THURSDAY, JANUARY 29, 1874

THE DUTY OF ELECTORS

IN his address to his Greenwich constituents Mr. Gladstone has undoubtedly attacked a weak point of human nature, by his announcement of a large balance, the promise of the removal of the income-tax, and other reductions in taxation; but those who really have the welfare of their country at heart cannot help feeling that, by making one doubtful good all-prominent, he has placed too far in the background many of those points which are daily becoming of more and more importance to the national welfare. Our country depends for its high position among nations, not only on its resources in coal and iron, but also, and more securely, on the mental capacity of its people, whose peculiarity is that they have the power of always using the resources at their disposal to better advantage than any others. We in nearly all cases have taken the lead in invention. A discovery, for instance, is made by which the amount of coal required to produce a certain amount of useful work is diminished greatly; this is adopted by others of ourselves, and is gradually spread to other countries, not however before sufficient time has elapsed to place us on the way to another method, which will have as great advantages over the new one as that had over the one which preceded it. There are those amongst us who, with our national tendency to depreciate our own abilities and resources, carefully compile statistics show that our gradual decline and destruction are inevitable in a certain definite number of years. They, however, inevitably leave out of the question the potentiality, as it may be termed, of the British brain.

But how is it that we are able to maintain this high position of progressive discovery? This is a question which may be well asked. The answer is not difficult to find. It is on account of the thoroughness of the work done by some of the scientific members of the community, who but too often use their best efforts, involuntarily though it may be, to the working out of those inductions which lead to the discovery of new methods that prove so invaluable to their fellow-creatures, and so often unremunerative to themselves. There are many who must feel that it is not too early to make it a part of all Government legislation, that more stress be laid on and more direct pecuniary assistance be given to such unremunerative scientific work, and encouragement offered for the production of it in greater quantity, so as to secure more of its invaluable results.

It may be said, and it is said by some, that we have gone on very well as yet without any great encouragement in this direction; but this is the old argument over again; we are now in a very different position to what we were formerly. When Science was in its infancy, it was not so essential to the production of good work that those who made the greatest strides should know much of the investigations of those who preceded them, nor of the principles of the sciences, by the employment of which alone they can expect to advance. But the last half century has been so prolific in scientific method and detail, that any one ignorant of all its branches, however great his ability, can have little or no chance of making fresh improvements or discoveries. What was not essential formerly is essential now; and just as the standard of general education is much higher at the present time than it was some years ago, so must the scientific education be.

But there is only one method of improving scientific education satisfactorily, and that is by making scientific work more possible and lucrative. A young man does not commence physics or chemistry or biology until he has really begun the battle of life; his mind is scarcely fit for it before; he must therefore, when he takes them up, see clearly a livelihood ahead. Such a livelihood at present is little more than a phantom. The prospect of a post in any Government institution, such as the British Museum, for example, is, to say the most, to scarcely a pittance, and there are many of the best workers who would undergo many privations rather than have to devote the greater part of their lives to the drudgery of an educational appointment. Most scientific men do not expect to become rich on their avocation; the inherent pleasure of their subject compensates to a certain extent for the diminished income; but they must live, and living means more than obtaining an income which is insufficient to allow of their maintaining the social position to which they are born, or to which their education has brought them.

Such being the case, ought not the nation in a fresh Parliamentary election to lay some stress on the improvements that are indispensable for the healthy progress of scientific thought? Why does Mr. Gladstone's interest in the higher Education begin and end with Ireland—can it have any reference to party questions? Why is there all too slight a reference to the University question and no reference at all to the Report of the Royal Commission which has recently been issued—is it because Mr. Gladstone knows that there are many Conservatives much more liberal and large-minded than the Liberals themselves on this subject?

Is there no feeling throughout the country on the subject of Museums, or the ever-growing necessity for a Minister of Education? Mr. Gladstone may well be excused from referring to these topics in his "prolix" manifesto, but are all the Constituencies to neglect them? Is the Sectarian or the Licensed-Victualler to be the only man who shall require his candidate to render a reason—to state his views? Our point is, that every voter in the kingdom has now an opportunity of helping on the cause of Science and Education by insisting upon his representative having ideas—and right ideas—on these questions.

Why should there not, among the numerous influential scientific societies which are spread through the country, be formed organised committees whose duty shall be to use their influence in representing their requirements to the candidates for parliamentary election, and doing all in their power to get their wants respected and complied with? Again, why should not those bodies, like the University of London, with a large number of scientific voters, and a representative, do all in their power to return for their member one who has the interests of Science and the higher education at heart, and who will do all he can to put these interests in the best light? That such will not be done by the University of London at least, will be evident if Mr. Lowe is again returned as their member at the coming election; for his principles of action are understood; his views with regard to the Universities and the higher teaching generally are known; and his unwillingness, even to consider the desirability of raising the salaries of the scientific officers of the British Museum to the level of those of ordinary Government officials is before the world. There is no doubt that he has forfeited all claim, to the support either of the Scientific or the Medical Graduates of the important Corporation which he represents.

PHYSICAL GEOGRAPHY

Physical Geography, in its Relation to the Prevailing Winds and Currents. By John Knox Laughton, M.A., F.R.A.S., Mathematical and Naval Instructor at the Royal Naval College. Second Ed. (J. D. Potter, 1873.)

The Ocean: its Tides ana Currents, and their Causes. By William Leighton Jordan. (Longmans, 1873.)

THE first part of Mr. Laughton's work consists of a comprehensive and valuable summary of the present state of our knowledge of the prevailing Winds in different parts of the globe; on the basis of which he proceeds to examine into the commonly-received theory of Atmospheric Circulation, and pronounces that "it describes the phenomena which do not exist, and misrepresents, or does not account for, phenomena which do." The second part treats of the Currents of the Ocean; and these (following Major Rennell) he attributes for the most part to the winds prevailing in the localities in which they originate, their effects being variously modified by coast-lines, the meeting of other currents, &c. We believe that he is quite justified in upholding this general doctrine, and in repudiating the notion of Captain Maury that differences of temperature, excess of evaporation, &c., can sustain the Gulf Stream or any great oceanic current. But he rides his hobby a great deal too hard, when he affirms that under no circumstances can these agencies produce currents; going so far as to attribute the in-current of the Strait of Gibraltar to the *vis-à-tergo* of the Gulf Stream. As well might he attribute to it the constant current which sets over the bar of the Karaboghaz or Black Gulf on the eastern side of the Caspian, and carries (according to the computation of Von Bär) 350,000 tons of salt a day into this great natural salt-pan, the water (which the natives fancy must have some subterranean outlet) being all got rid of by evaporation. According to Sir John Herschel's computations, the excess of evaporation from the Mediterranean area, over the return of water by rain, would require *twelve Niles* to supply it; and as there is only *one* Nile, and as Captain Wharton's recent researches in the Dardanelles show that the Black Sea sends very little of its river-water into the Mediterranean (the supply poured in by the Danube, the Don, the Dnieper, and the Dniester, being very little more than sufficient to make up for the evaporation of the Black Sea itself), it is obvious that an enormous deficiency must exist, after every allowance has been made for the Rhone, the Ebro, and the Po, which are the only considerable rivers, beside the Nile, that pour their waters direct into the Mediterranean basin.

Mr. Laughton does not seem to have made himself as well acquainted as a Government naval instructor might have been expected to be, with recent contributions to Oceanic Hydrography. Thus he repeats the statement of his first edition, that the Gulf Stream rushes through the Florida Channel at a rate varying from 80 to 120 miles a day; whereas the Admiralty Pilot Chart, based on the most trustworthy information, makes the annual average only 48 miles per day. He does not deign to notice the arguments adduced by Dr. Carpenter in his last report to the Royal Society, which have satisfied many eminent authorities that the amelioration of the climate of North Western Europe is due, not to the *true* Gulf Stream or Florida Current, but to a slow north-easterly movement of warm water sustained by thermal influences alone. He repeats (p. 200) the old fallacy that the cold of the ocean-bottom is "due to the great depth, to the impermeability of water by the sun's rays;" as if this had not been disproved by the fact, that the bottom-temperature of the Mediterranean, at depths ranging to 2,000 fathoms, is from 54° to 56°, whilst that of the Atlantic at similar depths and under the same parallel is *twenty degrees lower*. And in p. 250 he makes the astounding statement that "the gradual closing up of the channels [through which the Gulf Stream flows], by the ceaseless work of the polypes, has, *by diminishing the outlet, increased the force of the stream;*" which is tantamount to saying that the stream of water which issues from a fire-engine has a greater force than that which works its pumps! If we had only to narrow an outlet to create force, we need not be afraid of the exhaustion of our coal.

We recommend Mr. Laughton, before he issues another edition of his book, to dismiss from his mind, if he can, all prejudice in favour of his particular theory, and to open his mind more fully to the evidence of a *vertical* Oceanic circulation, which he already partly admits, and which is not in the least inconsistent with his fundamental principle (in which we entirely accord) of the maintenance of the *horizontal* circulation of the great Ocean-basins by the movements of the atmosphere.

The title of Mr. Jordan's book is very misleading; for, although professing to treat of the tides and currents of the Ocean, he devotes the greater part of his 344 octavo pages to an exposition of what may be called the Jordanian (in opposition to the Newtonian) system of Astronomy. This system is based on the doctrine of *inertion*, by which Mr. J. means the inherent tendency of all motion to come to an end. The only motor force he admits is that of gravitation; and he considers himself to have proved that the revolutions of the planets round the sun are due to the opposition between solar gravitation and astral gravitation, "so that, in their courses, they are borne smoothly along the lines of equilibrium lying between opposing forces of gravitation." He also maintains that "the rotation of a sphere tends to cause surrounding bodies to revolve around it;" and that, in this manner, the rotation of the earth from west to east tends to carry the moon in the same direction, its "lagging behind" beng due to "astral gravitation."

The application of Mr. Jordan's theory of inertion to the movements of the ocean is very obvious. Reasoning upon the fact that when a vessel containing water is made to rotate, "the water tends to maintain its position, and therefore has a relative motion over the surface of the vessel in the opposite direction to that in which the vessel is moved," Mr. Jordan supposes that this will *always* be so; and that the tendency of ocean-water to be left behind is the great source of tides and currents. But if he will try the experiment of *continued* rotation, especially with a vessel havng not a smooth but an irregular interior, he will find that *after a time* the water rotates as fast as the vessel itself, and partakes of its momentum. Were it otherwise in the case of the Earth, no rock could withstand the abrading power of the mass of water which would be constantly impelled against its eastern face—not only on the surface, as in the case of the trade-wind current, but at its greatest depths. That Ocean-water not changing its place northwards or southwards, *does* fully partake of the Earth's motion, and *does not* tend to lag behind, is proved by the exceptional cases in which a flow of water moving towards either Pole tends *eastwards* in virtue of its *excess* of easterly momentum, and in which a flow moving towards the Equator tends *westwards* in virtue of its *deficiency* in easterly momentum. The *Challenger* temperature-sections of the Atlantic show this to be the case with the cold-stratum beneath the Gulf Stream, which comes to the surface along the Atlantic sea-board of the United States; a similar "cold wall" has been found by our Naval Surveyor, Capt. St. John, to intervene between the Kuro Siwo (which is the counterpart of the Gulf Stream in the Pacific) and the eastern coast of Japan; and the recent researches of Dr. Meyer have shown that even in the North Sea a like upward movement of the colder understratum is distinctly traceable along the eastern shores of Britain, and still more on the eastern slope of the Dogger Bank.

