Taylor's clever contrivance of the damp-proof

course which both keeps down the damp and ventilates the ground-floor. Proceeding to fire-proofing methods, Mr. David Hartley's simple but little known contrivance for protecting dwelling-houses from fire by interposing sheet-iron or copper between the floor boards and the joists is mentioned. The plan described a little farther on, p. 46-47, would probably not be so effective as Hartley's.

In pp. 48-58 fire-grates are mentioned, and with a decided preference (perfectly justified in the experience of the writer of these remarks) for Mr. John Taylor's smoke-consuming grate; but the author should hardly have left Dr. Arnott's smoke-consuming contrivances unnoticed; and when at pp. 61-66 he speaks of ventilation, he should have mentioned at greater length Dr. Arnott's ventilating valve. Boyle's ingenious ventilators, however, quite deserve the praise given them in p. 63.

It would be interesting to have had some references given to sanction our author in claiming the authority of the Duke of Wellington, together with that of Aaron and the High Priests, his successors, for the practice of placing their beds nearly north and south so as to be in the line of the magnetic current. The theory no doubt has its advocates, but can hardly be of universal application, as there are many sound sleepers at all degrees of orientation.

Chapter iv. contains some good suggestions respecting London street improvements and the Sanitary Recipes at the end will be found deserving attention.

OUR BOOK SHELF

Natural Philosophy. Part I. Mechanics. By J. Alfred Skertchley. Pp. 168. (London: Thomas Murby, 1873.)

THIS work belongs to a series of small manuals which the publisher calls the "Science and Art Department Series of Text Books." It is designed for students who possess but little mathematical knowledge, and each of the theorems discussed is explained in very simple language. In some respects the work keeps pace with modern text-books, in others it lags behind them. Thus while we have chapters on Kinetics and Kinematics, and on Actual and Potential Energy, we find some of the units as primitive as possible, and the Metric system is ignored. The unit of length is given as the yard, and the unit of weight as the grain. The definitions leave much to be desired: thus Mechanics is defined as "the Science which treats of the laws of motion and force, especially as applied to the construction of Machines;" Hydrostatics "the science treating of the pressure of water." Again we find the following very loose definition of the force of gravity: "Every particle of matter has a tendency to draw to itself every other particle, and this tendency is called the force of gravity." The other attractive forces are here ignored, the student is left quite in ignorance as to whether the force acts through a sensible or insensible space, whether it acts between particles or masses, whether such particles or masses are necessarily of similar or dissimilar substances. A screw is defined as "an inclined plane revolving round a centre." "Any body capable of moving freely about a fixed axis is a pendulum." The chapter relating to Energy requires to be carefully revised, as, indeed, does much of the work so far as accurate and logical definition is concerned. The examples are useful, and the questions at the end of the book will be found of service in teaching elementary Science, but the book can scarcely be recommended until the definitions are more precise and absolute.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. No notice is taken of anonymous communications.]

The Dutch Photographs of the Eclipse of 1871

IN the account of the proceedings of the meeting of June 13 last of the Royal Astronomical Society, as published in Vol. viii. p. 175, of NATURE, I read the following:—

"Mr. Ranyard remarked that the paper copies of the Dutch photographs which he had seen had been printed from enlargements on glass, in which the moon had been stopped out with black paper or some other material. On measuring he had found that the body of the moon, as given in the photographs was by no means circular, and Mr. Davis had pointed out to him that the irradiation under the prominences was perfectly sharp at the edges, as it would be when printed through paper. It was therefore unfair to institute any comparisons as to the amount of the irradiation in these and in the other photographs."

I beg leave to state, in opposition to Mr. Ranyard's and Mr. Davis's remarks, that no stopping out with black or any other paper has taken place. I enclose hereby copies on paper of the originals and of one of the enlargements. In the first-mentioned everyone may see that the moon is sufficiently dark to render unnecessary every artifice before making a good enlargement. In fact I have seen the enlargements myself, and in them, too, the moon was as dark as the surrounding sky.

I think Mr. Dietrich's merit to be especially this, that he has directed the attention of astronomers again to a method, as it seems already wholly abandoned, if ever earnestly tried, viz. that of taking an image with a photographic lens of short focus but great force, so that a very short exposure might be sufficient. As to the profit his photographs brought to our knowledge of the sun, Col. Tennant says, almost every depression of outline of the Indian photographs could be recognised in the Java ones, and thereby it is proved that in the interval of time needed by the moon's shadow to make the traject from India to Java, say 50 minutes, almost no change whatever took place in the solar corona.

Of course the method could be improved by moving the camera by clockwork. Then the exposure could last a little longer, e.g., one second, and the exterior outline would reach farther; a larger camera, with photographic lens of the same force would without doubt give more details.

As to the not-circular (in fact elliptical) form of the moon in the photographs, I think it pleads more against than in favour of Mr. Ranyard's remark, for if a disc of paper were to be used to stop out the moon, of course a circular one would have been made, and not an elliptical one. The fact is that the copies of the original *cliché* present the same peculiarity, the difference between the longest and shortest diameter being about $\frac{1}{10}$ th of a millimeter, as is easily recognised with a lens and a measure of half-millimeters. In the accompanying diapositive the difference = $\frac{1}{4}$ mm. As in other photographs of total eclipses, the diameter corresponding to the poles of the sun is the longer. This phenomenon is in our case only partially explained by the moon's motion during the time of exposure; perhaps a stronger impression at the equatorial regions of the sun, or a trembling of the camera-stand has done the remainder.

In the glass photographs, of which I have sent a pair to Lord Lindsay and to Messrs. Lockyer, Huggins, Warren De La Rue, and Main, the details are finer and sharper than in the paper ones.

J. A. C. OUDEMANS

Batavia, Sept. 10

[We have no doubt from an inspection of the photographs sent, that no stop was used.—ED.]

Elevation of Mountains and Volcanic Theories

THE accompanying letter from Captain Hutton is in acknowledgment of my paper on "The Elevation of Mountains by Lateral Pressure," which I read at Cambridge in 1869. I sent it to him in consequence of seeing his lecture on Mountains, in the *Geological Magazine*. He could not have received my critique on that lecture at the time of his writing this letter. In accordance with his suggestion I forward it for publication in NATURE without comment.

OSMOND FISHER

Hartton Rectory, Cambridge

I have to thank you for sending me your paper on the Elevation of Mountains, which I have read with great interest. You and Mr. Mallet have done great service to geology by exploding the old-fashioned idea of cavities existing in the interior of the earth. I quite agree with you that a cooling earth must give rise to great pressure in the outer consolidated layers, and that this pressure must crush the rocks composing it; but I cannot think that this crushing is the cause of the elevation of mountains. My reasons for disagreeing with you are the following:—

1. The pressure from a shrinking globe must be uniform, and the lines of least resistance, once chosen, should remain always the same, and the elevation should be continuous. All minor differences would be insignificant in comparison with the flatter arch at the poles. These areas, therefore, would subside, and mountain chains should have had from the first an east and west direction. I see no provision for changing the localities of movement.

2. Where deposition was going on the rocks would be heating and no contraction could occur below them. But mountain chains have been always formed where the deposits were the heaviest, and where, therefore, uplifting would not be likely to occur.

3. All mountain chains are not formed on the same system, but can be divided into two groups, as I have pointed out in my lecture on this subject.

4. Whether a glacial epoch has ever extended over the whole earth or not, it is certain that the northern parts of America and Europe are much warmer now than they were in the Pleistocene period, consequently the rocks under them could not have contracted, and yet we know that extensive movements are even now going on in this area.

5. In order to produce a strain on the surface, the lower contracting rocks must be solid, consequently there would be nothing to support a large anticlinal, and no rocks to pass into the liquid state; the result would be a general small crumpling all along the surface. The relief also to the compression of the upper rocks could not be obtained by a single rising at a point, or along a line, without a horizontal movement of one bed over another, which appears to me to be impossible. Consequently I do not think that the shrinking could produce the observed effects, more especially as the Himalayas, &c. are of tertiary age, and the contraction of the globe, since the cretaceous period, cannot have been very great. These remarks apply also to Prof. Shaler's theory (*Proc. Bost. Soc. Nat. Hist.* 1866). Mr. Medlicott's section of the Himalayas is, to my mind, physically impossible. It is inconceivable that the beds could be engineered into the positions in which he has placed them.

6. The theory does not account for the numerous minor oscillations of level that coal measures often prove to have taken place.

7. The theory makes no provision for tension in the rocks. But it is a fact not sufficiently dwelt upon by geologists, that faults just as surely prove tension in rocks as contortions prove compression.

I have also a few objections to your theory of Volcanoes, and also to that of Mr. Mallet. They are as follows:—

1. The density of the crust has been shown by General Sabine to increase in volcanic regions, while, by your theory, it should decrease. Mr. Mallet's theory would account for this, as also would the one proposed in my lecture.

2. To cause a volcano the heat must go to the water, for the water cannot go to the heated rock, as your theory would require.

3. Volcanoes are not found in contorted countries, or where great lateral pressure has existed. In the older volcanic districts (e.g. North Wales) the eruptions occurred before the folding of the strata. This is also a strong point against Mr. Mallet's theory.

4. By Mr. Mallet's theory the crushing must be very sudden, or the heat would be conducted away, and as each eruption would require a fresh accession of heat, it ought to be preceded by elevation or subsidence on a large scale. The earthquakes that precede eruptions are just as likely to be effects as causes.

5. Faults show no heating where considerable crushing has taken place.

Such are the objections that occur to me, but, after all, we cannot well burke the question as to the state of the interior of the earth, and I must confess that the "Viscidists" appear to me to have a better position than the "Rigidists."

Mr. Hopkins' argument, drawn from precession and nutation, has proved untenable, and the only stronghold that the "Rigidists" now retain is the absence-of-internal-tide argument of Sir

W. Thomson. This has not yet been assaulted, but it probably has a weak point somewhere, for its author has allowed that the interior of the earth is probably "at, or very nearly at, the proper melting temperature for the pressure at each depth," which seems hardly consistent with its being "more rigid than glass." On the other hand, the "Viscidists" have a very strong point in the fact that faults are known with throws of several thousand feet (which apparently must penetrate into some yielding material), as well as some minor positions, such as the supposed effect of the moon on causing earthquakes, the composition of volcanic rocks (which contain more alkali than could be obtained by merely melting sedimentary rocks), and the mode of occurrence of granitic rocks, none of which have been seriously attacked by the "Rigidists."

At this distance I cannot take part in a discussion, as I must always be five months behind hand, but if you think that a preliminary skirmish in the pages of NATURE would do good, although it did not bring on a decisive battle, you are quite welcome to publish this letter.

F. W. HUTTON

Wellington, N. Z., July 21

P.S.—At the time of writing my paper on Elevation and Subsidence (*Phil. Mag.* Dec. '72), I was not aware that Mr. Scrope had been the first to suggest* the theory there developed, or I should certainly have mentioned his name, and not proposed to call the theory after Herschel and Babbage. I feel that I owe Mr. Scrope some apology for my inadvertence.

Deep-Sea Sounding and Deep-Sea Thermometers

WE have again to claim your indulgence for occupying space for a few comments on Mr. Casella's reply to our letter.

It is not true that we abstained from drawing attention during the lifetime of Dr. Miller to the fact that he had plagiarised our invention; on the contrary, we wrote to Dr. Miller as soon as we were told that he had read a paper before the Royal Society on his supposed invention, and we have before us Dr. Miller's answer, dated Nov. 23, 1869, wherein he writes:

"I am sorry if I have inadvertently done anything which may fairly be considered an injustice to you in respect to the deep-sea thermometer," &c.

We believe Dr. Miller did not know of our thermometer, but Mr. Casella did, having had one or more in his possession years previously, and as a fact our thermometer was well known in the trade; therefore he as the workman employed by Dr. Miller ought to have acquainted that gentleman with the fact. It is most likely that we should not have taken any further notice had the thermometer retained the modest title given to it by Dr. Miller, viz. the "Miller-pattern." This, however, did not suit Mr. Casella. Mr. Miller died—"mors tua vita mea,"—and forthwith the thermometer is styled the Miller-Casella, then by a little "progressive development," the instrument is brought out in the British Association as the Casella-Miller, and to day we have it in Mr. Casella's letter as "*my thermometer.*"

On reference to the Royal Society's Proceedings, vol. xvii. p. 482, we find no mention of Mr. Casella's name except as the workman who took Dr. Miller's instructions, and we have yet to learn what right a workman has to appropriate to himself an instrument made for Dr. Miller, or any other customer, supposing, even for argument's sake, that we had no priority in its invention.

Mr. Casella asks "What has Negretti and Zambra's thermometer done that it should be known?"

In the first place it served him as a pattern, it showed him how the best deep-sea thermometer was constructed, and how to make others on the same principle; and we contend that had our instruments been placed in the hands of skilful, careful, and trained observers, such as are now engaged in the *Challenger* Expedition, they would have given results equal to those now obtained with the instruments supplied by Mr. Casella, and obviously so, their principle being precisely the same.