It would be quite useless to either follow Mr. Jordan through his detailed application of a theory which is so completely baseless, or to examine into the validity of his criticisms of the views of others. He is obviously a man possessed, like the notorious upholder of the earth's flatness, by a "dominant idea" which nothing will dispel; and all we can do is to warn our readers that his book is good for nothing, except as a warning example of misdirected ingenuity.

ANIMAL MECHANICS

Principles of Animal Mechanics. By the Rev. S. Haughton, F.R.S. (Longmans, Green and Co.)

THIS formidable volume has four languages on the very title-page, and bristles throughout with numerical calculations, analytical formulæ, and geometrical constructions. When, in addition, we record that it contains anatomical details, teleological postulates, hints on the best mode of hanging, &c., it will be obvious that no one man can be expected to be able to pronounce upon its value from more than a few of the possible points of view.

We are told in the Preface that the object of the work is to show "the mutual advantages obtainable by anatomists and geometers from a combination of the sciences which they cultivate. Anatomists will gain by the increased precision which numerical statements must give to their observations, and geometers will find in anatomy a new field of problems opened out to their investigation." Surely there is nothing new in this statement! Every anatomist worthy of the name strives after the greatest attainable precision in those observations in which it is requisite, and many able mathematicians have treated of anatomical problems. But passing this over, we are obliged to say that Dr. Haughton's mathematics are barely such as are calculated to attract the anatomist. When writing for a class of persons who, at the best, rarely know more than the merest elements of mathematics—surely it would be well to use the simplest processes which will suffice. This is not Dr. Haughton's method; he rather acts on the principle of making an investigation as showy as possible by the introduction of an immense quantity of quite superfluous analysis. This is, no doubt, calculated to impress the majority of readers with an idea of the author's profundity; and, though even very ordinary mathematicians will find no reason to share this impression, we cannot understand the necessity for putting such a threatening barrier in the way of the poor anatomist who wishes to understand the reasons here assigned why muscles have the particular forms which it is part of his business to examine, describe, and classify.

Excellent instances of this peculiarity of the work may be given in great numbers, but one must suffice. Take the investigation in p. 239, which is given to prove that no work is done by a quadrilateral muscle when one of the bones acted on revolves about a certain given point. The result given in the text follows instantly from the most elementary geometry, if a single additional line be inserted in the woodcut; always, however, providing that the reader is prepared to allow the following postulates, which may, perhaps, not be very readily assented to, but which are as necessary for the elementary geometry as for the pompous analysis. The first is, that when muscular fibres are extended, as much *negative* work is done by them as there is done of positive work when they contract by the same amount! The second is, that in a plane quadrilateral muscle the fibres run in lines which, if produced, would all meet in the intersection of the lines joining the ends of their places of attachment to the bones, and that they are *uniformly* distributed radially from this point. Postulates of this kind are, indeed, very common throughout the work.

The three great features of novelty in the work, so far as we can perceive—in addition to the very numerous, and obviously careful, determinations of the weights, &c., of corresponding muscles in various beasts, birds, and fishes—are the *Law of Fatigue*, a grand teleological *Postulate*, and the *Principle of Least Action*.

These are enunciated as follows, the third as applied to the heart:—

"When the same muscle (or group of muscles) is kept in constant action until fatigue sets in, the total work done, multiplied by the rate of work, is constant."

"The Framer of the Universe (Δημιουργὸς τοῦ κοσμοῦ) has constructed all muscles upon the principle that each shall perform the maximum of Work possible for it under the given external conditions."

"The arrangement of the fibres of the heart must be such as to allow each fibre to contract to the fullest extent required by the law of muscular contraction."

As a simple comment on the first of these, rendered very instructive by the insight it affords us into the general cogency of the author's reasoning, take the following:—

"If any man wishes for a simple proof of the inferiority of the endurance of his muscles as compared with those of a woman, let him carry a child on his arm for the same time that his wife or nurse can do (*sic*) with ease, and he will find himself much fatigued."

In this striking passage, for "a woman" read "another man;" for "wife or nurse" read "coalheaver;" for "child" read "sack of coals;" and for "arm" "back." It is still obviously true! Many other, perhaps even more remarkable, forms of this statement will present themselves to the intelligent reader.

We had marked for comment or quotation a great number of passages, but considering the characteristic qualities of the specimens we have given, we think the reader who wishes more may safely be left to seek them in the work itself. Perhaps the most curious point we have not yet alluded to is the author's calculation of the force which can be exerted by the abdominal muscles. In his first publication of this astonishing result he adopted *seriously* a quotation from Sterne which Duncan, writing on the forces employed in parturition, had used (in its original intention) as a mere joke; and in the work before us, in spite of all that has been done, especially by Duncan and Schatz, since that first publication of his, Dr. Haughton still gravely writes:—

"Thus, we see that, on an emergency, somewhat more than a quarter of a ton pressure can be brought to bear upon a refractory child that refuses to come into the world in the usual manner."

It is only necessary to explain that this is assigned not as the whole pressure on the *surface* of the child, but merely as the component in the direction of its motion!

POLAR EXPLORATION

The Gateway to the Polynia: A Voyage to Spitzbergen. From the Journal of John C. Wells, R.N. With numerous Illustrations. (London, 1873. 8vo, pp. 355.)

EVERY fresh book on the Arctic Regions helps to awaken the dormant interest of the public in the question of Polar Exploration, and from that point of view this volume commands our attention. From no other, however, can we recommend it. The "rapid sketch of Arctic voyages" contained in the introductory chapter is rapid indeed—we might also add vapid—and it is followed by a disquisition on things in general in which some of the statements are true and a few of them new, though the new and the true do not seem to be always successfully combined. Of course it was not to be expected that the masterly summary of the progress of northern discovery given by Richardson in his well-known "Polar Regions" should be excelled or equalled, but we had a right, we conceive, to look for a few more details than we get of the American, German, and especially of the Swedish expeditions executed since Sir John's work appeared. But even letting that pass, we should have been contented with a plain narrative of Capt. Wells's own "Voyage," whereas we have nothing of the sort. We are told, it is true, that he sailed in the yacht *Sampson*, that he left this country in May 1872, and, after reaching lat. 80½°, returned in the following September—facts which any of our readers may find if they take the trouble of looking back into our columns; but of the incidents and results of the voyage we are afforded only the most vague outline, drawn in a confused and book-making way. One remarkable and suggestive fact is to be noticed. The name of the owner of the yacht never appears in regard to this voyage! Little bits of what may once have been written in a journal pieced together with stories more or less (and rather less than more) connected with the subject, such as that of the building of Scalloway Castle (imperfectly told by the way)—yarns spun by old whalers and sailors—scraps of zoology, botany, geography, and meteorology (some of them incorrect)—long extracts from Parry's well-known "Voyage"—the whole jumbled into one chaotic mass, from which it is difficult to derive any clear knowledge of what belongs to the writer of the "Journal," and what has been drawn from other authors. We are treated to certain woodcuts, the like of which were the wonder of our childhood, such as that of the Right Whale (p. 64); but whether Captain Wells saw a Right Whale, or knows one when he sees it, we don't profess to say, and this particular portrait is simply named "Whale." The cut representing "Whales' Food" (p. 82) is altogether wrong; whales would fare badly if they only swallowed such nourishment as the *Hydrozoa* there figured, and the author might have learnt better from old Friderich Martens, two hundred years ago. Shetlanders are said (p. 71) to be a "branch of the Celtic family." The Reindeer figured (to face p. 223) were certainly not drawn from Spitzbergen examples, and most parts of the book indeed might almost just as well have been written by a man who had never been to that country.

But perhaps all this may be looked upon as trifling. Capt. Wells's great object is to urge the claims of the Spitzbergen over the Smith's Sound route for future Arctic discovery. On this question much has been written and spoken; and though the opinion of experts is overwhelmingly strong in favour of the latter, the former is not to be dismissed in the off-hand way in which it frequently is. Impossible as it may seem, we wish to reconcile the adherents of either creed. Capt. Wells, we think, is not the ablest of advocates. He omits putting the point as strongly as it ought to be put, indeed his theory is utterly opposed to it. In his map all the space encircled by the 85th parallel is marked "Polynia," and an arrow-head obligingly informs us that "the gateway to the Pole" lies in long. 10° E. To force this gateway by steamer would seem to be his advice. Now we cannot agree with him here, for the idea of a great extent of perpetually open water, which is the essence of the notion of a *Polynia*, is a mere assumption, against which much seems to militate. Now there are two entirely different things for the Arctic discoverer to do. If his object be merely to reach the Pole by the cheapest and easiest means, our belief is that there is no way better than the Spitzbergen route, but one cannot expect to do it by water. The expedition should winter in the north of Spitzbergen, or on one of the outlying islets, and sledge-parties should be sent in early spring over the ice to reach the goal, and return with all possible speed. But if the object be to make a really satisfactory exploration, then the almost perfect agreement of Arctic authorities declares for Smith's Sound. It is possible that the Spitzbergen route might be accomplished by private enterprise, but for the other a Government expedition is essential. On parting with Captain Wells, we are glad to find we agree with him on one point :—" We want a new motive to rouse up the spirit of the nation and Government ; and what higher and nobler one can be found than the search for truth and the advancement of Science? This is the duty of a Government, to promote the national welfare ; and one of the surest ways in which this can be done is by encouraging scientific efforts. . . . There are few ways in which this spirit can be better fostered than by Polar exploration ; and so popular is such service amongst our sailors, more especially Arctic sailors, that hundreds of them volunteer to go when any project of this kind is afloat. From this point of view, the exploration of the higher latitudes is a matter for Government, and not for private enterprise " (pp. 2, 3).

OUR BOOK SHELF

Perils in the Polar Seas. True Stories of Arctic Adventure and Discovery : A Book for the Young. By Mrs. Chisholm, authoress of " Rana ; or, the Story of a Frog," &c. (London : John Murray, 1874.)

THIS is one of the best books of the kind we have met with. It is written for the young, but Mrs. Chisholm has wisely made no attempt to " write down " to the supposed mean capacity of the little folks ; she tells her intensely interesting story in simple, unaffected, clear, forcible English. Indeed, were it not for the occasional interruptive questions and remarks of the group of youngsters to whom the authoress is supposed to be telling her story, one would naturally fancy that the book, like " Gulliver's Travels " and " Robinson Crusoe " had been written for all who can understand plain English. Mrs. Chisholm, in her opening chapter, " Life with the Esquimaux," gives many details concerning the habits of that people, taken mainly from the late unfortunate Captain Hall's account of his residence among them. After another brief chapter on " North-East Voyages," she enters upon the history of Arctic discovery on the American side, and with the greatest care and clearness, tells what the principal explorers, from Frobisher down to Hall, have done to make known to us the outline of the lands and seas of these mysterious northern regions. In doing so the authoress's object is something more than merely to fascinate and thrill her readers by a narrative of strange adventures by flood and field ; while there is no apparent attempt at making the story a vehicle for conveying useful information, yet Mrs. Chisholm manages to convey, in an impressive manner, a great amount of knowledge of the geography, natural history, and meteorology of the Polar Regions. Indeed it would be difficult to devise a better method than is here followed, with the assistance of two excellent maps, of teaching the geography of Arctic America. As might be expected, the greater part of the book is occupied with modern voyages, mainly those of Parry, the Rosses, Franklin, and the Franklin Search parties. " Uncle George " gives a good deal of information concerning the whale-fishery, and also an account of Parry's boat voyage to the north of Spitzbergen. Besides the two maps already referred to, the volume contains many beautiful illustrations. Perhaps it was scarcely necessary to make the children interrupt the story-teller so frequently with their questions ; indeed the story is so attractively told that such diversions are sometimes irritating. But this is a small matter ; the work as a whole is capitally done, thoroughly interesting, healthy, and full of information.

Historische Fragen mit Hülfe der Naturwissenschaften beantwortet, von Dr. Karl Ernst v. Baer.

Studien aus dem Gebiete der Naturwissenschaften, von Dr. K. E. v. Baer, Part II., Sec. I. (St. Petersburg, 1873.)

THE " Historic Questions," just published by this eminent naturalist, aim at solving by evidence from natural history certain disputed traditions which have puzzled historical critics. The first subject remarked on is the " swan's song," which seems so fanciful a myth to western nations accustomed only to the songless swan, which the Russians call *shipûn*, the " hisser," but not to the other swan, which they name *klikûn*, the " caller," whose melancholy notes are so often heard by travellers in North-East Europe and North Asia ; it is stated on no less authority than that of Pallas, that the swans utter these tones when mortally wounded. Next follows an examination of the voyages of Odysseus, made with the view of ascertaining how much of ancient geography is embodied in the Homeric narrative. According to Dr. v. Baer's map, several localities of the ideal voyage are to be traced in the Black Sea, at whose entrance are Skylla and Charybdis and the Symplegades, while the Læstrygonians dwelt in the Krimea, and Kimmerian darkness began at the opening into the Sea of Azof. Lastly, the locality of the Biblical Ophir is discussed ; Dr. v. Baer finds it in the Peninsula of Malacca.

In the collected " Studies " we find a German version of a paper dating from 1848, on the Influence of External Nature on the Social Relations of Races. The next is dated Berlin, 1866, on Purpose in the Processes of Nature, in which he gives the name of *teleophoby* to the fear he observes among some naturalists of recognising an object or purpose in Nature. Dr. v. Baer's doctrine is summed up in a passage reproduced, with slight alteration, from his own writings 33 years ago : " Thus the earth is but the seed-bed in which the spiritual inheritance of man increases, and the history of Nature is but the history of continuous victory of Spirit over Matter. This is the fundamental idea of Creation, for the satisfaction or rather for the attainment of which individuals and series of generations must disappear, that the future may be built on the framework of an immeasurable past." The concluding paper is on Rivers and their Action, a contribution to physical geography in which arguments as to the antiquity of man founded on the presence of human relics in river-beds or deltas are treated as of little account.

LETTERS TO THE EDITOR

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

Prof. Barrett and Sensitive Flames

THOUGH my memory fails to recall the fact, I cannot, with Prof. Barrett's letter before me, refuse to believe that he sent me the paper to which he refers.

Perhaps I ought to have known what Mr. Barrett had been doing before large audiences, but I regret to say that I did not. My excellent assistant, Mr. Cottrell, first heard of Mr. Barrett's experiments from one of my own audience, and steps had been taken to do Mr. Barrett justice before his letter appeared. That act he has anticipated by very ably and very modestly doing justice to himself.

J. TYNDALL

Remarkable Fossils

ONE of the most remarkable collections of Wealden fossils ever seen, was lately on loan for a few days to the exhibition then open at Horsham, and is one that is not to be equalled by any at our public museums in the country. So remarkable is it that I am induced to give you a short description. As you enter the room to the left, the first thing to attract the attention of the palæontologist was the collection contained in a case of about 12 ft, long by 3 ft. wide, filled to repletion with the fossil bones of the "Great Horsham Iguanodon" and the "Tower Hill Iguanodon," and various other bones. There were the fibula, scapula, and caracoid of Iguanodon in juxtaposition with the humerus belonging to the same specimen, the jaw of the young Iguanodon and the caudal vertebræ, all figured and described in the monographs of the Palæontographical Society. Also the

Hawksbourne, femur, and tibia with metatarsals and a distal phalanx, and various other vertebræ, teeth and phalanges. The jaw of a very young Megalosaurus which evidently perished very shortly after its escape from the egg. The tibia, supposed scapula, and various other bones and teeth of Megalosaurus, the ribs, vertebræ, and teeth of Hylæosaurus. The jaw and other remains of a young *Suchosaurus cultridens* not long escaped from the shell, and teeth of *Suchosaurus*, a fine vertebræ of Streptospondylian type found with the "Great Horsham Iguanodon," and a femur of a young crocodile. The muzzle and portions of jaws, teeth, vertebræ, scutes, and various other bones of *Goniopholis crassidens*. This specimen shows the succession of three teeth. This specimen was borrowed in 1842 by a well-known palæontologist for the purpose of illustration and description. Three artists were employed, who executed five quarto plates of the various portions, but they have never yet been published. Seventeen specimens have not been returned. A younger and very beautiful specimen of *Goniopholis crassidens* in its matrix of stone is missing from this collection. It was borrowed shortly after the above specimen and lithographed at once. It has unfortunately made its escape from custody. It is clear from the specimens shown that the armour of Goniopholis was far more perfect than that of any other living or extinct crocodilian. The toothed and imbricated scutes were in connection with others of a hexagonal or pentagonal shape, which were suturally united. The abdominal scutes overlapped each other on one side. Besides these there are several bones of Pterodactyl, the vertebræ, ribs and teeth of Plesiosaurus, a fine jaw of a beaver, various pubic and tympanic bones, and the pubic bone of a saurian described by Dr. Mantell, bones of turtles and many other bones, too numerous to mention, and some of most gigantic size, and in a wonderful state of preservation. This collection is the property of Mr. Holmes, who is also the discoverer of them.

Many of the bones are altogether unknown, and their inspection may throw some light on the kind of animals to which they belong. THOMAS WM. COWAN

Horsham, Jan. 5

Earthquake in Argyllshire

I BEG to forward to you a letter from the principal light-keeper at Dhu Heartach Lighthouse, addressed to Mr. Cuningham, Secretary to the Board of Northern Lighthouses.

The Dhu Heartach is a trap rock about fifteen miles to the W.S.W. of Iona, in Argyllshire, which is the nearest land. It is 220 feet long and about 30 feet high, the tower, which is of granite, being raised to the height of 130 feet above the sea. The rock is everywhere surrounded by deep water, and is of an elliptical form. During the erection of the tower fourteen stones, each of two tons, which had been fixed in the tower by joggles and portland cement at the level of 37 feet above high water, were torn out and swept off the rock into deep water.

Although the tower is much subject to impact from the waves, in spite of its height above the sea, yet neither my brother nor I have any doubt that the light-keepers are right in tracing the shock to an earthquake. Perhaps some of your readers may have experienced the shock in other places.

Edinburgh, Jan. 16 THOMAS STEVENSON

"Dhu Heartach Lighthouse, Jan. 7, 1874

"Sir,—I beg leave to inform you of the following rare occurrence:—On the evening of the 6th inst. at 8.13 p.m. (local time), Mr. Leith and I were sitting in the kitchen, when we heard a rumbling noise, followed by a tremulous motion, which lasted about two seconds. On going to the light-room, Mr. McAllister (who was on watch at the time) states that the noise resembled the booming of a cannon, and the tremulous motion was very apparent. A fresh gale from W.S.W. was blowing at the time, but there was no sea striking the rock to cause the concussion; in fact there was less sea than had been for some days previous. When a heavy sea strikes the tower, it has quite a different effect, and cannot be mistaken for anything else. There was neither thunder nor lightning at the time; barometer steady at 29°·96; thermometer 46°; weather hazy.

"I can offer no suggestion as to the cause, unless it proceeded from a slight shock of earthquake: the rumbling noise and tremulous motion indicated such. One thing we are all confident of, it was not from a sea striking the rock. I have no wish to be at all sensational, but I have thought it right to send you the above details, as the same may have been felt in other parts of the country, and this may tend to corroborate it

(Signed) "JAMES EWING

"To the Secretary, Northern Lighthouse Office, Edinburgh."

Telegraphing Extraordinary

THERE appears to have been a misprint in your article "Telegraphing Extraordinary (Jan. 15).

It is there stated that the speed of the automatic instrument is but 200 letters a minute. This speed can be reached by *hand-signalling*, a very usual speed being 170 letters; and perhaps the writer intended to say that 200 letters, or 40 words, was the utmost limit of *un*-automatic service, which would be correct.

Post Office, Jan. 10 R. S. CULLEY

[In contrasting the work obtained out of the Wheatstone "high speed" automatic service in use by the General Post Office in this country with that of the new American instrument, by a slip of the pen the word "letters" was substituted for "words;" but in giving 200 words as the speed over a circuit of similar length to that between Washington and New York, a maximum under most favourable circumstances of insulation of the wires was recorded.

Practically the average working speed obtained on a circuit of from 300 to 400 miles in length, by the Wheatstone, does not exceed 90 words or about 450 letters per minute, and with the Morse about 25 words, or 130 letters. On circuits between 200 and 300 miles the Wheatstone Automatic Service may be considered practically to average 120 words, or about 600 letters per minute. The American instrument transmits from 1,200 to 2,500 words a minute over a 300 mile circuit.—ED.]

Echo at Maidenhead

THERE is a railway-bridge over the Thames at Maidenhead which is said to be of a wider span than any other in England. While standing beneath this arch, we hear the echo of a sound repeated fourteen or fifteen times with tolerable distinctness. From the first to the fourteenth echo occupies about five seconds. The sounds become, of course, less and less loud, but, at the same time, the *pitch* of the note is raised, and has at last risen three quarters of a tone as indicated by a delicate instrument which gives quarter-tones. As I have not seen a similar fact noticed in any work on Sound, I shall be glad if any of your readers can give an explanation.

I may add, that this echo repeats distinctly the sound of the letter *s*, which is not usually the case. J. P.

Belmont, Dartmouth

Flight of Birds

DURING the hurricane of October 6, 1873, I was residing on the west shore of Biscayne Bay, South Florida. In the early part of the gale, and while it was approaching its height, I noticed overhead innumerable "man-of-war hawks." They seemed to be "laying-to" (to use a nautical phrase), with but little motion of their wings; their heads were towards the wind, but instead of moving backwards they seemed to drift off in a line calculated to take them directly away from the storm-centre.