Mr. Casella talks about our thermometers having failed. Can Mr. Casella point out where are recorded any of the failures? Was Mr. Casella able to make them fail when he tried by placing one of them in his hydraulic press in the presence of gentlemen connected with the Meteorological Office? But this is not the point at issue, the sole question is, are the thermometers supplied to the expedition the same in principle as ours, or are they not?

Doubtless it would be much more agreeable to Mr. Casella that these questions should be decided by himself in private, hence his invitation to your readers "to go to his establishment

* "Volcanoes," 1st ed. 1826, p. 30.

and hear his explanation." Surely no such arrangement will satisfy "all the scientific men in the world." We contend that as Mr. Casella has publicly claimed the invention as his own, it ought to be decided with equal publicity whether he has done anything more than copy our instrument.

We again give the description of our thermometer (not in our own words, for we might be accused of shaping them to suit our purpose) but in the words of the late Admiral Fitzroy as they appear in the first number of Meteorological Papers, page 55, published July 5, 1857, in referring to the erroneous readings of all thermometers consequent on their delicate bulbs being compressed by the great pressure of the ocean, Admiral Fitzroy says:—

"With a view to obviate this failing, Messrs. Negretti and Zambra undertook to make a case for the weak bulbs which should transmit temperature but resist pressure. Accordingly, a tube of thick glass is sealed outside the delicate bulb between which and the casing is a space all round which is nearly filled with mercury. The small space not so filled is a vacuum into which the mercury can be expanded, or forced by heat or mechanical compression, without doing injury to, or even compressing the inner or much more delicate bulb," &c. &c.

Mr. Casella "did not wish to take up your valuable space to describe his thermometer." Well, it matters not; the late Admiral Fitzroy has done it for him. He described it sixteen years ago; and if the reader will take every syllable of the extract above quoted, and substitute the word "alcohol" for "mercury" (which colourable change was effected by Mr. Casella, to the detriment of the instrument), they will have a correct description of Mr. Casella's thermometer in the most minute details.

HY. NEGRETTI AND ZAMBRA

Rain-gauge at Sea

I BEG to send you a copy of a letter I received lately from Capt. Goodenough, of the Royal Navy, respecting the use of my rain-gauge at sea. (See NATURE, vol. vii. p. 202.)
Nov. 8 W. J. BLACK

"H.M.S. *Pearl*, lat. 6° S., long. 22 W.

"Dear Sir,—I should have taken an earlier opportunity of writing to you about the instrument which you were so good as to design for use on board ship, but have not had the good fortune to fall in with any rain up to the present time with which I could at all events in some measure test and chronicle the rain-gauge. It is odd that in a journey of twenty days I have had only '07 in. of rain, and that although I am at this moment in a district in which an average of seven hours' rain usually falls at this time of the year. On that one occasion '07 in. did fall and was duly caught in your instrument as well as in another mounted on gimbals, the measurements being exactly alike in each. I much prefer the mounting of your instrument, and will report to you as to the amount of weight it requires after some experimenting with it. The usually most steady instrument is one which is heavy, and whose centre of gravity is very near its centre of oscillation. I do not think it would be well to increase the size of the instrument, as it would become inconvenient to place, except for the use of a man who wishes to devote himself very much to that order of observation. Our poop is so high here that I do not anticipate any mixture of sea-spray in the gauge, but if it were so your table would be sufficient to clear it, supposing we had Carpenter's Hydrometer to test with, as we might not expect enough water to float an ordinary one.

"I remain, yours very truly,

"JAMES E. GOODENOUGH

"Captain R.N. Command H.M.S. *Pearl*, proceeding *via* the Cape to Australasia."

Glaciers

In a letter printed in your number for Oct. 16 (vol. viii. p. 506), Mr. J. H. Röhrs states that he believes that glaciers existed at or near the sea-level in central Hindustan in the glacial period. Glaciers undoubtedly existed in the Himalayas at a much lower elevation than at present; there are traces of their action in Sikkim in valleys, the bottoms of which are now only 4,000 ft. above the sea, and in the north-western Himalayas, Mr.

Medlicott, I think, considers that in some valleys, glaciers descended to within 1,000 ft. of the sea-level, but I have never heard of any marks of old glacial action in the Indian peninsula south of the Himalayas. There are no mountains in central Hindostan exceeding about 4,000 ft. in height, and a careful examination of the portions of the Nilgiri mountains in Southern India, which rise above 8,000 ft., has not afforded any proof of the former presence of ice. It is very probable that Mr. Röhrs possesses information upon this subject with which I am unacquainted, and it is without the least wish to express a doubt of the accuracy of his information, that I ask for any evidence he can produce in favour of his assertion, as the subject is one in which I am greatly interested.

W. T. BLANFORD

JOHANN NEPOMUK CZERMAK

JOHANN NEPOMUK CZERMAK was born June 17, 1828, in Prague. His father, Johann Conrad Czermak, was a medical practitioner of high repute in that city, and his uncle, Joseph Julius Czermak, enjoyed a considerable reputation as Professor of Medicine and Physiology, first at Gratz and afterwards at Vienna. Educated at the high school of his native town, Johann Czermak entered upon the study of medicine at the University of Vienna in 1845. In 1847 he moved to Breslau, where he had the great advantage of living with the distinguished physiologist Purkinje. From Breslau he passed on in 1849 to Würzburg, where in 1850 he received the degree of M.D., publishing on that occasion an inaugural dissertation on "The Microscopical Anatomy of the Teeth," in which he called attention to the larger "interglobular" spaces so often found in the upper part of the dentine. After a visit to England he settled at Prague, where he became assistant to Purkinje, who then held the chair of Physiology in that place. In 1855 he left Prague to take the chair of Zoology at Gratz; but zoology was not his proper province, and he gladly accepted in 1856 the offer of the Professorship of Physiology at Krakau, which however he left in the following year for the like chair in Pesth. In both these universities he established physiological laboratories and gave a decided impulse to physiological research; but the political agitations then rife made life distasteful to him there, and in 1860 he resigned his chair and returned to Prague. Such frequent changes must have interfered greatly with sustained research, but by this time Czermak had made his name known as well by several investigations in experimental physiology and in subjective vision, as especially by his researches on the laryngoscope, his treatise on which ("Der Kehlkopfspiegel und seine Verwerthung") embodying the results made known in various papers in 1858 and 1859, he published shortly before his return to Prague.

Here he resided some years, visiting at times England, Holland, and France, in order to make the value of the laryngoscope better known to his fellow-workers in science and medicine. There are many in England who retain pleasant memories of these visits.

The ample means brought to him by the gifted lady whom he had the happiness to marry, enabled him to build in Prague and furnish at his own expense a private laboratory for research, in which he not only worked himself, but which he also placed at the disposal of others. Many would have envied, and few would willingly have let slip, such an opportunity for quiet labour; but Czermak, conscious of the power he possessed of lucid exposition, delighted in teaching, and felt perhaps the want of the stimulus which pupils afford. Accordingly, when in 1865 he was offered the chair of Physiology in Jena, vacated by the removal of von Bezold to Würzburg, he at once accepted it. Here he continued until, in 1869, finding the disease to which he eventually succumbed (and the beginning of which he himself attributed to the irritation caused by the

controversies which arose out of his laryngoscopic work), was rendering him unfitted for the energetic performance of his professorial duties, he withdrew to Leipzig, where he was made Honorary Professor at the University, and where he continued to reside until his death, on Sept. 16 in the present year.

Carried off while yet in the prime of his life, and the energies of his last few years impaired by an insidious disease, Czermak has perhaps left a mark on the scientific progress of his time incommensurate with his talents or his promise. He will doubtless be best remembered through his laryngoscopic labours. We owe to him the real introduction into medical practice of this valuable instrument. But his other researches, such as those on the action of the vagus, the pulse, the sense of touch, the manège movements resulting from injuries to the brain, those on dyspnoea, and others, show remarkable acuteness and clearness of insight.

Two talents he possessed deserve special notice. He had remarkable aptitude in devising apparatus for observing or for demonstrating physiological phenomena. It was this faculty which made him successful where others had failed in the use of the laryngeal mirror; and

would be difficult to exaggerate the immense help to experimental physiology which has been afforded by the ingenious "holder" which bears his name.

The other faculty, that of popular exposition, less common in his country than in ours, he possessed to a very high degree. And his popular lectures, which were originally delivered at Jena, and which were reviewed in an early number of NATURE, achieved and deserved great popularity.

Perhaps had his love of teaching been less strong, his work as an investigator would have been more sustained and weighty. But while in this country we might with profit often lose a lecturer and gain an investigator, Germany could well afford that one whose powers of rigorous and yet clear and popular demonstration were so exceptionally great, should somewhat slacken in his work as an inquirer. Or perhaps we should not so much say that Czermak slackened in inquiry, as that the consciousness of his power as an expositor, and the delight he consequently took in exposition, drew much of his energy in that direction. In the grounds of his residence at Leipzig he had built and fitted, at his own expense, a large hall, or "spectatorium," as he called it, in which he proposed to deliver lectures on physiology, richly illustrated with experiments. In connection with the hall, the construction of which was admirably adapted in every way for its purpose, he had also erected a private laboratory for research; and on both he had spent much time and labour. They were intended to be a supplement—not a rival—to the more technical institute of Prof. Ludwig in the same city. The writer will never forget the delight with which Czermak showed this "Erklärungs-Tempel,"—as he was fond of calling it—to Dr. Sharpey and himself in the summer of 1871, and pointed out all its ingenious contrivances, and the enthusiasm with which he looked forward to the lectures which would be delivered, and the work which would be carried on in it. He lived to open it by an inaugural lecture in December 1872; but the effects of his fatal disease were already painfully evident; and after a vain struggle during the following summer, Czermak—just as the British Association was gathering for its meeting at Bradford—was taken away from his unfinished work. He was a man of broad culture, outside his professional attainments. In philosophy especially he was well versed; and his last contribution to scientific literature—a paper in "Pflüger's Archiv," on the mesmerism of animals—was doubtless prompted by his interest in psychological questions. His straightforward, generous, and unostentatious manner formed a fitting frame for his intellectual attainments.

A widow and children mourn his death. He is also

mourned for by many friends in many lands, both by those who had known him long and by those who knew him for a short while only.

M. FOSTER

THE ATMOSPHERIC TELEGRAPH

THE *Times* of the 15th inst. contained an article on the Pneumatic Despatch, which has never been used to any extent in this country. From that article we learn the following particulars as to the working of this method of conveyance in London:—

The pneumatic tube extends from the London and North-Western Railway Station at Euston Square to the General Post Office in St. Martin's-le-Grand. The central station is in Holborn, where is also the machinery for effecting the transit of the trains. Here the tube is divided, so that in effect there are two tubes opening into the station, one from Euston to Holborn, and the other from the Post Office. The length of the tube between Holborn and Euston is 3,080 yards, or exactly a mile and three-quarters, a greater length than was originally contemplated, but which was rendered necessary by the avoidance of certain property on the route. The tube is of a flattened horse-shoe section 5 ft. wide and 4 ft. 6 in. high at the centre, having a sectional area of 17 square feet. The straight portions of the line are formed of a continuous cast-iron tube, the curved lengths being constructed in brickwork, with a facing of cement. The gradients are easy; the two chief are 1 in 45 and 1 in 60, some portions of the line being on the level; the sharpest curve is that near the Holborn station, which is 70 ft. radius. The tube between Holborn and the Post Office is 1,658 yards in length, or 102 yards less than a mile, and is of the same section, and similarly constructed to the first length. Two gradients of 1 in 15 occur on the Post Office section, but this steep inclination is in no way inimical to the working of the system. The Holborn station is situated at right angles to the line of the tubes, which are therefore turned towards the station into which each opens. All through trains, therefore, have to reverse there, and this is effected in a very simple manner by a self-acting arrangement. A train upon its arrival runs by virtue of its acquired momentum up a short incline, at the summit of which it momentarily stops, and then quickly descends by gravity. In its descent it is turned on to a pair of rails leading to the other tube, into which it enters and through which it continues its journey, the whole process of reversing occupying barely 30 seconds. Trains containing goods for the Holborn station are simply run down from the top of the incline on to a siding.

The waggons, or carriers, as they are termed, weigh 22 cwt., are 10 ft. 4 in. in length, and have a transverse contour conforming to that of the tube. They are, however, of a slightly smaller area than the tube itself, the difference—about an inch all round—being occupied by a flange of indiarubber, which causes the carrier to fit the tube exactly, and so to form a piston upon which the air acts. The machinery for propelling the carriers consists of a steam engine having a pair of 24-in. cylinders with 20 in. stroke. This engine drives a fan 22 ft. 6 in. in diameter, and the two are geared together in such a manner that one revolution of the former gives two of the latter, or, in technical terms, the engine is geared at 2 to 1 with the fan. The trains are drawn from Euston and the Post Office by exhaustion, and are propelled to those points by pressure. The working of the fan, however, is not reversed to suit these constantly varying conditions; it works continuously, the alternate action of pressure and exhaustion being governed by valves. The engine takes steam from three Cornish boilers, each 30 ft. long and 6 ft. 6 in. in diameter. Telegraphic signalling is carried on between the three stations by means of needle instruments.

The system of Pneumatic Despatch, or "Atmospheric Telegraph," as the French call it, is utilised to a much greater extent in Paris than in London, though with some important differences in construction and object. We have thought that some details concerning the working of this system in Paris might be useful and interesting at the present time, and we therefore give an abstract of some articles on the subject which have recently appeared in *La Nature*.

The question of the distribution of messages in the interior of towns has revived the systems of pneumatic transport, which, after having had their day of celebrity, seemed for twenty years doomed to oblivion.

In following the aspects of this question, we shall show in what way the atmospheric telegraph is a result of the electric telegraph; we shall afterwards consider the former more specially, and after having shown its present condition, shall inquire what future is in store for it.

The telegraphic despatch has become an article of everyday use; as the age is a fast one, it is natural that it should utilise with eagerness so handy a means of transmitting almost instantaneously its impressions or its wishes to all distances. It is necessary to remember that a city like London or Paris sends out and receives every day an immense number of telegrams. The wires which serve as conductors of electricity are multiplied in all directions for the purpose of meeting the demands of this traffic. They meet in the interior at the central office. This central station speaks *urbi et orbi*; in other words, it receives the messages of the city for the purpose of spreading them over the entire world, and it accomplishes also an inverse movement. The aspect with which we are here concerned is the distribution throughout the city itself; let us see what has been done in Paris to accomplish this purpose.

As each house cannot be put in immediate communication with the telegraphic network, it became necessary to adopt some other convenient plan. In the case of Paris, the city is divided into districts of a mean radius of 500 metres in order to limit the journeys of the foot-messengers. The application of this rule gave fifty points, distant one kilometre from each other, where are established so many branches of the chief office.

This system was found, however, not to work well, and was moreover very expensive, for reasons which we need not detail here; and after *voitures* were tried for some time as a means of sending despatches from the head office to the more important branches, it was resolved to have recourse to the pneumatic tube. We have just referred to the extent to which it has been carried in London. Paris and Berlin followed the example of London in 1865: we shall speak here of the system of Paris.

In Paris there are fifty stations, distant from each other about a kilometre, connected by an iron tube, which is interrupted at each station. The central station, by which the transit of messages is effected with the interior, is in the Rue de Grenelle; there are seventeen district stations, in the Rue Boissy-d'Anglas, Grand-Hôtel, Bourse, &c.

How is this network managed? Like a diminutive subterranean railway, in which the waggons are cylindrical boxes and the motive power compressed air prepared in the stations. At the central bureau the trains are formed, composed of as many boxes as there are branch offices to supply. The trains are *omnibus* when they stop at the intermediate stations, *express* when they shoot past them.

Every quarter of an hour an omnibus train leaves the Rue de Grenelle, and accomplishes the distance which separates it from the Rue Boissy-d'Anglas (1,500 metres) in a minute and a half. There it is received in a vertical column, and the box which carries the messages to be distributed in the district having been taken out, the others are put into the section of the line which

runs towards the Grand Hotel, a new box having been added containing messages to be transmitted, which have been deposited since the last train. The train again takes its departure, composed of as many boxes as before; it goes through the same operations at the Grand Hotel, the Bourse, the Théâtre Français, and at the Rue des Saints-Pères. It re-enters the Rue de Grenelle twelve minutes after its departure, having changed all its boxes and carried back messages for distribution.

Besides this there is a secondary network, the details of which, however, we need not now enter upon. There is a direct line which goes from the Rue de Grenelle to the Bourse, and to branches in the Champs-Élysées, the Place du Havre, and the Rue des Halles. On the first run the express trains going and returning, the departures of which are intercalated between those of the omnibus trains, for the purpose of supplying those stations which are busiest, twice every quarter of an hour. The departure is accomplished by pressure, the return by aspiration. The same method of working is applied to the branches, which correspond with the omnibus trains of the principal network.

The tubes which compose the lines are of iron, the interior diameter being 0.065 metre. They are connected by bridle joints (*à brides*), and admit of curves having a radius of from 5 to 20 metres.

Various systems for the production of compressed or rarified air are employed. The first in date is an application of the principles of the apparatus known as Hiero's Fountain. Atmospheric air is decanted from a first receiver B (Fig. 1) into a second receiver communicating with the first by means of the tube *bb*, by the introduction of water into the receiver B. The air thus forced is drawn into the receiver for the purpose of being dispersed in the tubes. Where the machines are not allowed to be used, the employment of steam is much more economical for the compression of air. Recourse is then had to ordinary pumps, which insure an active service and are subject to fewer causes of irregularity. The latter method has been preferred in recent establishments.

Trains composed of ten boxes weigh about four kilograms, they are either pushed or sucked along by a difference of pressure of three-fourths of an atmosphere, which gives a mean speed of a kilometre per minute.

The travellers which take their places on the Lilliputian carriages already described are closed envelopes containing messages; they are piled in groups of thirty or forty in a *courseur*, or box. This box is formed of two cylinders, the interior one of sheet-iron, the outer one, enveloping the former, of leather. To make up a train, a piston must be affixed after the last box, for the purpose of enabling the compressed air to take effect. The piston is a piece of wood provided with a leather collarette, which assumes the shape of the interior of the tube, and forms an almost hermetical joint, without much friction.

The apparatus at first adopted for receiving and despatching the boxes having been found neither sufficiently rapid nor convenient, a much more complete system, shown in Fig. 2, is now employed. The figure explains itself: two lines enter the office, each attached to separate apparatus. In the first place, for the purpose of despatching messages, a man opens the door A by means of the lever *d*; the boxes and the piston are thrown into the tube, and await at the bottom the current of air which will propel them. This current is produced as soon as the cock *c* is opened, which commands the head of the apparatus opposite to the tube. The cock *c'* distributes the air upon the second line. In the second place, the receiving door B is opened by a second attendant, who finds the train at the station, and takes out the boxes in order to bring the telegrams to light. The entire apparatus has somewhat the form of a cannon, only the effect is more blessed, the artillerymen are not exposed to death;

the worst accident they have to fear is the bursting of the tube. To this drawback, which happens very rarely, we shall refer by-and-by.

The messages are divided into two classes,—questions

and answers, orders and the execution of orders, which can at once be exchanged between any point of the city and any point of the interior, in the provinces, or abroad,—or inversely. All that is necessary in this case is a

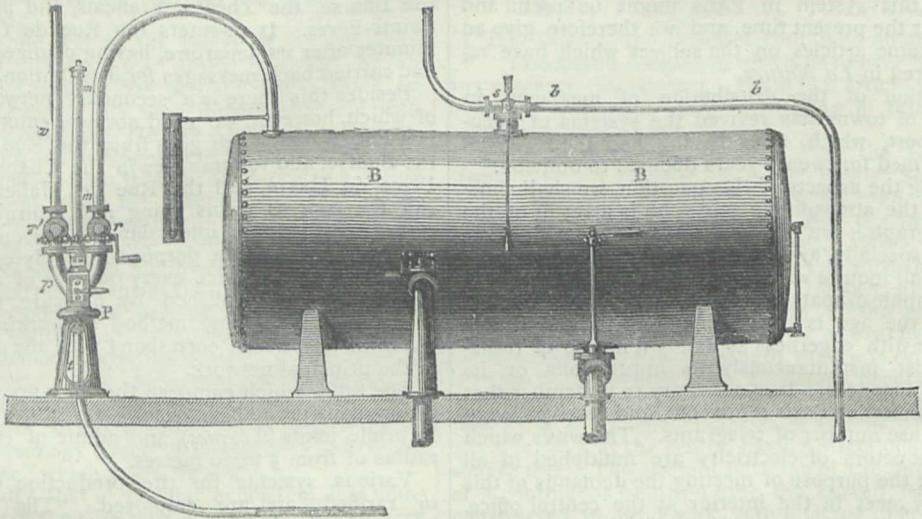


FIG. 1.—Apparatus for the production of compressed air.

centre, as the Hôtel des Télégraphes in the Rue de Grenelle is called. Connected in the one part with the exterior by the network of electric wires, and

with the interior by the network of pneumatic tubes. These tubes are, moreover, well adapted for the service of the local post, *i.e.* for the exchange of messages within

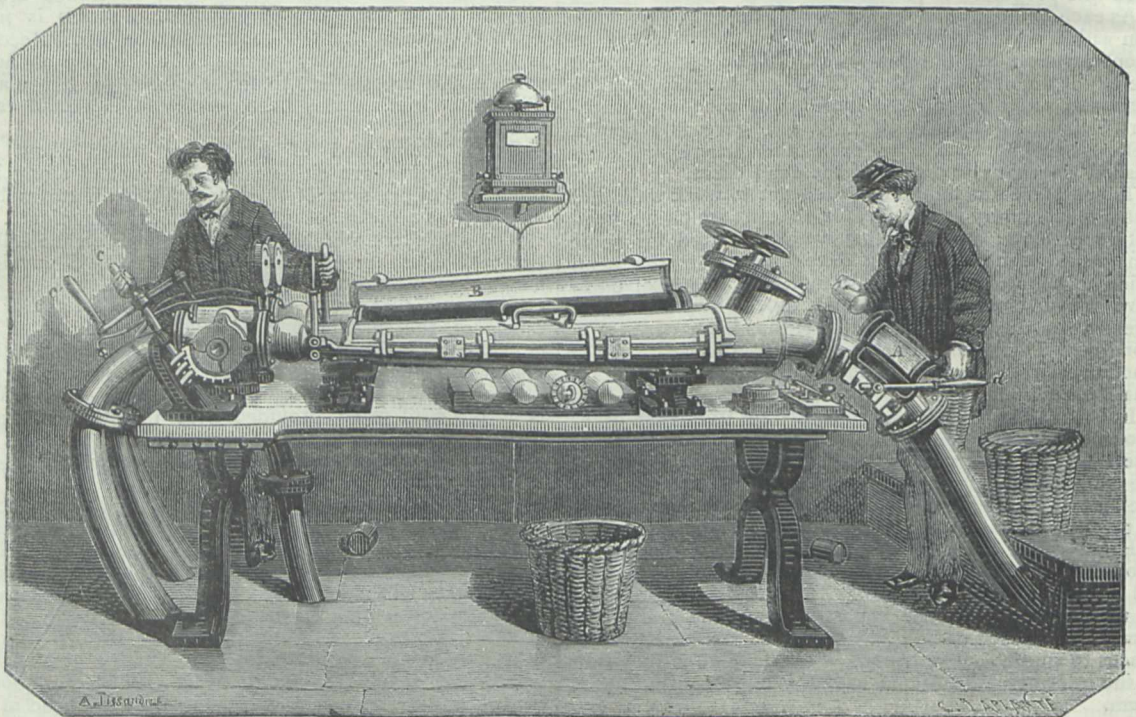


FIG. 2.—Apparatus for reception and despatch.

the city. The great advantage in this case is that the despatch can be sent. On the plan adopted, when the network is complete, a letter may always be sent from one quarter to another at any distance within Paris in less

than an hour. Every year the development of the lines increases, and the number of Paris telegrams meant for the city, and of which the originals themselves can be transmitted, is getting greater and greater.

THE COMMON FROG*
V.

THE third order of the class *Batrachia* is made up of a few creatures the distribution of which is limited to the warmer regions of the earth, where one of the genera (*Cacilia*) comprising the group is distributed over both hemispheres, being found in India, Africa, and South America. Two other genera (*Siphonops* and *Rhinatrema*) are exclusively American, while a fourth genus

(*Epicrium*) is only found in Asia. The order is called *Ophiomorpha*. These creatures are singularly unlike the frog in external appearance, as they are entirely destitute of limbs and have quite the appearance of earthworms, because they are not only very long and slender, but have also a skin which is soft and naked. By earlier naturalists, and even by Cuvier, they were classed with snakes.

In spite of this striking dissimilarity between the *Ophiomorpha* and *Anoura*, the former are really more like frogs than they are like efts in one important respect.



FIG. 22.—*Cacilia*.

This is because, for all their elongated figure, the tail in them is quite rudimentary or altogether absent.

The *Ophiomorpha* would by many be supposed to present an analogy with serpents, from their long and elongated bodies, and from the utter absence of limbs.

There are, however, but very few snakes (the "rough-tails" *Uropeltidae* and the *Tortricidae*) which have long bodies and very short tails.

It is rather the singular family of lizards, *Amphisbenidae* (with one exception completely limbless) that the *Ophiomorpha* resemble.

increases their resemblance to earth-worms) and feed on worms and other small animals and mould.

To turn now to another aspect of our subject, let us consider the relations of the Frog to past time. If, extending our survey over the records of past epochs, we search the tertiary and all other rocks above the Lias for fossil allies of our Frog, we shall (judging by what we yet know) fail to find any not at once referable to one or other of the three ordinal groups above enumerated.

Fossil frogs and toads have as yet only been found down to the miocene, the oldest being some found in the so-called "brown coal" which is not a carboniferous deposit



FIG. 23.—Skeleton of the Ichthyosaurus.