A short time ago I communicated these facts to the secretary of the Smithsonian Institution, who immediately informed me that what I had observed was new to him, and probably to the scientific world, and he advised me to send a copy of my letter to you. The learned secretary also wrote a flattering approval of my suggestion that the behaviour of the birds under consideration might be explained on the theory of "natural selection." I have forgotten the exact wording of my letter, but the idea embodied in it was that during a cyclone the "man-of-war hawk" profits by the experience of its ancestors, an experience which has become organised in the race, and which enables them to make the best possible adjustment to the circumstances which surround them.

Kasson, Minn., Dec. 28, 1873 HORACE B. PORTER

Vivisection

ASSUREDLY "the worthy and humane Huxley" stands in no pressing need of the testimonial of Mr. G. W. Cooke (NATURE, vol. ix. p. 202) to his worth and humanity. (By the way, I thought at first that the gratuity came from the generosity of Mr. E. W. Cooke, whose amusing vivisections, in his "Grotesque Animals," could offend nobody.) Still less does the practice of vivisection stand in need of such encouragement as is given to it in the leading article in NATURE, vol. ix. p. 177. With such a champion as Mr. Ray Lankester, there is fear of physiologists losing sight of the duty of vivisection, not merely for the discovery of truth, but for its demonstration to students of physiology.

Meanwhile I (for one) who, not being an expert in any branch of physiological science, have been educated to set the highest value on its conquests, cannot concede to the physiologists the principle which has been somewhat arrogantly put forth in recent discussions, that research for the purpose of acquiring new facts in physiology necessitates and justifies vivisection. On the contrary, I cannot admit that to ascertain the order of Nature is so high an end in itself as to render superfluous or irrelevant the preliminary question, Whether the means to be employed for that object are right or wrong? We have no need to discuss the rights of the lower orders of sentient beings; it is sufficient that we should recognise the fact that they have been endowed with organisms of exquisite sensibility, not for the purpose of affording man a ready means of experiment, but for the fulfilment of their own functions. To overlook this, to exercise the law of the strong over the weak, and to accustom ourselves to the conscious and deliberate infliction of pain on those beings, with no other object than to satisfy a rational curiosity, must recoil on the operator, and do violence to his moral nature.

When I see acts of wanton cruelty I am revolted, but I have hope; for I trust to the ameliorating effect of education to eradicate the propensity to cruelty. But when I learn that acts of deliberate cruelty are done by "worthy and humane" men, I am revolted without hope. Convince me that the cultivation of physical science culminates in making men so "worthy and humane" that they can practise the vivisection of an animal (to quote Isaac Walton's words) "as if he loved him," and you convince me of the mischievous tendency of such an education.

One word more: if there were a race of intelligents as much superior to man as man is to the dog, and certain investigators of that race were to capture men and women, and subject them to vivisection, in order to advance a knowledge which is beyond the faculties of man, what should we do? Submit, of course; but should we bow with resignation to our lot, and think our pains well spent, if our wretched tortured bodies did thereby add one jot to the scientific capital of our captors? Or, should we not protest to the God of Heaven (if we happened to believe in Him) against the monstrous and enormous injustice of which we should be the victims? Surely there is the same injustice in the abuse of animal organisms (*i.e.*, the use of them against their nature) for the purpose of scientific exploration.

Valentine House, Ilford, Jan. 18 C. M. INGLEBY

Instinct of Monkeys

HAVING read the letters of Dr. Gulliver and G. J. R. in NATURE, vol. viii. pp. 103 and 163, in which the affection of monkeys for their dead is discussed, I think that I may perhaps be permitted to record my experience in regard to a certain class of monkeys that I have peculiar facilities for observing, which is not in accordance with the observation of Mr. Forbes or G. J. R.

I keep, in my garden, a number of Gibbon apes (*Hylobates agilis*); they live quite free from all restraint in the trees, merely coming when called to be fed. One of these, a young male, on one occasion fell from a tree and dislocated its wrist; it received the greatest attention from the others, especially from an old female, who, however, was no relation; she used, before eating her own plaintains, to take up the first that were offered to her every day and give them to the cripple, who was living in the eaves of a wooden house; and I have frequently noticed that a cry of fright, pain, or distress from one would bring all the others at once to the complainer, and they would then condole with him and fold him in their arms.

But one morning one of the flock was found hanging dead in the fork of a tree, his comrades took no notice whatever of him, and were playing and singing their peculiar song as usual close to him; on the body being removed they took no notice whatever.

A neighbour of mine who keeps a pair of these apes, informs me that the male lately came home after an absence of two days very sick; the female, who had theretofore been very affectionate, carefully avoided him, and on his death a few days after showed the most thorough indifference. Very possibly the alleged affection for their dead may exist among some families of monkeys, and not among others. Though my apes live in complete freedom, they have never shown any disposition to breed, though I have had some of them over two and a half years.

Æ

VIVISECTION

AS public attention has again been directed to this question, we think it convenient to reproduce the report of a Committee of the British Association on the subject.

The committee consisted of ten individuals, appointed at the meeting of the British Association, held at Liverpool in the year 1870, to consider the subject of Physiological Experimentation, in accordance with a resolution of the General Committee hereto annexed. The following report was drawn up and signed by seven members of the Committee:—

i. No experiment which can be performed under the influence of an anæsthetic ought to be done without it.
ii. No painful experiment is justifiable for the mere purpose of illustrating a law or fact already demonstrated; in other words, experimentation without the employment of anæsthetics is not a fitting exhibition for teaching purposes.
iii. Whenever, for the investigation of new truth, it is necessary to make a painful experiment, every effort should be made to ensure success, in order that the suffering inflicted may not be wasted. For this reason, no painful experiment ought to be performed by an unskilled person with insufficient instruments and assistance, or in places not suitable to the purpose, that is to say, anywhere except in physiological and pathological laboratories, under proper regulations.
iv. In the scientific preparation for veterinary practice, operations ought not to be performed upon living animals for the mere purpose of obtaining greater operative dexterity.

Signed by:—M. A. LAWSON, Oxford. G. M. HUMPHRY, Cambridge. JOHN H. BALFOUR, ARTHUR GAMGEE, Edinburgh. WILLIAM FLOWER, Royal College of Surgeons, London. J. BURDON SANDERSON, London. GEORGE ROLLESTON, *Secretary*, Oxford.

Resolutions referred to in the Report.

That the Committee of Section D (Biology) be requested to draw up a statement of their views upon Physiological Experiments in their various bearings, and that this document be circulated among the Members of the Association.

That the said Committee be further requested to consider from time to time whether any steps can be taken by them, or by the Association, which will tend to reduce to its minimum the suffering entailed by legitimate physiological inquiries; or any which will have the effect of employing the influence of this Association in the discouragement of experiments which are not clearly legitimate on live animals.

The following resolution, subsequently passed by the Committee of Section D (Biology), was adopted by the General Committee:—

"That the following gentlemen be appointed a Committee for the purpose of carrying out the suggestion on the question of Physiological Experiments made by the General Committee:—Prof. Rolleston, Prof. Lawson, Prof. Balfour, Dr. Gamgee, Prof. M. Foster, Prof. Humphry, Prof. W. H. Flower, Prof. Sanderson, Prof. Macalister, and Prof. Redfern; that Prof. Rolleston be the Secretary, and that they be requested to report to the General Committee."

AMERICAN SCIENTIFIC ENTERPRISE

THE magnificent Free Museum and Menagerie already established in the Central Park, New York, will ever stand as noble monuments of their founder's munificence, and it is now proposed to add to these a third source of benefit to science, and of recreation and instruction to the commonwealth at large. The scheme now in contemplation is the erection in the same Park of a Marine and Fresh-water Aquarium on the most approved system, and of greater magnitude than anything of the kind hitherto attempted. Following a similar principle, it is likewise intended to raise the funds requisite for establishing this aquarium through appeals to the public spirit, and proverbial liberality of New York's more wealthy citizens, as also hereafter to endow the institution, and throw the same freely open to all comers.

The credit of starting this praiseworthy enterprise is due to the Messrs. Appleton, the proprietors of *Appleton's Journal*, a house well-known for their zeal and energy in the promotion of the interests of science, and for the educational benefits that have been conferred through their agency on all branches of the American community. Learning some time since from a notice in NATURE that Mr. Saville-Kent was about to resign his late curatorship of the Brighton Aquarium, Messrs. Appleton at once placed themselves in communication with that gentleman with the view of securing his aid in their scheme. As a site, New York offers remarkable inducements for the establishment of a marine and fresh-water aquarium on the magnificent proportions intended, the sea and the Croton river being equally available for the supply of the two descriptions of water required, while as a position for the acquisition of specimens to stock its tanks its advantages cannot be over-estimated. The art of transporting fish from one distant locality to another has been already practised under the auspices of the "American Fisheries Commission," on a larger scale and with more momentous results than have been obtained on this side of the Atlantic, through means of special cars fitted up with tanks. These last appliances will prove of eminent service and importance for the ordinary transfer of aquarium specimens, while a slight modification of the same might be adapted for accommodation on ship-board, and for the conveyance of fish from distant seas. In fact, starting with this proposed aquarium in the Central Park, the future aim of high-class aquaria should and will doubtless be, to as perfectly represent in its tanks the marine fauna of every quarter of the globe as Menageries and Zoological Gardens do at present the terrestrial inhabitants. The most solid and important advantages, however, likely to arise from an institution founded on the basis of the New York scheme, are associated with the pre-endowed system on which it is to be established; this of itself constitutes a guarantee for the attention to, and accomplishment of, scientific results unattainable in connection with any similar undertaking set up as a mere commercial speculation, and necessarily weighted with the many antagonistic interests upon which its financial profits are dependent. The time again could not be more ripe than the present for projecting the proposed scheme, a sufficient number of aquaria having been established in this country and on the Continent to illustrate the advantages or defects attendant upon the several principles of construction which have been hitherto attempted, as also to indicate the special modifications yet required to make them thoroughly efficient for biological research.

It is to be hoped that the meritorious example set by America will not be lost on this country. England, with her great resources, richly indented coast-line, and innumerable populous centres scattered along the latter, offers remarkable facilities for the establishment of a large zoological station and aquarium, and which, conducted under the auspices of a body of scientific men, with a trained naturalist to superintend it, could not fail to yield the most valuable results. In the absence of sufficient funds forthcoming from private sources for free endowment, the self-supporting system initiated by Dr. Anton Dohrn at Naples offers singular advantages. His scheme of letting out laboratory tables to various universities, governments, and scientific bodies is particularly worthy of notice. The fact that Cambridge has consented to take a share in one of these tables, while testifying to the praiseworthy spirit of that University, carries with it at the same time a severe censure upon the insufficiency of the means provided for scientific investigation nearer home. A well-appointed marine aquarium with suitable laboratories established at Torquay, Plymouth, or such other desirable locality, could not fail to command the support of our leading English universities, and it might be anticipated that also of many others in France, Belgium, Denmark, and other countries of Northern Europe, too far removed to profit fully by the advantages of the Naples station. Through the supply of specimens for class demonstration, such an institution might also derive a considerable income. One of the great disadvantages under which science courses are at present conducted throughout this country arises from the difficulty of obtaining for dissection typical examples of the commonest representatives of our marine fauna and flora, all of which might be furnished regularly and at a low rate through the medium of a large seaside aquarium, towards which is constantly flowing from every side an amount and variety of material more than sufficient for its own requirements.