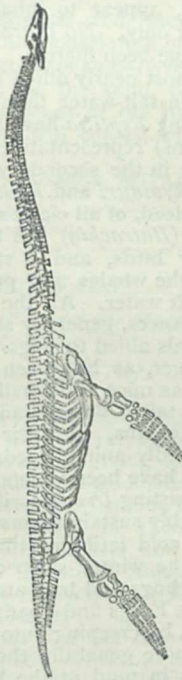


FIG. 24.—Skeleton of the Plesiosaurus.

These Amphisbenians have a softer skin than any other Saurians except chameleons. It is also marked in grooves which are arranged in transverse rings. They have an exceedingly short tail which is blunt, so that the head being small, one end of the body is as large as the other.

The *Ophiomorpha* also have the body marked with numerous transverse grooves or rings; they are utterly devoid of limbs, and the head is scarcely, if at all, larger than the hinder end of the body.

These creatures burrow beneath the soil (which habit

* Continued from p. 30.

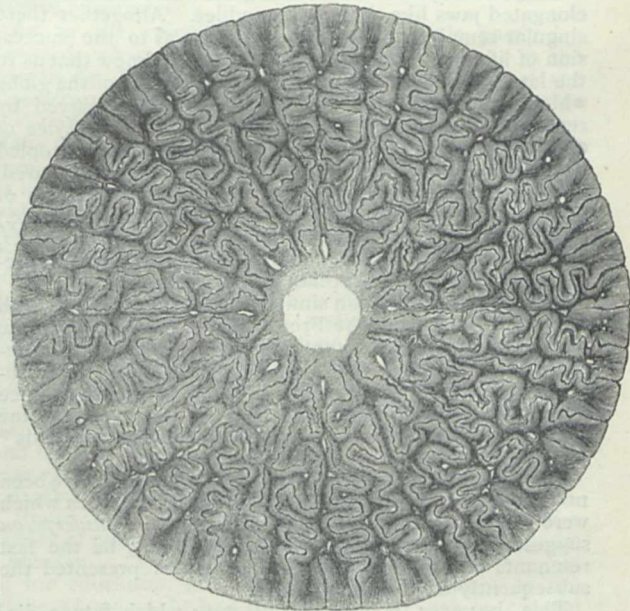


FIG. 25.—Much enlarged horizontal section of the tooth of a Labyrinthodon

at all. The remarkable thing, however, is that the difference between these oldest known Frogs and the existing forms is so very trifling. They are as complete and thorough frogs as any that live now.

Again, the fossil Urodeles similarly resemble their existing representatives, and no one extinct species exhibits characters in any way tending to bridge over the chasm which separates the Urodela from the *Anoura*.

When, however, we descend to the Lias, Trias, and Carboniferous rocks, we come upon a rich variety of extinct species of animals evidently allied to those forming the three Batrachian classes already described. They form, however, an order by themselves, to which the term *Labyrinthodonta* has been applied, and thus our search into the past has brought us a rich and important harvest,

and has introduced us to the fourth and last Order belonging to the frog's class of vertebrate animals. The Labyrinthodonts were creatures with long tails and mostly two pairs of limbs, but these members were always relatively small with slender toes. Some species attained a greater size by far than does any existing Urodele, even the gigantic Salamander.

To what existing animals can these huge monsters be considered to have affinity? It is impossible to say that they in any way bridge over the chasm separating the Frogs from the Efts. They appear indeed to have been almost equally removed from both—for the possession of short limbs and a long tail (characters common to so many widely different animals) cannot be regarded as any good evidence of affinity.

It is not improbable that they find their nearest allies in the existing insignificant *Ophiomorpha*. The latter, though apparently naked, have minute scales imbedded in the skin and arranged in rings at intervals, and the skull is provided with certain extra ossifications. The Labyrinthodonts have similar extra cranial ossifications, and though they have not rings of scales, the ventral region was protected by minute plates arranged in linear series converging inwards and forwards towards the middle line. Moreover, some forms appear to have been entirely devoid of limbs; at least no remnant of such parts has yet been discovered. Nevertheless the degree of development of the tail constitutes a marked distinction between the *Labyrinthodonta* and the *Ophiomorpha*.

Certain Labyrinthodonts had great formidable teeth in elongated jaws like those of crocodiles. Altogether these singular remains tempt us to speculate as to the succession of life upon this planet's surface. We know that as to the later secondary period that part in the life of the globe which is now played by beasts was then played by reptiles. Instead of the existing bats, Pterodactyles of all sizes flitted through the air. The ocean was peopled not by whales and dolphins, these had not yet appeared, but by huge Ichthyosauri and Plesiosauri. Reptiles of huge bulk (Iguanodonts, Megalosauri, Notosauri, &c. &c.) fulfilled the parts of herbivorous and carnivorous beasts, and altogether the Mammalian fauna of to-day was represented by analogous reptilian precursors.

May it not have been similar in yet older periods with regard to animals of the Frog class? We have seen the possibility of aerial locomotion in even the existing *Rhacophorus*. It is true that all existing Urodeles are fresh-water forms, but it may well be that marine creatures once bore the same relation to them as the great marine *Ganoid* fish fauna bears to the few existing Ganoids* which now constitute a fresh-water group.

The great crocodile-like Labyrinthodonts must have been no ignoble predecessors of the rapacious reptiles which were to succeed them, and the fossil form *Ophiderpeton* suggests that the existing *Ophiomorpha* may be the last remnants of a race which preceded and represented the subsequently developed serpents.

This, however, is but a conjecture which future discoverers will probably ere long establish or refute.

The name *Labyrinthodonta* was bestowed upon the great fossil group on account of the beautiful and singularly complex structure of the teeth of some members of the order. These teeth are conical, and exhibit slight vertical grooves on their surface. A horizontal section shows that these surface-grooves are the external indications of deep indentations of the substance of the tooth. All these indentations converge towards the centre of the tooth, but not in straight lines, each indentation being elaborately inflected. Radiating from the centre of the tooth are a corresponding number of processes of the central pulp cavity—the radiating processes undulating like the converging folds.

* Existing Ganoids are the sturgeon, bony pike (*Lepidosteus*), mud-fish (*Lepidosiren*), and others as noticed earlier.

A similar structure of tooth is found in some Ganoid fishes, and an incipient stage (as it were) of the same condition existed in the Ichthyosaurus.

We have now reviewed the closest as well as the more remote allies of our Frog, and have seen how the Frog is a species of a group (*Anoura*) which is one of three existing and widely divergent orders, supplemented by an extinct ordinal group of the carboniferous period—the four orders (1. *Anoura*, 2. *Urodela*, 3. *Ophiomorpha*, and 4. *Labyrinthodonta*) being embraced in a higher unity termed a "Class," which is the Frog's class, as "*Anoura*" is his order. This class is with propriety spoken of as the *Frog's class*, since the Frog is the species from which its scientific derivation *BATRACHIA* is derived. This class may now be considered as a whole.

The Batrachians (of all three existing orders) are in the main aquatic animals, inasmuch as the greater number, even when adult, frequent, at least at intervals, ponds and streams, or delight in humid localities. Water also is necessary for the larval stages of almost all; and absolutely all, at one period of life, possess gills, while some (as we have seen) retain gills during their whole existence, and are permanently and constantly inhabitants of water.

The extinct forms (*Labyrinthodonta*) were, no doubt, also aquatic, as, besides their general relation to other Batrachians, traces or indications of the hard parts which supported the branchiæ of some Labyrinthodonts appear to have been actually found.

It is somewhat singular that in spite of this predominating aquatic habit, all Batrachians, both living and fossil, appear to inhabit, and to have inhabited, fresh water only. No Batrachian of any period is yet known to have been marine. This is the more remarkable since the most nearly allied class, that of fishes, is much more rich in salt-water than in fresh-water forms; while even existing *Reptilia* have (in the true sea-snakes and in chelonians) representatives which inhabit the open ocean, while in the secondary geological period marine reptiles (*Ichthyosauri* and *Plesiosauri*) abounded.

Indeed, of all classes of vertebrate animals, this aquatic class (*Batrachia*) has the least to do with the ocean, for many birds, and a still greater number of Mammals (e.g. the whales and porpoises), are constant inhabitants of salt water. All the adult Batrachians feed on animal substances, generally small worms, insects, or slugs, and animals allied to slugs. The larger Frogs and Toads will, however, as has been said, devour vertebrate animals, such as mice and small reptiles and birds. The existing large, tailed Batrachians devour fishes. The extinct tailed Batrachians, in their adult condition, were also undoubtedly animal feeders, but they may, in their young state, have been vegetarians. At any rate the tadpoles of the existing *Urodela* will eat vegetable matter, and indeed probably sustain themselves mainly upon it.

In cold latitudes the *Batrachia*, like the *Reptilia*, go into the winter sleep called *hibernation*, as also do the hedgehogs and bats amongst Mammals.

The Frogs and Toads sometimes hide and shelter themselves by creeping into out-of-the-way holes and corners, but more generally they (as also the Newts) bury themselves in mud at the bottom of ponds and streams. In hot latitudes, some forms pass the dry season in a similar state of lethargic inactivity.

Many beasts, birds, and fishes, range in flocks. The Batrachians, however, usually wander about in a solitary manner, and only congregate in the breeding season. It is then that their vocal powers find utterance, though only in the Anourous order; the tailed Batrachians never make more than a very feeble sound.

As regards the geographical distribution of the whole class, the northern hemisphere, and especially the American portion of it, is the more richly furnished. Africa, India, and Australia, are the most poorly supplied on the whole, because, though possessing very many kinds of

frogs and toads, the whole Eft order is unknown in those regions.

Our question "What is a Frog?" has now been somewhat further answered; but it cannot be completely so until the organisation of the animal has been more fully surveyed, and not only the relation of the frog to other Batrachians thus more clearly seen, but also the relations and affinities borne by the several orders of Batrachians and by the whole class to the other orders and other classes of the Vertebrate sub-kingdom.

Accordingly, we have now to make an acquaintance with more than those obvious and external characters which are found in the Frog, and to penetrate into its inner anatomy, surveying successively its bony framework and the various parts and organs which subserve the several actions necessary to its continued existence.

At the same time the more noteworthy resemblances presented by the Frog to other creatures will be pointed out. Thus we shall become acquainted with the relations existing first between the Frog and other members of its order; secondly, between the members of its order (*Anoura*) and its class fellows—i.e. other Batrachians; thirdly, we shall comprehend the degree of relationship existing between the Batrachia and the other classes of the Vertebrate sub-kingdom; and fourthly, we shall come to recognise certain singular resemblances which exist between the various groups of Batrachians (the Frog's order of course forming one), and some of the orders into which other vertebrate classes—especially the class of Reptiles—have been divided.

The skeleton of the Frog, both external and internal, naturally comes first as the support and foundation of the other structures. The internal skeleton (or *endo-skeleton*) will include the bones of the head, i.e. the skull, backbone (already referred to), and the bones of the limbs. The external skeleton (*exo-skeleton*) will consist of the skin only.

ST. GEORGE MIVART

(To be continued.)

ASTRONOMICAL ALMANACS*

V.—The "*Connaissance des Temps*" under the continued direction of the old Academy

LET us return to the *Connaissance des Temps* of the old Academy.

Jeaurat, who succeeded Lalande in 1775, adopted exactly the same principles as the latter; he, however, extended considerably the ephemerides of the moon, giving its declination for every six hours, to facilitate the calculation of the altitude, when at the same time only the distance could be observed. Méchain succeeded Jeaurat in 1788; he followed the example of his two predecessors, and like them, continued to take from the "Nautical Almanac" the distances of the moon, which Maskelyne had the kindness to send him even in manuscript.

Moreover, besides the ephemerides and the lunar distances, the *Connaissance des Temps* still contained observations, memoirs on various astronomical topics, an abridged notice of new books likely to be of interest to astronomers and navigators, and a brief history of astronomy during the past year, due to the skilful and well-informed pen of Lalande. This state of things continued until 1794, the year when Méchain left Paris, to take part in the meridian work. Soon after, the suppression of the academies having dispersed the astronomers, the *Connaissance des Temps* for 1795 was compiled and published by the temporary Commission of Weights and Measures. Finally, on June 25 of the same year, 1795, the publication of this work was placed under the eminent direction of the Bureau des Longitudes. Here we may conclude

* Continued from vol. viii. p. 531.

the first part of our account of the *Connaissance des Temps*—a work at first completely independent, then published with the approbation of the Academy, which included at the time nearly all those who were occupied with astronomy; and afterwards entrusted to the care of the Bureau des Longitudes, a commission which still continues to be charged with its publication.

VI. The "*Connaissance des Temps*" under the Bureau des Longitudes

The first care of the Bureau was to entrust one of its members with the publication and direction of the *Connaissance des Temps*, thus showing, from the first, the true course which ought to have been adopted from the beginning, that a work of this kind demands strictly personal superintendence. Its choice fell upon Lalande, then Astronomer of the Observatory of *l'Ecole Militaire*. As to the calculations, however, the superintendence of this astronomer was more nominal than real; he was occupied mainly with the *Additions* which he had commenced in 1760, and towards which the bent of his mind,—“more of a collector than an inventor”—carried him. Thanks to the great quantity of material which he had acquired, he made of these additions a work really useful, for at this time periodic scientific publications were very rare. His *Journal d'Astronomie* (history of astronomy during the preceding year), contains a mass of information of great value, even at the present day, to all who take an interest in the history of the science of astronomy.

As to the calculations, they were made partly by Bouvard, whom Laplace had appointed adjoint to the Bureau des Longitudes, and partly in the bureau of the *Cadastre*, under the direction of Prony, its chief. It was in the office of this celebrated engineer that the distances of the moon from the sun and from the principal stars were calculated, distances which ceased from that time to be taken from the *Nautical Almanac*. Let us, however, add, that up to the year 1806 the greater part of the other calculations of the *Connaissance des Temps* were drawn from the *Nautical Almanac*, “with the view,” according to the preamble, “of accelerating the publication.” Despite this assistance, nevertheless, this work appeared only about a year and a half or two years in advance; it was then, at that time, completely useless to navigators who had to make a long round. The attention of the Bureau des Longitudes was not however turned in this direction. Its president was then the illustrious Laplace, one of the glories of the mathematical sciences, and who first knew how to deduce from the great discovery of Newton, all the consequences which it was calculated to yield.

Pierre Simon Laplace was born March 23, 1749, of a family of poor farmers of Beaumont-en-Auge (Normandy, Calvados). It is not known where he got the elements of his education, for when later he was raised to the highest honours, he had the weakness to wish to conceal his humble origin. Appointed in 1770, on the recommendation of d'Alembert, Professor of Mathematics at *l'École militaire* of Paris, he became in 1772 adjoint member of the Academy of Sciences, next succeeded Bezout as examiner of the pupils of the royal corps of artillery, and in 1785 was made titular Academician. During this time, his beautiful memoirs on which he founded his *Mécanique céleste*, succeeded each other almost without interruption. Finally, in 1795, he was nominated president of the Bureau des Longitudes, a position which he held till his death, March 5, 1827.

Under his leadership the Bureau was occupied mainly in perfecting and re-constructing the tables, by means of which are calculated in advance the positions of the different stars. The tables of Delambre (the sun, Jupiter, Saturn, Uranus and the satellites of Jupiter, 1792), of Mayer (corrected by Mason, 1787), for the moon, of

Lalande for Venus and Mercury, showed with the observations very great errors which the theory of Laplace promised to eliminate, or at the very least to diminish. It was to the solution of these questions that Laplace directed the forces of the Bureau, and it was to their practical execution that he applied the resources which the budget granted him.

"To accelerate the work, the different parts were distributed to various members of the Bureau. The tables of the moon, on account of the constant use made of them in astronomy and navigation, were those which it was of special importance should be completed promptly; but the length of the researches, the magnitude of the calculations, which so complicated a theory required, only permitted the hope to be cherished that in the distant future errors might be made to disappear which had gone on increasing from day to day. This was the occasion of making an appeal to all astronomers, national and foreign, who might have sufficiently advanced works upon the lunar tables. With this object the Bureau des Longitudes was authorised to offer a prize.*

This prize of 8,000 francs was awarded by the Bureau to an astronomer of Vienna, Bürg, whose tables, based upon 2,500 observations, made at Greenwich from 1765 to 1795, were deemed the most accurate and convenient. At the same time, Delambre published new tables of the sun; Bouvard, pupil of Laplace, whom he had assisted in the publication of the *Mécanique céleste* (Laplace resigned to him entirely the detailed investigations and astronomical calculations), published *Nouvelles Tables des planètes Jupiter et Saturne* (1808), a new edition of which he brought out in 1824, to which were added tables of Herschel's planet, Uranus; Delambre published his *Tables écliptiques des satellites de Jupiter* (according to the theory of Laplace and the totality of the observations made from 1662 to 1802); Burckhardt, a German astronomer, whom the conquests of Napoleon had given to France, published new *Tables de la lune* (1812), which, in the estimation of some astronomers, took the place of those of Bürg.

However, the impulse given by the splendid works of Laplace was not confined within the French frontiers. In Italy, a celebrated astronomer, Francisco Carline, published, in 1810, new tables of the sun, which were soon employed everywhere except in France.† In Germany, a man of Science, who was at one and the same time an eminent lawyer, a distinguished captain, and an excellent astronomer, Bernhard von Lindenau, published, according to Laplace's theory, tables of Venus, Mars, and Mercury.‡

Unfortunately these excellent works, due to the powerful initiative of Laplace, were not made use of in the publication of the *Connaissance des Temps*.

In 1808, Delambre, one of the most eminent French astronomers, undertook the direction of the *Connaissance des Temps*. No essential change was made in the work till 1817; at that time the right ascension of the moon, which had until then been calculated only to a minute, was given to a second for noon and midnight. Sailors could thus determine the longitude of their ships with more exactness; and astronomers, instead of finding in the *Connaissance des Temps* only the indication of the time at which they ought to observe our satellite, could thus compare the results of their observations with those which the tables gave, and prepare the material for their improvement. Finally, in 1820, were introduced the diffe-

rences in right ascension and in declination of the sun, differences useful in calculating the preceding co-ordinates at an hour other than that of noon. This was still another advantage to sailors.

But these improvements were of very little consequence in comparison with those which astronomy, geography, and navigation demanded. Germany was the first to set an example in this direction, and the Royal Astronomical Society of London, after a long and learned discussion, came to the conclusion that they were necessary. Moreover, besides being incomplete, the *Connaissance des Temps* was full of errors from beginning to end, errata being found even among the errata themselves. Radical reforms were indispensable; but to make this clearly evident, we must return to the history of the "Nautical Almanac" and the Berlin "Jahrbuch."

(To be continued.)

MAN IN THE SETTLE CAVE

UNTIL the appearance of Mr. Tiddeman's paper in NATURE, vol. ix. p. 14, I had not fully realised the important issues which, according to him, depend upon the proper identification of the fragment of bone from the Victoria Cave to which he refers; nor was I aware that he was about to commit me in such very absolute terms to the opinion that it was human, but of this, as it turns out, I have no reason to complain.

Looking, however, at the apparent gravity of the statement, and knowing, also, that opinions might, and as I believe did, differ as to the origin of the bone, I have been induced to go into the matter again, and am now in a position to affirm that there is no room for the slightest doubt on the subject.

Mr. James Flower, the excellent and estimable articulator to the College of Surgeons, to whom I am under many obligations for assistance in such questions, and who at one time suggested, and had almost convinced me, that the bone was elephantine, has, after much search, found amongst the Museum stores of human osteology, a *fibula* which places the question beyond all doubt, and fully confirms the opinion I had come to, especially after seeing the Mentone skeleton, that the Victoria relic, pre- or post-glacial as it may be, is human. It is further important as showing that bones of the same conformation may occasionally be met with at the present day.

GEO. BUSK

Harley Street, Nov. 14

NOTES

DR. A. DEW-SMITH and Francis M. Balfour of Trinity College, Cambridge, have been nominated by the Board of Natural Science Studies, in accordance with the grace of the Senate (May 1, 1873), to study at the Zoological Station at Naples under Dr. Dohrn, until the end of July 1874.

AT the General Monthly Meeting of the Royal Institution to be held on Monday first, a President will be elected in the room of the late Sir Henry Holland, Bart.

PROFESSOR TR'QUAIR, of the Royal College of Science in Dublin, has been appointed to the Keepership of the Natural History Museum in the Edinburgh Museum of Science and Art. This gentleman was formerly one of the Demonstrators to the Professor of Biology in the University of Edinburgh, and is the author of several important contributions to Science.

MR. W. F. BARRETT, F.C.S., has been appointed Professor of Physics to the Royal College of Science, Dublin, in succession to the late Professor W. Barker. We feel sure that this appoint-

* Report of the Bureau des Longitudes, 1800.

† "Esposizione di un nuovo metodo di costruire le Tavole Astronomiche applicato alle Tavole del Sole" (Milan, 1810).

‡ "Tabulæ Veneris novæ et correctæ ex theoria gravitatis, clarissimi de Laplace, et ex observationibus recentissimis in specula astronomica Seebergen's habitis erectæ" (Gotha, 1810). "Tabulæ Martis novæ et correctæ ex theoria gravitatis, clarissimi de Laplace, et ex observationibus recentissimis erectæ" (Essenbergh, 1811). "Investigatio nova orbite a mercurio circa soli descriptæ, accedunt Tabulæ Planetæ ex Elementis recens repertis et theoria gravitatis, illustrissimi de Laplace constructæ" (Gotha, 1813).

ment will give great satisfaction. Sir Robert Kane, F.R.S., having resigned the post of Dean of Faculty to the College, for the purpose of spending his winters in the south of Europe, Professor Galloway has been selected to fill this post. It is said that there either are, or will very shortly be, a vacancy in the Professorship of Chemistry owing to Professor Sullivan's appointment to the Presidency of the Queen's College, Cork.

DR. E. H. BENNETT has been elected Professor of Surgery in the University of Dublin, in succession to the late Dr. R. W. Smith; and Dr. Thos. E. Little has been elected to fill the post of University Anatomist. In connection with news from the Dublin University, we may mention that it is understood that the authorities have determined to build a new museum for their anatomical and zoological collections. At present, in connection with the Medical School, there is a small collection of human and comparative anatomy, and, in the Arts' School a very good collection of zoology. It is intended to combine these two in a new building. The College authorities would confer a great boon on natural science in Dublin if they would venture to go a step further and make their new museum contain all their biological collections. The advantages would be great of having the distribution of animals in space and time shown in connection the one with the other; and there is something incongruous in separating the specimens illustrating the past and present races of mankind from the zoological collection, and combining the specimens illustrating the anatomy and physiology of the human species with those illustrative of the other animals. For the convenience of the students, we trust that the extensive herbarium of the College may also be lodged under the roof of the new building, which, to be useful, need contain no lofty halls or grand corridors, but should consist of a series of well-lit rooms, after the fashion of, we would suggest, that nicest of museums, the one for Economic Botany at Kew.

THE following memorandum on the Whitworth Scholarships, prepared by Sir Joseph Whitworth, has been approved by the Lords of the Committee of the Council on Education:—"I wish that candidates for my Scholarships in 1874, who, owing to the shortness of the notice, may not have been able to be in a mechanical shop for six months before the competition takes place, should be allowed to compete, but that if successful, their scholarship should not begin until they have worked six months in a mechanical shop. I think the same privilege should be accorded to candidates in 1875, who have not served eighteen months in a mechanical shop, the scholarship not beginning until this period is completed."

THE 120th session of the Society of Arts was opened on the 19th inst. with an address by the Chairman of the Council, Major-General F. Eardley-Wilmot, F.R.S.

THE *magnum opus* of three generations of botanists, De Candolle's "Prodromus Systematis naturalis vegetabilium," containing a diagnosis of every known species of flowering plant, has now been completed as far as Dicotyledons are concerned, and it is not intended to continue the work into the Monocotyledons. In commemoration of the completion of the work, the Horticultural Society of Belgium has awarded M. de Candolle a special medal. The publication of the work was commenced in 1818.

THE trustees of the Gilchrist Educational Fund offer a scholarship of the value of 50*l.* per annum, tenable for three years at Girton College, Cambridge, to be competed for at the General Examination for Women, conducted by the University of London in May, 1874.

FROM the commencement of next year, *The Gardeners' Chronicle and Agricultural Gazette* will be divided into two papers,

each weekly, to be devoted to the interests of the two sister sciences.

DR. WILLIAM WALLACE, in opening recently the session of the Chemical Section of the Philosophical Society of Glasgow, spoke, among other things, of the endowment of research. From what he said on this subject, we think the following pointed remarks worthy of attention:—"With regard to students who attended evening lectures and classes, a very great deal had been done for them by the Society of Arts, and by the examiners of the Science and Art Department, both of which had given great encouragement to the class of students whom they were intended to benefit. What was lacked most was a stimulus to men of the highest educational class. In this country, apart from professorships, there were no means of assisting that class except, perhaps, a few sinecures and the conferring of empty titles. In France, at least under the Imperial *régime*, when a man acquired renown in a particular line of investigation, a laboratory with all the best and most suitable appliances was immediately fitted up for him. Hence Paris was provided with a series of the most complete laboratories for metallurgy, for agriculture, for the sugar manufacture, and for many other branches of the science; and students might go to study a particular subject with the certainty that they would have a most efficient teacher and the advantages of a laboratory fitted up specially, and, as one might say, regardless of expense, with the apparatus and requirements necessary for the teaching and study of the subject. It appeared to him (Dr. Wallace) that the endowment of research would form a desirable stimulus for chemists, many of whom had the necessary education and talent, but could not afford the time nor the expense, often considerable, of obtaining the apparatus and materials required.

A SOCIETY of Physical and Natural Science was founded four years ago at Caracas, Venezuela; but the political agitations of the country have, until recently, hindered its development. Meanwhile it has commenced the publication of a Bulletin under the title of *Vargasia*, so named in honour of the American botanist Vargas. *L'Institut* learns, by a letter from Dr. Ernst, who is at once president, secretary, and treasurer of the society, that the present Government of Venezuela intends to promote, as much as it can, the growth of scientific studies, mainly by the establishment of various institutions for public instruction. Dr. Ernst, appointed Professor of Botany in the University of Caracas, where hitherto there has been no such chair, has been charged with the direction or rather the creation of a botanic garden and a museum of natural history. In the museum Prof. Ernst intends to collect—1st, a herbarium of Venezuela; 2nd, a general herbarium; 3rd, a collection relating to economic botany. He intends to publish in a few years a Flora of Caracas. Dr. Ernst appeals to European botanists and collectors for exchanges to assist him in the formation of these herbaria.