TUBES FOR SILENT ELECTRICAL DISCHARGES *

RUHMKORFF'S induction coil is now a classical instrument found in every laboratory. It is constantly employed to obtain the sparks intended to combine gases in eudiometric analyses, but its use is not limited merely to effecting combinations, it effects also decompositions, another property utilised in chemistry, particularly to show that at the moment of its decomposition into nitrogen and hydrogen, ammonia gas doubles its original volume. We never obtain, however, in this experiment, a perfectly accurate result, for the induction spark which separates the ammonia gas into its elements is also capable of determining anew their combination to reform the original gas. It exercises thus two actions of a perfectly opposite kind, one of which seems due to true electric action, and the other to the heat which accompanies the passage of the spark.

It would certainly be advantageous to separate these two actions, since they are capable of acting in opposite directions, and it is especially in the preparation of ozone that this separation would be valuable, since ozone, which is easily formed under the influence of the spark, is destroyed by the action of heat. For the purpose of more easily obtaining ozone M. Houzeau has recently constructed an apparatus worked by a Ruhmkorff coil, in which there are no longer sparks, but only dark discharges—*effluvia*—far more efficacious in the production of modified oxygen.

It is known that at the end of last century, Van Marum noticed a peculiar odour in the vicinity of an electric machine giving large sparks, and that he attributed this odour to electricity. In 1840 Schœnbein showed that oxygen disengaged by electrolysis from water has this same odour, and preserves it after being kept in well-stoppered phials; he gave to the substance characterised by this odour the name of ozone.

There remained, however, some doubts as to the real nature of this substance, until the investigations of M. Marignac and of De la Rive in Switzerland, and MM. Fremy and E. Becquerel in France. They succeeded in demonstrating with precision that it was merely pure oxygen which assumed, under the electric influence, a new form. Researches on this modified oxygen soon accumulated, and chemists investigated it with the greater ardour, thinking that in studying this particular form of oxygen, they were touching that important question of simple bodies which at present remains the "great unknown" of chemistry.

So far as research has gone, ozone appears to be a strongly oxidising gaseous body, of one and a half times the density of oxygen, and possessing affinities infinitely more energetic than the latter. Thus it can oxidise cold silver, which so strongly resists the action of ordinary oxygen, it can inflame pure phosphuretted hydrogen, can burn ammonia, transforming it into nitric acid, and can displace the iodine of iodide of potassium. All these properties have been observed in the traces of ozone contained in oxygen submitted to suitable treatment, and the difficulty of obtaining appreciable quantities of ozone

* Translated from an article in *La Nature*, No. 29.

was not one of the least obstacles which stood in the way of continuous researches. Thus chemists and physicists have eagerly sought to discover a regular process of preparation, or at least a method of obtaining appreciable quantities of ozone. M. Houzeau, who has devoted much of his time and talents to the study of ozone, has recently devised an apparatus which is spreading rapidly among the laboratories, and which has already yielded very remarkable results, of which the following is a brief *résumé*.

The apparatus of M. Houzeau consists of two concentric tubes, the middle one enclosing a metallic wire, fixed to one extremity of a Ruhmkorff coil; the other wire, attached to the second pole of the coil, is rolled spirally round the exterior tube; finally, the gas circulates in the annular space comprised between the interior and exterior tubes, and, consequently, is not directly in contact with either of the two wires. The two metallic wires, along which the electricity flows, play the part of a Leyden jar, and the gas which circulates in the space traversed by the dark effluvia, by means of which the two different electricities shot along the wires are re-united, is essentially modified. If it be oxygen, it is charged with a notable quantity of ozone, whose odour rapidly spreads around the apparatus.

M. Houzeau's method produces oxygen much more charged with ozone than any other process; thus it has enabled some new properties of the gas to be discovered. Let the gas issuing from the effluvia-tubes come into contact with olefiant gas and the latter will be immediately set on fire with a loud explosion. M. Houzeau has devised a beautiful experiment, by introducing gradually into a somewhat large tube, a current of bicarburetted hydrogen, obtained by the reaction of sulphuric acid on alcohol; then by means of another narrower tube, penetrating about a centimetre into the tube filled with ethylene, he directs very gently a current of ozone, condensed as much as possible; the ozone which is introduced causes detonation.

When ozone is made to act on benzine a product is obtained, which, according to M. Houzeau, is essentially detonating; this ozo-benzine under concussion or pressure disengages suddenly a considerable quantity of gas, as do nitro-glycerine or the picrates, whose fulminating properties are well known. A few decigrammes of ozo-benzine produce a detonation so violent that the windows of the laboratory are invariably broken, and thus only the very smallest quantities should be used in experiments; 3 to 5 milligrammes suffice to establish the eminently explosive properties of this dangerous substance.

M. Houzeau has also been able to show by means of his apparatus, the remarkable decolourising properties of ozone. If a solution of indigo is thrown into a bottle containing oxygen mixed with ozone, it is as easily deprived of its colour as if it were in contact with chlorine. It is known, moreover, that dyed stuffs are bleached by being simply exposed to the air, and as it is now proved that our atmosphere contains ozone, it appears very probable that it is this gas which is the active agent in the old process of bleaching on the grass.

Such are the new properties which M. Houzeau has been able to establish by employing ozone in a state of condensation infinitely greater than that which is presented when it was prepared by the old methods; and these results are certainly not the only ones which may be looked for.

M. Houzeau is not the only one who has made use of the tubes whose structure he has made known, and soon we may expect to see them modified so as to make them much more durable. M. Boillot, a writer well known to the readers of the *Moniteur*, proposes to substitute for the wire of M. Houzeau's tube, whalebone charcoal contained in the interior tube and in the space comprised between the gas-holding tube and a thin tube concentric with the first two; and M. A. Thénard has brought to bear on the construction of the tubes a further modification which makes them still more efficacious.

As is shown in Fig. 1. M. A. Thénard's apparatus is composed of three tubes of unequal length, welded together. The central tube *aa'* is filled with chloride of antimony in solution with hydrochloric acid; the negative pole B of the coil dips in the liquid which descends to the bottom of the tube at *a'*; the same solution of chloride of antimony is placed in the exterior tube E; it receives the positive wire of the coil at A. The liquid E E is then positively electrified, the liquid *aa'* negatively, and the gas which enters at C and issues at D, after having passed across the annular space between the two tubes, is submitted to the electric effluvia determined by the two opposite electricities of the two liquids.

Into the tubes thus arranged M. A. Thénard directs the gases on which he wishes the electric effluvia to act. One of those which he first submitted to this treatment was carbonic acid, which is decomposed in oxygen and carbonic oxide, with increase of volume. The experiment is perfectly clear, and such as to show the complete difference between the action of the effluvia and that of the spark. While carbonic acid submitted to the decomposing power of dark discharges contains about one-fourth of its volume of the mixture of oxygen and oxide of carbon, which proceeds from its decomposition, carbonic acid decomposed by the luminous sparks of a coil never yields more than 7·5 per cent.; for the latter act not only by their decomposing power, but also by their heat, which determines the combination of the gases as first separated, up to the moment when carbonic acid, oxygen, and carbonic oxide, are formed in such a state of equilibrium, the spark produces no further effect, the decomposition being equal to the combination. This equilibrium is reached when the mixture contains precisely 7·5 per cent. of carbonic oxide.

This experiment is not, however, the most curious of those which have been published during the course of last year by MM. Paul and A. Thénard working together in that laboratory in the place Saint-Sulpice, which is so liberally opened to all who wish to study.

M. Paul Thénard has noticed that marsh-gas sometimes contains equal volumes of carbonic acid and protocarburetted hydrogen, *i.e.*, it constitutes a mixture in which the carbon, the hydrogen, and the oxygen are found in equal quantities, as when they are combined in a very largely diffused organic matter—glucose. Has the effluvium the power of determining the union of these different elements, so as to reconstitute an organic substance? Such was the idea which MM. P. and A. Thénard wished to verify by making a mixture in equal quantities of formic acid and carbonic acid in one of their effluvia tubes, so arranged that the changes of volume which the gases may undergo are easily determined.

After ten minutes, the condensation of the gases was already sensible; it increased in time, and soon there was seen to appear upon the sides of the tubes a liquid possessing a strong refracting power, viscous, yellowish, which was found to be an organic substance of a somewhat high order, burning readily. Its nature has not been determined, but it is sufficient to prove the importance of MM. Thénard's experiment, that its formation has been established.

The synthesis of organic matters from the elements has always been one of the problems which profitably engage the attention of chemists; and vegetation, indeed, enables us to witness their formation by a series of reactions which we cannot reproduce in the laboratory. Is it not surprising, for example, that under the influence of light a leaf can decompose carbonic acid and water, both extremely stable substances, and which we can only reduce to their elements by means of the most elevated temperatures which we can produce? But this work which is accomplished in the leaf of a plant, the effluvium performs equally well; it decomposes water into oxygen and hydrogen. It can reduce carbonic acid to oxygen and oxide of carbon, just as happens in the green parts of plants under the rays of the sun.

As we learn by experiment that for one volume of carbonic acid decomposed by the green parts of plants, one volume of oxygen is given off, *i.e.* one volume of oxygen exactly equal to that of the carbonic acid, the decomposition of the latter being only partial, it is necessary that the water be forcibly decomposed in the same time as the carbonic acid, and that it yield us the half volume of oxygen necessary to complete that which appears at the moment of insulation, so that the decomposition is represented as follows :—

1 vol. carbonic acid = 1 vol. carbonic oxide + $\frac{1}{2}$ vol. oxygen.
1 vol. vapour of water = 1 vol. hydrogen + $\frac{1}{2}$ vol. oxygen.