IT is not often that Mr. Disraeli says anything which calls for particular notice in a journal of this kind, therefore it is with peculiar pleasure that we quote the opinion he uttered last week at the Glasgow banquet as to the share which Science has had during the present century in moulding the world. Coming from a man of his shrewdness and sentimentality withal, the words have a striking force. Speaking of the last fifty years, he said:—"How much has happened in these fifty years—a period more remarkable than any, I will venture to say, in the annals of mankind. I am not thinking of the rise and fall of empires, the change of dynasties, the establishment of Governments. I am thinking of those revolutions of science which have had much more effect than any political causes, which have changed the position and prospects of mankind more than all the conquests and all the codes and all the legislators that ever lived."

AT the first meeting of the Edinburgh Botanical Society for

the winter, Mr. James McNab, curator of the Royal Botanical Gardens, delivered an address on the change of climate in Scotland, which, during the last fifty years has undergone a considerable lessening of the summer heat. From this cause peaches and nectarines cannot be ripened to the same perfection in the open air as formerly, while asparagus, mushrooms, and tomatoes are gradually disappearing. The larch, in spite of the enormous quantities of seed annually imported, is declining in vigour, and there is a talk of substituting for it the Wellingtonia as a nurse-tree. Mr. McNab proposes that a central committee should be appointed to investigate the whole subject of the change of climate in Scotland.

THE following is an ephemeris (for 0^h Berlin time) of the comet discovered by M. Coggia at Marseilles, on the evening of the 10th inst:—November 22, 14^h 51^m 25^s—6° 8' 2"; November 30, 14^h 14^m 30^s—22° 43' 0"; December 8, 14^h 0^m 17^s—32° 1' 8". Its elements are:—T=Dec., 4^h 1348, Berlin mean time; $\pi = 94^\circ 23' 14''$; $\Omega = 254^\circ 14' 9''$; $i = 27^\circ 2' 7''$. Mean Equinox, 1873^o *log. q.* = 9^o83810.

ONE of the special results of the United States geological and geographical survey of the Territories, in charge of Prof. F. V. Hayden, during the past summer, has been the discovery that Colorado Territory is the centre of the greatest elevation of the Rocky Mountain chain. In Central Colorado the chain proper is about 120 miles broad, made up of three lofty parallel ranges, running nearly north-north-west, and flanked from the west by great plateaus and groups of peaks. Between the ranges lie the great elevated basins known as "parks." The front range, which rises abruptly from the plains, is seen from Denver in a grand panorama 120 miles long. From its snowy serrated crest rise many peaks between 13,000 and 14,000 ft. high. On the west side of the parks is the Park Range, whose highest group is at Mount Lincoln, this and Quandary Peak each rising to about 14,000 ft. The survey has established a permanent meteorological station at Fairplay, 10,000 ft. above the sea, and another at Cañon City, about 6,000 ft. These stations are all connected by a spirit-level line, and the comparison of their observations will be of remarkable interest. The National Range lies east of the Park Range, and is separated from it by the Arkansas Valley. West of the National Range rises the great group of Elk Mountains, five of whose peaks are 14,000 ft. high. So far as known, there are in the district explored during the past season by the survey 72 peaks, ranging from 14,000 to 14,200 ft. in height.

IN the article on Local Societies (vol. ix. p. 24) we inadvertently confounded the Manchester Natural History Society with the Microscopical and Natural History section of the Manchester Literary and Philosophical Society. The former of these is extinct—having handed its collections over to the Owens College—and also contributed a handsome sum of money to promote, permanently, the study of Natural History in the Literary and Philosophical Society. This endowment now enriches the Natural History section of that society. Manchester science will gain rather than lose by these changes. The defunct society was never more than the creator and guardian of a museum. That museum will still be preserved and increased, as well as utilized, by the College, whilst the Natural History section affords promise of a healthy career of scientific work.

M. CHARREL, of Marseilles, writes as follows to the *Bulletin International*, of the Observatory of Paris, on the invention of balloons:—In the literary history of the City of Lyons, published by Father Colonia (1830, vol. i. p. 112), it is stated that in the reign of Louis le Debonnaire, the Archbishop of Lyons learned that some aerial navigators had fallen with their boat on the banks of the Saone, and were going to be put to death as sor-

cerers. He ordered them to be brought into his presence, and after having heard them, he caused them to be nonsuited (*le fit mettre hors de procès*). The memoir of the prelate bears such a character of authenticity as leaves no doubt of the fact. The following words are taken verbatim from the memoir: "Videmus exhibere vinctos quatuor homines; tres viros et unam feminam, quasi qui de ipsis navibus ceciderunt, quos . . . exhibuerunt in nostra presentia tanquam lapidandos." It follows, then, from this memoir, that already, in the ninth century, aerial navigation was known; how it was accomplished the memoir does not give any indication.

THE first Annual Exhibition of the West London Entomological Society, established 1868, will be held on December 2 and 3, at the "Mason's Arms," Tichborne Street, Edgware Road.

A *Times* telegram from Teheran, November 24, says that Colonel Baker and Lieutenant Gill have arrived at Teheran, and leave immediately for England, *via* Tabreez and Erivan. Travelling to the north from Meshed, they passed along the Turcoman frontier by Kelat, Abiverd, Dereguez, Annau, Astrabad, and Nissa. Striking south, they discovered the source of the Atrek at Karakazan, an extraordinary spring near Shirvan, and followed the course of the river a considerable distance north-west of Bojnoord, until stopped by hostilities between Bojnoord and the Turcomans. Striking into the mountains, they were enabled to trace the course of the river until it fell into the plains, and also to observe the great range of mountains which runs along the whole Persian frontier from Sarakhs to Kizil Arvat. Existing conjectural maps of this country are quite incorrect.

ON the 1st inst. the Earl of Dalhousie formally opened the Art Exhibition and Museum of the Albert Institute of Dundee, which, with the previously opened portions—free library and lecture-hall—form one handsome block of buildings. In the list of towns, with their scientific societies, published by us a week or two ago, we were surprised to see Dundee, so rapidly advancing in population and wealth, occupy so humble a place. We cannot see how towns like Leeds, Newcastle, Manchester, Glasgow, and others should have their flourishing and well-equipped scientific societies, while Dundee has only one small struggling society of young men, the Naturalists' Field Club. The neighbouring and comparatively stagnant town of Perth, with its large and efficient society, puts Dundee to the blush in this respect. We shall be disappointed if the opening of the Albert Institute in Dundee, a town so dependent for its commercial and manufacturing success on the applied results of Science, does not give an impetus to the study of Science. There are already Science and Art Classes in the town, and we hope to hear soon of the establishment of regular courses of scientific lectures, such as those which are found in several of the large English manufacturing towns, and the formation of at least one flourishing scientific society and field club around the small nucleus already existing. We hope also that the collections in the museum will be made worthy of the wealthy town and be really representative of the treasures of the various kingdoms of Nature. We feel sure that the citizens of Dundee only need their attention to be drawn to the backward state of their town in the matter referred to to rouse them to put it on a level in this respect with the large English towns.

THE additions to the Zoological Society's collection during the last week include an Eagle (*Spizaetus*?) from Burmah, presented by Mr. H. Fielder; a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mr. Gore; a pair of Jaguars (*Felis onca*) born in the Jardin des Plantes, Paris, received in exchange.

ON SOME RECENT RESULTS WITH THE
TOWING NET ON THE SOUTH COAST OF
IRELAND*

I.—*Mitraria*

ONLY a single specimen was obtained of the little *Mitraria*, which formed the subject of the present communication, and neither its structure nor development was made out as completely as could have been wished. From the Mediterranean species described in a former communication (British Association Report for 1872), it differs in some points of structure and in the mode of annulation of the developing worm. It possesses the usual *Mitraria* form, that of a hemispherical dome having its base encircled by a band of long vibratile cilia. In the side of the dome a little above the ciliated band is the mouth which leads into a rather wide pharynx clothed with a ciliated epithelium. The pharynx runs through the dome parallel to its base and opens into a capacious stomach which continues in the same direction until it joins the intestine. This then turns down abruptly at right angles to the previous portion of the alimentary canal, and then projects for a slight distance beyond the base of the dome, carrying with it hernia-like the walls of the base.

The true body walls of the future worm, of which the *Mitraria* is the larva, seem as yet confined to the intestinal segment of the alimentary canal. They already present the commencement of annulation, which, however, exists only on the dorsal and ventral sides, while two broad bands of very distinct fibres may be seen, one on the right and the other on the left side, extending transversely from the dorsal to the ventral surface.

The ciliated band which runs round the base of the dome possesses a rather complex structure. It consists of two concentric rings: an outer one composed of large oval distinctly nucleated cells, and an inner one of a granular structure and yellowish colour, in which no distinct cells could be demonstrated. The cilia form two concentric wreaths borne by the under side of the band, an outer wreath consisting of very long cilia, and borne by the inner edge of the outer portion of the band, and an inner wreath of much shorter cilia borne by the inner edge of the inner portion. The band with its cilia is interrupted for a very short space at the aboral side of the dome. There is probably at this spot an entrance into a water-vascular system. No such system, however, was observed in the specimen, though the author had described in another species of *Mitraria* a system of sinuses which appear to exist in the walls of the dome, and which he regarded as representing a water-vascular system (Brit. Assoc. Report for 1872).

Occupying the very summit of the dome is a large, somewhat quadrilateral ganglion, from which two distinct filaments are sent down, one on each side of the alimentary canal, but he was not able to follow these filaments to their destination. The bilateral symmetry of the ganglion suggests its formation out of two lateral halves. Though its very superficial position gives it the appearance of being a mere thickening of the walls, the view here taken of its being a nervous ganglion seems to be the only one consistent with its relations to the surrounding parts.

On each side of the pharynx, a little behind the mouth, is a small oval ganglion-like body from which a filament runs to the ciliated band. Some delicate filaments may also be seen lying between the pharynx and the walls of the dome on which they seem to be distributed, but the author could not trace them to any distinct ganglionic centre.

The great apical ganglion carries two very obvious black ocelliform spots, and besides these two clear vesicles enclosing each a clear spherical corpuscle. The two vesicles may probably be regarded as auditory capsules.

The further development of this larval form has not been observed. It probably consists chiefly in the continued prolongation of the alimentary canal beyond the base of the hemispherical dome, the completion of the annulation by its extension to the right and left sides, and the gradual contraction of the dome and final absorption of the ciliated band.

2.—*Tornaria*

Two specimens of the larval form originally discovered by Johann Müller, and described by him under the name of *Tornaria*, were obtained, but these unfortunately perished before a sufficiently exhaustive examination of them could be made. On the whole their structure agrees closely with what has been

pointed out by Alex. Agassiz in his valuable and elaborate memoir on *Tornaria* and *Balanoglossus*. The species appears to be different from those hitherto described. The gills had not begun to show themselves, and there were but traces of the "lappets" described in other species as appended to the posterior extremity of the stomach.

The author believed that he could distinguish a minute ganglion on each side of the cesophagus; filaments were sent off from it to the neighbouring parts, and the two were connected to one another by a sub-cesophageal commissure. The water-vascular chamber was very distinct, but the so-called heart was not observed; while within the body-cavity, lying close to the dorsopore and over the canal by which the great water-sac communicates with the external medium, was a small, closed, rather thick-walled vesicle containing numerous oval corpuscles. Of the nature of this vesicle the author could not offer any opinion.

The cushion-like body which occupies the summit of the larva exactly as in *Mitraria*, and supports the two ocelliform spots, was very distinct, and so also was the contractile chord which extends from this to the walls of the water-sac. The author, however, could not here, any more than in *Mitraria*, regard the cushion-like body as a mere thickening of the walls; he believed it to be a nerve-mass, and thought he could trace two fine filaments proceeding from it and running down, one towards the right and the other towards the left side of the alimentary canal, but he was not able to follow them for any distance, and he does not regard their existence as confirmed. The extremely superficial situation of this body, which makes it resemble a mere thickness of the walls, is paralleled by that of the great ventral nerve-mass in *Sagitta*.

The contractile chord which runs to the water-sac is probably attached to a capsular covering of the ganglion, rather than directly to the ganglion itself. This chord, though showing strong contractions by which the summit of the larva is drawn down towards the water-sac, is of a homogeneous structure, presenting no appearance of distinct fibrillæ or of other contractile elements.

The author instituted a comparison between *Tornaria* and *Mitraria*. We have in both the external transparent pyramidal or dome-shaped body, with a lateral oral orifice, and a basal anal orifice, enclosing an alimentary canal which is divisible into three regions, and takes a partly horizontal and partly vertical direction in its course from one orifice to the other;* we have in both, near the base of the body, the circular band which carries long vibratile cilia accompanied by a row of pigment spots, and in both the cushion-like ganglion carrying ocelli.

From *Mitraria*, *Tornaria* chiefly differs in the presence of the thick sinuous and convoluted bands which give it so close a resemblance to certain Echinoderm larvæ, and which are entirely absent from *Mitraria*, and in its water-vascular system with the contractile cord which extends from this to the apical ganglion. If a water-vascular system is present in *Mitraria*, it consists there of a system of sinuses excavated in the walls of the dome, but without any representative of the great central sac. In *Mitraria* the great apical ganglion carries not only the two ocelli, but also two capsules, probably auditory; these capsules do not exist in *Tornaria*. In *Mitraria* the two nerve chords which the apical ganglion sends down one on each side of the alimentary canal are very distinct; in *Tornaria*, if they exist at all, they are by no means obvious. Finally, the ciliary cirlet is simple in *Tornaria*, while in *Mitraria* it is double.

According to Alexander Agassiz's account of the development of *Tornaria* into *Balanoglossus*, the great transverse cirlet of cilia becomes, by the elongation of the body, gradually pushed backwards, so as to form the anal ciliated ring of the young worm; in *Mitraria* the great ciliary cirlet remains unchanged in position, and is probably ultimately absorbed, the worm during its development acquiring a new anal wreath of cilia.

3. *Ametrangia hemispherica* (nov. gen. et spec.)

Among the most abundant products of the towing-net was a little hydroid medusa, remarkable for the want of symmetry in the distribution of its gastro-vascular canals. It is of a hemispherical form, with the base about half-an-inch in diameter, and provided with very numerous (more than 100) marginal tentacles, which are very extensible, and may at one time be seen floating away to a length of three or four inches and at another coiled into a close spiral against the margin of the umbrella.

* In the species of *Mitraria* described by J. Müller and by Metschnikoff, both oral and anal orifices are basal, and the alimentary canal presents a U-shaped curvature.

* Paper read at the Meeting of the British Association, Bradford by Prof. Allman, F.R.S.

Each tentacle originates in a bulbous base with a distinct ocellus. No lithocysts are visible on the margin. The velum is of moderate width.

The manubrium forms a small projection from the summit of the umbrella, and terminates in four rather indistinct lips. From the base of the manubrium three rather wide offsets are sent off at equal intervals into the walls of the umbrella. These gradually contract in diameter, and then, as three narrow tubes of uniform diameter, run towards the margin, where they open into the circular canal. The symmetry of the radiating canals is confined to these three primary trunks. From their wide proximal ends each sends off branches, some of which may be traced to the margin where, like the three primary canals, they enter the circular canal, while others can be followed for various distances in the umbrella walls, in which they terminate by blind extremities without ever reaching the margin. These branches are very irregular in the number sent off from each primary canal, as well as in their length and directions.

The generative elements are formed in oval sporosacs developed one on each of the three primary canals at the spot where the wider base passes into its narrower continuation. The ova may be seen within them in various stages of development; they increase considerably in size before the commencement of segmentation, always showing up to that period a large and distinct germinal vesicle with germinal spot and with a distinct nucleolus in the interior of the germinal spot. The development of the ovum proceeds within the sporosac to the segmentation of the vitellus and the formation of the planula, which now breaks through the outer walls of the sporosac and remains for some time adhering to their external surface. The planula differs remarkably from the typical hydroid planula. It remains of a nearly spherical form, never acquiring cilia, and possesses little or no power of locomotion. The gastric cavity, however, is fully formed. The author was unable to follow the ova in their further development.

The little medusa now described, departs in several important points from the typical hydroid medusa. From this it differs in the ternary disposition of the primary radiating canals, and in the irregular non-symmetrical arrangement of those which are subsequently formed. Among the very many specimens examined, the author never found any in which the canals had become regular in their disposition, even in those which had discharged the contents of their sporosacs, and had evidently attained the term of their existence. It differs also from the typical medusa in the form and non-ciliated condition of the planula; and still further in the fact that while the generative elements are borne on sporosacs, developed on the radiating canals, the marginal bodies are ocelli and not lithocyst.

4.—*Circe invertens* (nov. spec.)

Among the hydroid medusæ captured in the towing-net, were two or three specimens of a species referable to the genus *Circe* of Mertens. It measures about half-an-inch in its vertical diameter, and about a quarter of an inch transversely. It is cylindrical from its base upwards, for about two-thirds of its height, and then contracts abruptly, and arches dome-like towards the truncated summit, which is surmounted by a solid cone of the gelatinous umbrella substance. From the summit of the umbrella-cavity, a solid somewhat fusiform extension of the roof hangs down in the axis of its cavity for about two-thirds of its depth, and at its free end carries the manubrium, which extends nearly to the codonostome. The margin of the umbrella carried eighty very short and but slightly extensile tentacles, which were connected at their bases by a very narrow membranous extension of the margin, with rather irregular free-edge. Lithocysts are situated at irregular intervals upon the margin. There are about sixteen of them; they consist each of a minute spherical vesicle with a single large spherical concretion. There are no ocelli. There is a moderately wide velum.

The radiating canals are eight in number. They spring from the base of the manubrium, run up the sides of the solid process which hangs from the summit of the umbrella; pass from this to the walls of the umbrella, and then run down towards the margin in order to open into the circular canal.

The generative elements are borne in pendent sporosacs, which spring from the radiating canals close to the summit of the umbrella cavity.

The motion of the medusa takes place by means of sudden jerks, reminding us of the way in which certain Diphydæ dart through the water.

The medusa possesses also a very singular habit of partial inversion. This takes place along the line which separates the dome-like portion of the umbrella cavity from the lower cylindrical portion, and consists in the withdrawal of this dome-like summit and the lower portion of the cavity. When thus inverted the little animal presents a drum-shaped form, with the manubrium hanging far out of the codonostome.

Alexander Agassiz considers the genus *Circe*, of Mertens, as synonymous with *Trachynema* Gegenbaur, and points out that the name of *Circe* had been already used for a genus of mollusca. He further removes it from among the true hydroid medusæ, and regarding it as closely allied to the *Eginidæ*, places it along with those in the *Haplostomeæ* Agassiz, a sub-order of the *Discophora*.

The author, however, could not see sufficient grounds for the removal of Mertens' genus from the true *Hydroida*, with which the medusa now described agrees in all essential points, including the form and disposition of the gastro-vascular and generative systems and the structure of the marginal lithocysts. Neither could he agree with Alexander Agassiz in identifying it with *Trachynema*. The greatly developed solid peduncle by which the manubrium in *Circe* is suspended from the summit of the umbrella-cavity in a way, however, which has its parallel in *Tima* among others, is of itself a character of generic importance by which *Circe* must be kept apart from *Trachynema*. It is true that Gegenbaur's *Trachynema* has the character of a young form, and until we have further evidence of its adult state its affinities cannot be regarded as established.

Gegenbaur believes that he has established the direct development of *Trachynema* from the egg without the intervention of a hydriform trophosome, but unfortunately we have no data by which to compare in this respect *Circe* with *Trachynema*.

It must be admitted too that in the imperfect contractility of the marginal tentacles and in the somewhat greater firmness of the umbrella walls the little medusa described in the present communication possesses characters which look towards the *Eginidæ*, but these are by no means sufficiently strong to justify its separation from the ordinary hydroid medusæ.

5.—*Tomopteris*

A few young specimens of this beautiful little worm were obtained, and the author was enabled to confirm the statements of Grube and of Keferstein, who describe in it a double ventral nerve chord, though other observers have failed to discover this part of the nervous system and throw doubt upon its existence. In adult specimens examined some years previously by the author no ventral chord could be detected.

The ventral portion of the nervous system consists of two flat ribbon-shaped chords which are given off from the inferior side of the nerve ring which surrounds the pharynx just behind the mouth. These run parallel to one another, separated by a narrow interval; they lie on the ventral walls of the animal, and may be traced through the narrow tail-like termination of the body as far as its extremity. They present no ganglionic swellings, but opposite to every pair of feet each sends off a filament which passes to the foot of its own side in which it is distributed.

Dr. Anton Dohrn has just informed the author that he too had distinctly seen the ventral chord of *Tomopteris*.

SCIENTIFIC SERIALS

AMONGST the papers in the October and November numbers of the *American Naturalist*, are included Dr. J. L. Smith's Address to the American Association for the Advancement of Science, on Science in America and Modern Methods of Science. —Mr. R. Ridgway describes some new forms of American Birds, which he considers as geographical races, and not distinct species. Included are *Catherpes mexicanus*, var. *conspersus*; *Helminthophaga celata*, var. *lutescens*; *Dendroica vieillotii*, var. *bryanti*; *D. dominica*, var. *albiflora*; *D. gracia*, var. *decora*; *Myiodioctes pusillus*, var. *puleolata* (Pallas), and *Collurio ludovicianus*, var. *robustus* (Baird), which are described and followed by a synopsis of the genera of *Certhiola*, *Junco*, and *Cardinalis*. —Prof. C. A. Riley has a paper on the Oviposition of the Yucca Moth, in which he shows that the female conveys her eggs into the young fruit by a lateral puncture. The Structure and Growth of Domesticated Animals, forms the subject of a popular lecture by Prof. Agassiz, which is followed by one on Stauroliite

Crystals and Green Mountain Gneisses of the Silurian Age, by Prof. Dana.—The Rev. D. T. Hill gives instances of intelligence in *Bufo americanus*.—Mr. G. W. Morehouse analyses the structure of the scales of *Lepisma saccharina*.—Mr. D. Scott gives a popular explanation of the differences between the two genera of North American Goatsuckers, the Whippoorwills (*Caprimulgus*), and the Nighthawks (*Chordeiles*), which is followed by a short note from Mr. Packard, jun., on the Embryology of *Lilulus*, with remarks on its affinities. His results are confirmatory of those of M. Alphonse Milne-Edwards.

The fourth and concluding part of vol. xxviii. of the *Transactions of the Linnean Society*, is chiefly occupied by a supplementary paper by the Rev. O. P. Cambridge, on New and Rare British Spiders; but also contains some short papers of importance.—Prof. Oliver describes a new genus of Begoniaceae from New Granada, under the name of *Begoniella*, a monotypic genus of great interest as respects the geographical distribution of the order; and three new genera of Malayan plants from the herbarium of Dr. Maingay—*Pteleocarpa* and *Ctenolophon* (Olcaceae), and *Maingaya* (Hamamelidaceae).—Dr. M'Nab publishes his important paper on the Development of the flowers of *Welwitschia mirabilis*. Dr. M'Nab considers that in the male flowers of this very remarkable plant we have a very close approach to the Angiosperms, the axis of the flower ending in a mass of tissue which, in the female flower, is the terminal ovule; while, in the female flower, we have the truly gymnospermous condition, there being no carpels, but a terminal ovule, the modified end of the axis of the flower, with a single ovular integument, the pollen grains being applied directly to the naked nucleus.

SOCIETIES AND ACADEMIES

Royal Society, Nov. 20.—“Note on the Electrical Phenomena which accompany irritation of the leaf of *Dionaea muscipula*,” by Dr. J. Burdon Sanderson, F.R.S.

1. When the opposite ends of a living leaf of *Dionaea* are placed on non-polarisable electrodes in metallic connection with each other, and a Thomson's reflecting galvanometer of high resistance is introduced into the circuit thus formed, a deflection is observed which indicates the existence of a current from the proximal to the distal end of the leaf. This current I call the *normal leaf-current*. If, instead of the leaf, the leaf-stalk is placed on the electrodes (the leaf remaining united to it) in such a way that the extreme end of the stalk rests on one electrode and a part of the stalk at a certain distance from the leaf on the other, a current is indicated which is opposed to that in the leaf. This I call the *stalk-current*. To demonstrate these two currents, it is not necessary to expose any cut surface to the electrodes.

2. In a leaf with the petiole attached, the strength of the current is determined by the length of the petiole cut off with the leaf, in such a way that the shorter the petiole the greater is the deflection. Thus in a leaf with a petiole an inch long I observed a deflection of 40. I then cut off half, then half the remainder, and so on. After these successive amputations, the deflections were respectively 50, 65, 90, 120. If in this experiment, instead of completely severing the leaf at each time, it is merely all but divided with a sharp knife, the cut surfaces remaining in accurate apposition, the result is exactly the same as if the severance were complete; no further effect is obtained on separating the parts.

3. *Effect of constant current directed through the petiole on the leaf-current*.—If the leaf is placed on the galvanometer electrodes as before, and the petiole introduced into the circuit of a small Daniell, a commutator being interposed, it is found that on directing the battery-current down the petiole (*i.e.*, from the leaf), the normal deflection is increased; on directing the current towards the leaf, the deflection is diminished.