The disengaged oxygen presents then a volume equal

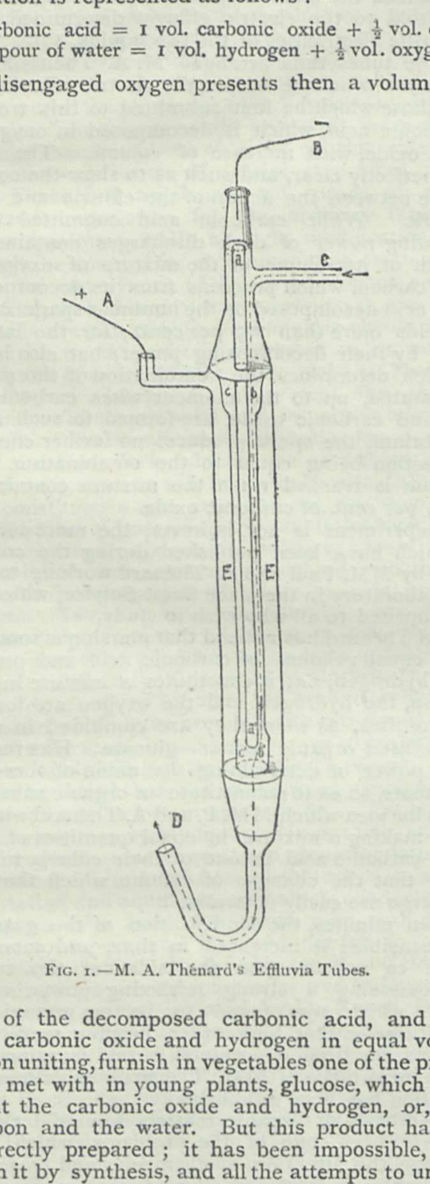


FIG. 1.—M. A. Thénard's Effluvia Tubes.

to that of the decomposed carbonic acid, and leaves instead carbonic oxide and hydrogen in equal volumes, which, on uniting, furnish in vegetables one of the products that are met with in young plants, glucose, which exactly represent the carbonic oxide and hydrogen, or, again, the carbon and the water. But this product has never been directly prepared ; it has been impossible, so far, to obtain it by synthesis, and all the attempts to unite the carbonic oxide to the hydrogen have been futile. There is, however, a problem of the same order which has been solved by MM. Thénard, and, in our opinion, is one of the most important points of their recent labours. They have not obtained, it is true, the organic matter, yet without a name, which was condensed upon their tube by directly combining hydrogen and the carbonic oxide, but by employing carbonic acid and formic acid, in which the elements are met with in the same proportions, in fact, instead of having

2 vols. carbonic oxide containing . . . . } 1 vol. oxygen, 1 vol. carbon vapour.
2 vols. hydrogen.

they have employed

4 vol. carbonic acid, containing . . . . . } 4 vols. oxygen, 2 vols. carbon vapour.
4 vol. carburetted hydrogen containing . . . . . } 2 vols. carbon vapour, 8 vols. hydrogen.

in which the oxygen and carbon, as in the first case, are in equal volumes, and the hydrogen in double volume. We may then regard the experiment of M. Thénard as opening a new way to the synthesis of organic substances, already so brilliantly studied by M. Berthelot.

The first apparatus employed by MM. Thénard presented a drawback ; the gases circulated with considerable difficulty, and their union was not so complete as could be desired ; they could not easily be renewed. MM. Thénard have got rid of this difficulty by means of the apparatus represented in Fig. 2. It will be seen that the electricity

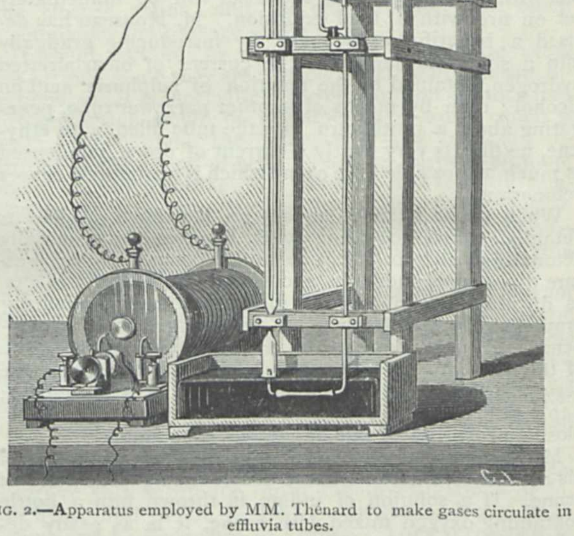


FIG. 2.—Apparatus employed by MM. Thénard to make gases circulate in effluvia tubes.

from the coil is distributed in the two tubes by cups filled with chloride of antimony, one forming the external tube, the other the interior, between which circulate the gases. These are kept in continuous motion by means of a very ingenious employment of mercury. By examining the figure it will be seen that the mercury placed in the large vessel, firmly fixed above the apparatus, can be let out drop by drop into the vertical tube on the right and carry along a certain quantity of gas imprisoned between two consecutive drops. The excess of mercury falls back into the vat into which the horizontal tube goes, while the moving gas received into a funnel which dips into the mercury, is brought into the annular space where it is subjected to the effluvia.

It is thought that if the gases in coalescing yield a liquid or solid substance, which can only happen by a great diminution of volume, it may be possible to introduce through the funnel placed under the mercury, a new proportion of the gases which, under the influence of the effluvium, will react upon each other.

HAECKEL ON INFUSORIA

IN this communication* Prof. Haeckel discusses the different views which have been entertained as to the structure of the Infusoria, and adopts that of Prof. Siebold, that they are unicellular. This constitutes in his opinion a fundamental distinction betweent hem and the rest of the animal kingdom, although, strictly speaking, some species, as for instance, *Loxodes rostrum*, and *Enchelys gigas*, have more than one nucleus, and must, therefore, be regarded as physiologically consisting of more than one cell. Prof. Haeckel, however, does not attach much importance to these exceptional cases, because the multiplication of the nuclei involves little change of organisation in other respects.

The difficulty of conceiving a single cell with such complex properties becomes lessened, if we remember the nerve-cells of the higher animals, the thread-cells of many Acalephæ.

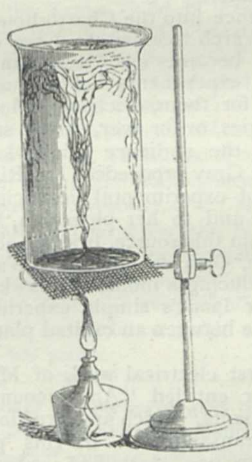
Considering, then, that the true Infusoria are unicellular, as first maintained by Prof. Siebold in 1845, Prof. Haeckel denies that they have any near connection with either Cœlenterata or the worms. In all the higher groups of the animal kingdom the organism is multicellular, and develops itself from the original egg-cell by the characteristic process of segmentation, and the cellular mass thus formed differentiates itself into two epithelial layers, from the inner one of which the digestive canal, with all its appendages, develops itself; while from the outer layer are formed the skin, nervous system, &c. In his monograph of the Calcareous Sponges, Prof. Haeckel has developed his views of the relations of these two primary layers in the principal groups of animals, and from this fundamental homology has enunciated the theory of a common original form, which he proposed to call "Gastraea," and from which all the higher forms of animals are derived. This theory, which he calls the Gastræa theory, is based upon the consideration that all the six higher animal classes, from the sponges to the lowest vertebrates, pass through a similar stage of development, which he proposes to call the Gastrula stage, and which he considers to be the most important and instructive embryonal form of the animal kingdom. In the calcareous sponges, for instance, this Gastrula law forms a simple generally egg-shaped body, surrounding an ample hollow, the primitive stomach, or digestive cavity, and with an orifice at one end, the primitive mouth. The wall of the digestive cavity consists of two layers, the entoderm, and the ectoderm, which, as Prof. Huxley was the first to point out, are homologous with the outer and inner layers of the vertebrate embryo. Similar larvæ occur in other sponges, and in many zoophytes, while as examples of embryonal forms in other groups he refers to the researches of Kowalevsky in Phoronis, Sagitta, Euaxes, Ascidia, &c.; and of Ray Lankester in Mollusca. He considers that the larval forms of Arthropods can be reduced to the same type; and finally that the researches of Kowalevsky have shown that the same is the case with the lowest vertebrata (Amphioxus). The Infusoria, on the contrary, have no yolk-segmentation, no blastoderm, and consequently nothing which corresponds to the Gastrula stage, nor any homologue of the digestive cavity of other animals. The resemblance of many ciliated larvæ to the Infusoria is therefore merely superficial, the latter being unicellular, the latter multicellular. He regards this difference as so fundamental that he proposes to divide the animal kingdom into two great groups, the Protozoa, and the Metazoa, Blastozoa, or Gastrozoa. The Metazoa, to use his first name, he again divides into two; the Zoophytes, or Cœlenterata on one side, and the Worms, from which again the Molluscs, Echinoderms, Arthropods, and Vertebrates have sprung, on the other.

* Zur Morphologie der Infusorien. Sep. Abdruck aus der Jenaischen Zeitscrift. Bd. vii.

A LECTURE EXPERIMENT

THE ordinary experiment described in books for demonstrating the heating of a body of fluid by convection currents consists in throwing bran into a vessel of water, to the bottom of which a source of heat is afterwards applied. Mr. Clowes's experiment, given in NATURE, vol. ix. p. 162, is no doubt more effective. I have, however, found that the ordinary experiment admits of being made quite satisfactory for the purpose of clear demonstration, and the hint may be useful to those to whom it has not already occurred.

Take a large beaker filled with water, and introduce down to the bottom the end of a burette filled with a strong indigo solution and closed at the top by the finger. If necessary, the solution may be driven out by the application of the mouth to the other end, and gently blowing. The burette must be carefully withdrawn without producing upward currents; this can be easily managed with a little care. The dark fluid now lies at the bottom of the clear water, with which, during a time sufficient



for the experiment, it does not appreciably mix. But when a spirit lamp is applied it rises in slender streams, which can be rendered very visible by placing a sheet of white paper behind the beaker. W. T. T. D.

A SCIENCE LECTURE AT THE CHARTERHOUSE

A LECTURE on one who was once a Brother of the Charterhouse, and who laid the foundations of scientific electricity, could not fail to be of interest when delivered within the walls of that building, where indeed many of the experiments of the original investigator in question were conducted. This pleasant duty devolved on Dr. Richardson on Thursday, January 22, when he gave to the brethren of the Charterhouse, and to many eminent friends, an experimental demonstration of the work of the early electrician, Stephen Gray.

The lecturer opened his discourse with an exposition of the personal history of Mr. Gray; of this, he said, he could gather little. He discovered Gray first at Canterbury, in 1692, making an observation of a mock sun, in the afternoon of February 6. At this time Gray was evidently engaged on physical and astronomical research. In 1696 he was busy constructing a water microscope; in 1698 he was engaged making a microscope with a micrometer for measuring the height of mercury in the barometer more exactly; in 1699, on April 7, between 4 P.M. and 5 P.M., he was observing an unusual parhelion and a halo; in 1701 he was studying the fossils of Reculver

Cliff and inventing a method for drawing the meridian line by the Pole star and finding the hour by the same; in 1703, on June 15, 16, and 18, he was making some observations on spots on the sun; and in 1706, on May 12, in conjunction with Flamstead at Greenwich, Captain Stannyan at Berne, and Mr. Sharp at Bradford, he was taking observations of the great solar eclipse of that day.

From his various reports on these subjects it is clear that Mr. Gray, while at Canterbury, had a good observatory; he had three telescopes, one of which was of 16 ft., an astronomical table, a theodolite, a pendulum clock, and various other instruments, with the use of which he was quite familiar; but what his occupation was, otherwise, there is no record.

We now lose all sight of Gray until 1717, when we find him being recommended to the Charterhouse by Prince George to become a pensioner there. The letter of recommendation is signed by the Prince, but says no more than that the applicant is a proper person to receive the advantage of residence. In 1719 he entered the building as a pensioner and remained there until his death, seventeen years later.

With his entrance into the Charterhouse a new career of scientific research seemed to have opened itself to Mr. Gray. He became an electrician, and, said Dr. Richardson, his experiments led to such extraordinary results that, but for them, electrical science might have waited for centuries, or for ever, in the state in which he found it. That the audience might know upon what pre-existing data Gray proceeded, Dr. Richardson traced back the origin of experimental electricity to the reign of Queen Elizabeth and to her physician, William Gilbert. He reviewed from this source, briefly and succinctly, the labours of Boyle, Otto de Guericke, Wall, Newton, and Hawksbee, introducing a model of Hawksbee's revolving cylinder, and Sir Isaac's simple experiment of making light bodies move between an excited plate of glass and a table.

In 1720 the first electrical work of Mr. Gray saw the light in a paper entitled "An account of some new electrical experiments," which appeared in that year in the Philosophical Transactions. In this paper the communicability from one electrified substance to other substances not previously electrified is described.

From this point in Mr. Gray's career Dr. Richardson traced him step by step through his experimental researches, making each of his (Gray's) experiments a matter of direct demonstration to the audience, and using only the simple kind of instruments the original investigator himself had at command. Thus were demonstrated the experiments of the cork and the excited tube, the ivory ball on the wooden rod, and the pack-thread experiments, by which Gray discovered that electricity could be conducted long distances. Next were demonstrate the famous loop experiments and those with bridges of pack-thread, silk, and wire, by which silk was discovered to be an insulator, and the new fact of insulation was recorded. The audience, at this point, were carried, by description, to the Mansion of Mr. Granville Wheeler, Otterden House, near Faversham, and were shown by a beautifully simple diagram, drawn for the occasion by the distinguished George Cruikshank—how Mr. Gray, putting up poles in Mr. Wheeler's grounds, insulated a pack-thread line on silk supports, and on July 14, 1729, sent by the line a communication through a distance of 650 ft.

Another series of experiments showed how Mr. Gray discovered induction, the conducting power of water and of metals; the fact that electricity arranges itself upon the surfaces of bodies; that attraction will take place *in vacuo*; and that an insulated, pointed iron rod, when electrified by induction, will yield a brush at its extreme point, will charge another insulated conductor, will give a spark to the knuckle when tha is brought near, and will pass through a chain of animal bodies, if they be insulated.

A beautiful experiment with a soap-bubble, showing how, when insulated and charged, it will attract, closed the experimental part of the lecture. The experiments throughout were highly successful, and were so rendered as to be distinctly visible to all the observers.

A few more points in the personal history of Gray were introduced. It was told that he gained the first Copley Medal of the Royal Society in 1731, and the second in 1732, and that he was admitted a Fellow of the Society on March 15 of the latter year. A graphic description was given of a meeting of the Royal Society on November 25, 1731. At this meeting Prince George was present with the Duke of Lorraine, and the Duke was admitted a Fellow. Afterwards a model of a fire-engine, used at York, was exhibited; then Dr. Frobenius lectured on phlogiston, and on the transmutation of phosphorus, using several pounds' worth of that now common element. Finally, the company ascended to the library, where Mr. Gray showed some experiments, proving how electricity travels along conductors, and succeeded well, notwithstanding the largeness of the company.

Two remaining subjects relating to Gray were briefly touched upon. One was his prediction that what he was doing *in minimis* would some day be so extended, that electrical phenomena would be made to resemble those of thunder and lightning; and the other, his belief that he had invented what he called a Planetarium, that is, a method of making a pith-ball suspended by silk move in circles or ellipses round a metallic centre set in a cake of resin, while the resin was excited by friction of the hand. The first of these observations of Gray had been fulfilled; the latter had appeared as an error of the last days of this wonderful man, and might well be forgiven.

The death of Stephen Gray afforded the lecturer an opportunity for a touching description of a man of science struggling to the last with his labours. On February 14, 1735-36, he was visited by Dr. Cromwell Mortimer, the secretary of the Royal Society, who took from his lips the account of the Planetarium by which, "if God spared his life," the electrical philosopher would create, he thought, much astonishment: but the following day, experiment, speculation, and hope, lay alike low in death.

NOTES

The report which reached England a few days ago of the death of Livingstone, and which Dr. Kirk was able to characterise as possibly unfounded, as it closely resembled a discredited one current in Zanzibar before he left, received important confirmation yesterday morning. We are enabled, however, to state that a letter seems to have come from Lieut. Cameron at Unyanyembe, reporting that a man named Chumas, who was with Livingstone, had arrived there with a circumstantial story of his death, which Lieut. Cameron, with his slight knowledge of Suabili, had to turn into English. It now depends upon the veracity of Chumas, of which at present there is no means of judging. The circumstantiality is nothing, for the tale of the lying Johanna man was quite as detailed. There is, however, we are bound to confess, much reason to fear that we have lost one of the most unselfish, noble, and devoted investigators the century has produced.

The Council of the Geological Society has awarded the Wollaston Medal for the present year to Prof. Oswald Heer of Zurich, and the balance of the Proceeds of the Wollaston Donation Fund to M. Henri Ngst of Brussels. The Murchison Geological Medal was awarded by the Council to Dr. Bigsby, F.G.S., and the balance of the Proceeds of the Murchison

Geological Fund to Mr. Alfred Bell and Mr. Ralph Tate, F.G.S., between whom it will be divided.

WE are glad to note that the Emperor of Brazil has conferred upon Dr. Huggins, F.R.S., the honourable distinction of Commander of the Order of the Rose.

WE are informed there is a scheme in contemplation for the erection of an aquarium at Margate. The building will commence at Cold Harbour and pass round Fort Point to the flagstaff point on the Fort Promenade, and will be carried out by a limited liability company, with a capital of 15,000*l.* In all likelihood the work will be commenced early in the spring and will take about nine months to complete. According to present plans the aquarium will be 250 ft. long by 100 ft. broad, and will be connected with a large hall suitable for concerts and balls.

THE Royal Irish Academy have granted to Messrs. Draper and Moss the sum of 30*l.* towards their researches on Selenium, and 35*l.* to G. J. Stoney, F.R.S., towards the construction of the Academy's spectroscope.

ON the 19th inst. Prof. Corfield delivered a lecture on Small-pox and Vaccination, in connection with the Laws of Health Class of the Birmingham and Midland Institute.

A COURSE of "Science Lectures for the People" has been arranged by the Council of the Crewe Mechanics' Institution, to be delivered in their hall. The following is the programme for the next two months :—February 5th and 12th, two lectures on "Mechanics," by Sedley Taylor, M.A., late Fellow of Trinity College, Cambridge ; February 19th and 26th, two lectures on "Waves," by G. W. Hicks, B.A., scholar of St. John's College, Cambridge ; March 5th and 12th, two lectures on "Light," by William Garnett, B.A., scholar of St. John's College, Cambridge. These two last will treat of spectrum analysis, and its application to the Bessemer flame. H. N. Read, B.A., of St. John's College, Cambridge, will give the two concluding lectures on "Chemistry," on March 19th and 26th. Each lecture will be illustrated by experiments.

WE have received two more of the penny reprints of the Science Lectures for the people delivered at Manchester, namely: —"Muscle and Nerve," by Prof. Gamgee, M.D., F.R.S., and "The Time that has elapsed since the Era of the Cave Men of Devonshire," by William Pengelly, F.R.S. They both seem admirably adapted for the purpose for which they were given, the subjects being treated clearly and familiarly without that sacrifice of scientific accuracy which is often the bane of popular lectures delivered before mixed audiences.

WE have received the thirteenth annual report of the Manchester Scientific Students' Association, containing an account of the various soirées, excursions, and papers for the past year. We are pleased to see that the Committee speak very favourably of the position and prospects of the Society. The total number of members is 177. During 1873 two soirées were held, seventeen lectures delivered on various branches of science, and eleven excursions made to places of scientific and antiquarian interest in the locality.

A NEW society has been formed at Londonderry under the name of the "Londonderry Scientific Association" to promote the study of physical, natural, and historical science. Courses of lectures will be delivered on scientific subjects, single lectures on special subjects by eminent Lecturers will also be provided as occasion may serve, and excursions made during the summer for the field-study of Geology, Zoology, and Botany. The first meeting was held on January 14, when Mr. W. E. Hart, M.A., President of the Society, occupied the chair and opened the proceedings by reading a paper on "Local Scientific Societies; their aims and objects ;" in which he pointed out the importance of the study of natural science, both as in itself a valuable branch of education, and as a means of intellectual discipline. This was followed by a discussion on the "Relations of Physico-Geographical Conditions to Civilisation." The "Londonderry Scientific Society" is chiefly composed of ex-members of the "Londonderry Natural History and Philosophical Society," which ceased to exist some two years ago.

WE learn from Mr. Gerard Krefft, F.L.S., Curator of the Australian Museum at Sydney, that the museum, which is the oldest and richest in the Australian colonies, was visited last year by nearly 250,000 persons, who were admitted free. We understand that Mr. Krefft will be glad to receive specimens of all kinds from any individuals interested in the progress of science in New South Wales.

MR. HENRY SOLLY writes to the *Times* with reference to the address issued by the Trades Guild of Learning noticed in NATURE. He says that the Guild originated with himself, and was first proposed at a meeting he called last March to a number of leading working men, when Lord Lyttelton was in the chair, and when Mr. James Stuart, of Trinity College, Cambridge, the originator of the University Extension Scheme, was present at his invitation. A Provisional Committee was then formed, consisting of most of the working men present, with the addition of Mr. Stuart, Mr. Webster, Q.C., Mr. Hodgson Pratt, Mr. Edward Hall, himself, and a few other friends of the movement. That committee resigned its trust, after doing a good deal of work, to a conference held in June at the Hall of the Society of Arts, when the Guild was formally founded, and a Council was appointed on which nearly the whole of the Provisional Committee was placed.

DURING several days in December, says the *Levant Times*, consternation prevailed in the town of Adramytti, in Asia Minor, in consequence of certain ominous noises which seemed to proceed from a considerable depth below the earth's crust. The sound which was heard at intervals and resembled the report of distant cannon, was accompanied and followed by shocks of earthquake, which added to the terror of the inhabitants. At a short distance from the town and in the surrounding villages there was no such cause for alarm, the earth maintaining its normal condition of harmless repose. These details are, no doubt, trustworthy, as they are taken from the report sent in by the Governor of Adramytti to the Governor-General of the Vice-Royalty of Smyrna.

ON December 1, at 10.25 A.M., a violent shock of earthquake was felt at Sofia, in European Turkey. The shock was accompanied by a loud subterranean noise.

THERE were two shocks of earthquake at 8 P.M. on Dec. 26 at Salonika, in European Turkey.