4. *Negative variation*.—*a.* If the leaf being so placed on the electrodes that the normal leaf-current is indicated by a deflection *leftwards*, a fly is allowed to creep into it, it is observed that the moment the fly reaches the interior (so as to touch the sensitive hairs on the upper surface of the lamina), the needle swings to the right, the leaf at the same time closing on the fly.

b. The fly having been caught does not remain quiet in the leaf; each time it moves the needle again swings to the right, always coming to rest in a position somewhat farther to the left than before, and then slowly resuming its previous position.

c. The same series of phenomena present themselves if the

sensitive hairs of a still expanded leaf are touched with a camel-hair pencil.

d. If the closed leaf is gently pinched with a pair of forceps with cork points, the effect is the same.

e. If the leaf-stalk is placed on the electrodes, as before, with the leaf attached to it, the deflection of the needle due to the stalk-current is *increased* whenever the leaf is irritated in any of the ways above described.

f. If half the lamina is cut off and the remainder placed on the electrodes, and that part of the concave surface at which the sensitive hairs are situated is touched with a camel-hair pencil, the needle swings to the right as before.

g. If, the open leaf having been placed on the galvanometer electrodes as in *a*, one of the concave surfaces is pierced with a pair of pointed platinum electrodes in connection with the opposite ends of the secondary coil of a Du Bois-Reymond's induction apparatus, it is observed that each time that the secondary circuit is closed, the needle swings to the right, at once resuming its former position in the same manner as after mechanical irritation. No difference in the effect is observable when the direction of the induced current is reversed. The observation may be repeated any number of times, *but no effect is produced unless an interval of from ten to twenty seconds has elapsed since the preceding irritation*.

h. If the part of the concave surface of the leaf which is nearest the petiole is excited, whether electrically or mechanically, the swing to the right (negative variation) is always preceded by a momentary jerk of the needle to the left, *i.e.* in the direction of the deflection due to the normal leaf-current; if any other part of the concave surface is irritated, this does not take place.

i. Whether the leaf is excited mechanically or electrically, an interval of from a quarter to a third of a second intervenes between the act of irritation and the negative variation.

“On the Algebraical Analogues of Logical Relations,” by Alexander J. Ellis, F.R.S.

The object of this paper is to examine the “mathematical theory of logic,” thus laid down by Dr. George Boole in his “*Laws of Thought*,” p. 37:—“Let us conceive of an Algebra in which the symbols x, y, z , &c. admit indifferently of the values 0 and 1, and of these values alone. The laws, the axioms, and the processes of such an algebra will be identical in their whole extent with the laws, the axioms, and the processes of an Algebra or Logic. Difference of interpretation will alone divide them.” For this purpose, first the laws of such an algebra have been investigated independently of logic, and secondly the laws of primary and secondary logical propositions as laid down by Dr. Boole, have been developed in an algebraic form, and compared with the former. The main results presumed to be established are:—

1. That there is a fundamental difference between such an algebra and logic, inasmuch as the algebra admits of only *two* phases, 0 and 1, and logic admits of *three* phases, namely, not only *none* and *all*, corresponding to 0 and 1, but also *some*, “which, though it may include in its meaning *all*, does not include *none*” (*ibid.*, p. 124), and hence has no analogue in such an algebra; that is, an algebra of 0 and 1 can correspond only to a logic of *none* and *all*.

2. That, notwithstanding this difference, there are certain formal relations of equations which allow the algebra of 0 and 1 to be used as an *algorithm* for the purpose of arriving at certain logical forms, which, however, have then to be interpreted on a basis which has not even any analogy to the algebraical.

3. That the introduction of this algorithm introduces theoretical difficulties, adds to the amount of work, and is entirely unnecessary even for the purposes of the theory of probabilities founded upon it by Dr. Boole.

Mathematical Society, Nov. 13.—Prof. Cayley, and subsequently Prof. Sylvester, in the chair.—The following gentlemen have been elected officers of the new council:—President, Dr. Hirst; Vice-Presidents, Prof. Cayley, and Messrs. Spottiswoode and Sylvester. The retiring members were Prof. Crofton and Mr. J. Stirling, in whose room Mr. Sylvester and Lord Rayleigh were elected.—Mr. Sylvester then gave a description of a new instrument for converting circular into general rectilinear motion, and into motion in conics and other plane curves. (A brief sketch of the historical aspect of the communication, from the pen of Mr. Sylvester, forms the subject of a paragraph in NATURE of Nov. 13.) Several instruments were placed on the table for inspection.—Mr. W. Marsham Adams

exhibited his Mensurator and Cælometer, and gave a short account of the objects to which they could be applied. The Mensurator is an instrument designed primarily for the instantaneous solution of triangles, but capable, from its construction, of many other uses; such as illustrating most of Euclid's theorems with regard to the triangle, of performing addition, subtraction, rule of three, and extraction of square roots, of solving quadratics and simple binomial equations, and of reducing to mechanism some part of analytical geometry. The Cælometer is an apparatus consisting of a stand carrying a globe mounted somewhat like a sea compass, and illustrates celestial longitude and latitude, the phenomena of the seasons, the correspondence of the calendar with the solar year, the precession of the equinoxes, the times of sunrise at any place on any day, the position of the principal stars during the night, and the general relations between the conceptions necessary for nautical astronomy. Medals were awarded for both instruments at the Vienna Exhibition.—Mr. S. Roberts (treasurer) read a short note "On the expression of the arc of a Cartesian by elliptic functions." The author showed that the hyper-elliptic part of the integral which gives the value of an arc of a Cartesian, is reducible to the form which Jacobi has shown to depend on elliptic functions.

Zoological Society, Nov. 19.—Dr. A. Günther, F.R.S., vice-president, in the chair. Mr. Selater exhibited and pointed out the characters of two new species of birds obtained by Mr. Salmon during his expedition to the State of Antioquia, Columbia. These were named *Chlorochrysa nitidissima* and *Grallaria ruficeps*.—A letter was read from Mr. R. Swinhoe, H.B.M. Consul at Chefoo, containing a note on the White Stork of China, and stating that he had recently obtained a live Pitta in China, which appeared to be *Pitta nympha* of the Fauna Japonica.—Mr. A. H. Garrod exhibited and pointed out certain peculiarities in the cæcum of a Crab-eating Fox (*Canis cancrivorus*).—Mr. Selater exhibited and made remarks on a pair of horns of the new Bubaline Antelope from the Bogos country, lately named *Alcelaphus tora* by Dr. Gray.—A paper was sent by Dr. Edward L. Moss, Surgeon in charge R.N. Hospital at Esquimalt, on a singular Virgularian Actinozoon taken at Burrard's Inlet, close to the northern mouth of the Fraser River.—A communication was read from Dr. O. Finsch, containing the description of a most remarkable and interesting new Passerine Bird which he had received from Mr. T. Klinesmith of Levuka, Ovalou, Feejee Islands. This little bird, which was not only new as a species, but also the type of a new genus, he proposed to call *Lampyrolia Victoria*.—A communication was read from Mr. W. S. Atkinson, of Darjeeling, containing the descriptions of two new species of Butterflies from the Andaman Islands, which were named respectively *Papilio mayo* and *Euploea andamanensis*.—Dr. Cobbold communicated the first of a series of papers entitled "Notes on the Entozoa;" being observations based on the examination of rare or otherwise valuable specimens contributed at intervals by Messrs. Charles Darwin, Robert Swinhoe, Charles W. Devis, the late Dr. W. C. Pechey, Dr. Murie, and others.—Mr. Edwin Ward exhibited and gave the description of a new Bird of Paradise, of the genus *Epimachus*, which he proposed to call *E. eliotti*.—A communication was read from Surgeon-Major Francis Day, containing remarks on Indian Fishes, mostly copied from the original manuscripts of the late Dr. Hamilton Buchanan.—Mr. J. W. Clark read a memoir on the Eared Seals of the Auckland Islands, one of which he recognised as *Otaria hookeri*, thus fixing the locality of this species.

Linnean Society, Nov. 20.—Mr. G. Bentham, president, in the chair.—Prof. Dyer exhibited a specimen of the fruit of *Luffa aegyptiaca*, a gigantic species of gourd, grown in this country.—An account of the flora of Monte Argentaro, on the borders of Tuscany, by Mr. Henry Groves, of Florence, was read.—On the Alge of Mauritius, by Dr. Dickie. The total number of species recorded is 155. These include 17 well-known European species, most of which are cosmopolitan; 23 South African species; 12 Australian; 15 East Indian; 14 species found in the Red Sea; 12 being peculiar to the island.—On a peculiar embryo of Delphinium, by the Rev. C. A. Johns. The interesting point in the structure was the non-separation of the two cotyledons, the plumule forcing itself through a chink in the undivided cotyledon. Dr. Masters stated that this peculiarity is well known to occur occasionally in Ranunculaceæ, as well as in some other plants.—On the buds of Malaxis, by Dr. Dickie. This is supplementary to the paper already published in the "Journal" of the Society.—On the Alge of St. Thomas and Bermuda, by Mr. H. N.

Moseley. These were the results of the explorations on board the *Challenger*, one marine flowering plant being also found in flower for the first time.

Chemical Society, Nov. 20.—Dr. Odling, F.R.S., president, in the chair.—A paper on "the coefficient of expansion of carbon disulphide," by J. B. Hannay, was read by the secretary.—Dr. Russell then communicated his researches on the action of hydrogen on silver nitrate, giving an account of the precipitation of metallic silver in the crystalline state by means of hydrogen.—There were also a note on the action of zinc chloride on codeine, by Dr. C. R. A. Wright; on the chemical properties of ammoniated ammonia nitrate, by E. Divers, M.D.; and on the analysis of a meteoric stone and the detection of vanadium in it, by R. Apjohn.

PARIS

Academy of Sciences, Nov. 17.—M. de Quatrefages, president, in the chair.—The following papers were read:—An answer to M. Tarry's remarks on the theory of the sun's spots, by M. Faye. M. Tarry's objection to M. Faye's theory was that, instead of a down-rush, he ought to have employed an up-rush as the cause of the spots, as a terrestrial cyclone rushes up, and not down. M. Faye answered the objections in detail.—Second memoir on the way in which water intervenes in chemical reactions, and on the connection between electro-motive force and affinity, by M. Becquerel.—Studies on beer; a new method of brewing it and rendering it unchangeable, by M. L. Pasteur. The author considers the spoiling and souring of beer to be due to germs, and suggests methods for preventing their access or destroying them during the processes of brewing.—An answer to M. Oudemans' observations on the influence of refraction, &c., during the transit of Venus, by M. E. Dubois.—On the use of the prism for the verification of the law of double refraction, by Prof. G. G. Stokes.—On certain metallic spectra (lead, chloride of gold, thallium, and lithium) by M. Lecocq de Boisbaudran. The author found that the combination of a metal was attended with the loss of some of the lines it exhibited when in the free state.—On the maximum density of water, by M. Piarron de Mondesir.—On the cooling effects of the joint actions of capillarity and evaporation, by M. C. Decharme.—On the quantity of ammonia contained in atmospheric air at different altitudes, by M. Truchot. The author stated that the ammonia increases as the cloud region is approached, and gave tables of determinations in support of his views.—Remarks on the paper of Pelouze and Audouin on the condensation of liquifiable matters held in suspension by gases, by M. D. Colladon.—Remarks on the paper of M. Derbès on the *Pemphigus* of *Pistacia terebinthus* compared with the *Phylloxera quercus*, by M. Balbiani.—On the swellings produced on vine rootlets by the *Phylloxera*, by M. Max. Cornu.—On triple planes tangent to a surface, by Mr. W. Spottiswoode.—On the direction of the propagation of electricity, by M. Meyreneuf.—An answer to M. Mercadier's last note on the study of the vibratory movements of an elastic wire, by M. H. Valerius.—Observations on the molecular structure of meteoric iron and on solid ferrous chloride in meteorites, by Mr. J. Laurence Smith.—On the tertiary supra-nummulitic formations of the department of Hérault, by M. Rouville.—The death of M. Cl. Burdin, correspondent of the mechanical section, was announced.

CONTENTS

PAGE

THE SOUTHERN UPLANDS OF SCOTLAND, II. By Prof. R. HARKNESS, F.R.S.	57
LEYBOLD'S EXCURSION TO THE ARGENTINE PAMPAS	59
A HEALTHY HOUSE	60
OUR BOOK SHELF	61
LETTERS TO THE EDITOR:—	
The Dutch Photographs of the Eclipse of 1871.—J. A. C. OUDEMANS	61
Elevation of Mountains and Volcanic Theories.—REV. O. FISHER, F.G.S. Cupt HUTTON	61
Deep-sea Soundings and Deep-sea Thermometers.—HY. NEGRETTEI and ZAMBRA	62
Rain-gauge at Sea.—W. J. BLACK. Capt. J. E. GOODENOUGH	63
Glaciers.—W. T. BLANFORD, F.G.S.	63
JOHANN NEPOMUK CZERMAK. By Prof. M. FOSTER, F.R.S.	63
THE ATMOSPHERIC TELEGRAPH (<i>With Illustrations</i>).	64
THE COMMON FROG, V. By St. GEORGE MIVART, F.R.S. (<i>With Illustrations</i>)	67
ASTRONOMICAL ALMANACS	69
MAN IN THE SETTLE CAVE. By Prof. G. BUSK, F.R.S.	70
NOTES	70
ON SOME RECENT RESULTS WITH THE TOWING NET ON THE SOUTH COAST OF IRELAND. By Prof. ALLMAN, F.R.S.	73
SCIENTIFIC SERIALS	74
SOCIETIES AND ACADEMIES	75