AT the Berlin Medico-Psychological Society in November last, says the *Medical Times and Gazette*, Dr. Hitzig, the author of the method of examination of the brain by electricity, made some remarks on Dr. Ferrier's well-known experiments on the localised functions of the brain, especially with regard to the discrepancies between his own and the latter's results. He considers that the chief of these is that while he and Fritsch have found only one part of the convexity of the hemispheres capable of electrical excitation, Ferrier extends this property to nearly the whole of it. This Hitzig explains by saying that Ferrier has in his experiments used two strong currents (the secondary coil of Stohrer's battery being pushed into eight and even four centimetres), and has thus excited the ganglia at the base of the brain, so that it is to them, and not to centres localised in the cortex, that the movements noted must be referred. Another reason why Hitzig doubts some of the effects of irritation in Dr. Ferrier's cases is because, although there is such a remarkable similarity between the brains of the dog and the cat, the latter found that electrisation of the spot on the cat's brain corresponding to the centre of movement for the tail in the dog gave no result. Hitzig has repeated several of the experiments in which Ferrier's results differed from his own, and declares that his own views are re-confirmed. He will shortly publish a detailed account of all his work in Du Bois-Reymond's *Archiv*.

DR. PETERS of Berlin, in the 1873 *Festschrift* of the *Gesellschaft Naturforschen der Freunde zu Berlin*, has described a very interesting new genus of Rodent animals, named by him *Dinomys branickii*. The specimen on which the memoir is based is a skin and skeleton, which were placed in his hands by Mr. L. Taczanowski, Conservator of the Zoological Museum at Warsaw, the latter naturalist having obtained it from Mr. Constantin Jelski, who found it in the high lands of Peru.

WE are glad to know that a Microscopical Society has been founded in Victoria quite recently, this being the first of such institutions established in Australia. The first meeting, held at Melbourne, was under the presidency of Mr. W. H. Archer, the Registrar-General of the Colony, who gave an interesting introductory address, in which he showed the great field there is for fresh work in that comparatively unexplored country.

WE noticed in NATURE last week the announcement of a work by Sir Bartle Frere, G.C.B., G.C.S.I., called "The Impending Famine in Bengal; how it will be met, and how to prevent future Famines in India," with maps; to be shortly published by Mr. John Murray. Amongst Messrs. H. S. King and Co.'s forthcoming books we find the following:—"The Threatened Famine in Bengal; how it may be met, and the recurrence of Famines in India prevented," by Sir H. Bartle Frere, G.C.B., G.C.S.I., &c., with three maps. Is it not somewhat strange that two publishing firms should announce separate works by the same author, with titles that are so nearly synonymous?

MESSRS. H. S. KING & Co. will shortly publish—"Longevity: the Means of prolonging Life after Middle Age," by Dr. J. Gardner, author of "Household Medicine." "The Principles of Mental Physiology, with their applications to the training and discipline of the Mind, and the Study of its Morbid Conditions," by W. B. Carpenter, M.D., LL.D., F.R.S. "Physiology for Practical Use," by various eminent writers. Edited by James Hinton. 2 vols., with 50 illustrations. "The History of Creation:" a popular account of the development of the earth and its inhabitants, according to the theories of Kant, Laplace, Lamarck, and Darwin. With coloured plates and genealogical trees of the various groups of both plants and animals, by Prof. Ernst Haeckel of Jena. "The New Chemistry," by Prof. Josiah P. Cooke, of Harvard University, with numerous illustrations.

MESSRS. WM. BLACKWOOD AND SONS have in the press the following works relating to natural science:—An "Advanced Text-book of Botany for the Use of Students," by Robert Brown, F.R.G.S., Lecturer on Botany under the Science and Art Department of the Committee of the Privy Council on Education and author of the "Races of Mankind," just published by Messrs. Cassell, Petter, and Galpin; "Domestic Horticulture, Window Gardening and Floral Decorations," by F. W. Burbidge; and "Economic Geology, or Geology in its Relation to the Arts and Manufactures," by David Page, F.G.S., Professor of Geology in the Durham University College of Physical Science, Newcastle.

MR. WILLIAM TOPLEY'S interesting paper, with maps and sections "On the Relation of the Parish Boundaries in the South-east of England to Great Physical Features, particularly to the Chalk Escarpment," has been reprinted in a separate form from the *Journal of the Anthropological Institute*.

IN *Le Tour du Monde*, is appearing a French translation of the account of the voyage of the German Arctic Expedition of 1869—70, in the ships *Germania* and *Hansa*. The illustrations are plentiful and beautiful.

WE have received the following reprints of papers by Mr. F. W. Putnam, from the *Bulletin of the Essex Institute* (U.S.):—"Description of a Stone Knife found at Kingston, N.H.," "Description of a Carved Stone representing a Cetacean, found at Seabrook, N.H.," and "Descriptions of Stone Knives found in Essex County, Massachusetts."

THE success of Professor G. W. Hough, of the Dudley Observatory, in constructing self-recording barometers and thermometers, lends additional interest to his announcement of the successful construction of an automatic evapometer and rain-gauge. The apparatus consists of a vessel two feet square and one foot deep, suspended on levers, and held in equilibrium by a small spring, the amount of change in the weight of the mass, either from rainfall or evaporation, being indicated on the scales of a delicate balance. In order to secure the mechanical record of the hourly variations in the weight of the vessel and of its contents, the professor causes the lever to vibrate between two platinum points so placed that whenever a change in the weight of the vessel by a given amount (say ten grains) takes place, a magnetic circuit will be established passing through an electro-magnet. A micrometer screw will then be operated by means of clock-work, thereby tracing a curve on a revolving drum, precisely as in the case of the self-recording barometer and thermometer.

THE principal articles in the last number of the *Canadian Journal of Science, Literature, and History* are—on "An Ancient Carved Stone, found at Chesterholm, Northumberland, England," by the Rev. Dr. M'Caul; an article by Dr. Daniel Wilson, on the work done by Alexander Gordon, the Scottish antiquary, author of the *Itinerarium Septentrionale*, and a paper, also published separately, by Prof. H. A. Nicholson, on "The Species of Favosites of the Devonian Rocks of Western Ontario." Appended are meteorological tables for Toronto for the half-year May to October 1873.

THE addition to the Zoological Society's Gardens, during the past week, include an Ocelot (*Felis pardalis*) from America, presented by Mr. J. Ryde; a White-headed Sea Eagle (*Haliaëtus leucocephalus*) from Nova Scotia, presented by Mr. H. Walpole; two Grey-breasted Parrakeets (*Bolborhynchus monachus*) from Monte Video, presented by Mrs. C. Dawkins; a Bernicle Goose (*Bernicla leucopsis*), European, presented by Mr. T. P. Tyndale; two Sclater's Curassows (*Crax sclateri*) from Maranham, and a Prince Albert's Curassow (*C. alberti*) from Columbia; a Capybara (*Hydrochœrus capybara*) from South America; a Rhea (*Rhea americana*) from Rosaria, and a Chimachima Milvago (*Milvago chimachima*) from Brazil, purchased or deposited, the last-named bird being new to the collection.

THE ACOUSTIC TRANSPARENCY AND OPACITY OF THE ATMOSPHERE*

THE cloud produced by the puff of a locomotive can obliterate the noonday sun; it is not therefore surprising that in dense fogs our most powerful coast lights, including even the electric light, become useless to the mariner.

A disastrous loss of life and property is the consequence. During the last ten years, for example, the number of total wrecks on the coasts of the United Kingdom, which were reported to have been caused by fog and thick weather, amounted, I am informed, to 273 vessels.

Of late years various efforts have been made, both on our own coasts and on the American seaboard, where trade is more eager and fogs more frequent than they are here, to furnish warning and guidance to ships by means of sound signals of great power established along the coast. Regarding the performance of such signals, the most conflicting evidence exists; and no investigation has been hitherto instituted sufficiently exhaustive to remove the uncertainty.

The problem has occupied for some time the attention of the Elder Brethren of the Trinity House; and soon after my return from America they requested me, as their official adviser in scientific matters, to superintend an investigation of the entire subject. They had appointed a committee under whose auspices two stations had been established at the South Foreland. I entered upon the inquiry with such ardour as I could derive from a sense of duty, rather than from the pleasure of hope, for I knew it would be long and difficult, and that I was at the mercy of a medium, the earth's atmosphere, which could not be put into the witness-box and cross-examined scientifically. The experimenter can usually impose his own conditions upon Nature, and force her to reply. In the present case we were forced to accept the conditions which Nature imposed.

Nevertheless, if the student only holds on faithfully to any natural problem, intending his mind upon it, and not falling into hasty despair, he is sure to be rewarded in the end; and after a time results, important not only in a practical but in a purely scientific point of view, appeared to grow out of the investigation. I mentioned this to the Deputy Master of the Trinity House, saying that I thought such results might, without impropriety, be communicated to the Royal Society and the Royal Institution. His response was prompt and cordial, and he was seconded by his colleagues in this response. They gave not only the requested permission (which on various pleas they might have withheld), but they have aided me in every way in the preparation of this discourse.

I would add that the Elder Brethren themselves have had a large share in the executive portion of this investigation, and whatever success has attended the inquiry is in a great measure due to the cheerful promptness and thoroughness with which my wishes and suggestions were carried out by the gentlemen with whom I had the honour to act. It is not necessary to mention names when all have been so sympathetic and so helpful, but I should like to refer to a few gentlemen on the working staff of the Trinity House, who have aided me with all assiduity and all zeal. They are the able Trinity House engineer, Mr. Douglass, his assistant engineer, Mr. Ayres, and Mr. Price Edwards, the private secretary of the Deputy Master of the Trinity House.

On Monday, May 19, the experiments began. The instruments employed had been previously mounted at the top and bottom of the South Foreland Cliff. They were two brass trumpets, or horns, 11 ft. 2 in. long, 2 in. in diameter at the mouth-piece, opening out at the other end to a diameter of 22 in. They were provided with vibrating steel reeds, 9 in. long, 2 in. wide, and ¼ in. thick, and were sounded by air of 18 lbs. pressure. They were mounted vertically on the reservoir of compressed air; but within about 2 ft. of their extremities they were bent at a right angle, so as to present their mouths to the sea. These horns were constructed by Mr. Holmes. There were also two whistles shaped like those in use on locomotives, one 6 in. in diameter, sounded by air of 18 lbs. pressure; the other constructed by Mr. Baily of Manchester, 12 in. in diameter and sounded by steam of 64 lbs. pressure.

We embarked on the steamer *Irene*, and placed ourselves abreast of the signal-station, halting at a distance of half a mile from it. The wind was strong, the sea rough. The superiority of the trumpets to the whistles was very marked, and I may say continued marked throughout. Their sound was exceedingly fine and powerful. At 1 mile's distance their sound was clear and strong; at 2 miles they were heard distinctly, though not loudly. The whistles were also heard, but as fog-signals they had become useless. At 3 miles the horns became also useless. It required great attention to hear them distinctly. At a distance of 4 miles, with the paddles stopped, we listened long and attentively, but heard nothing.

On May 20, at 3 miles' distance, the steam whistle was not at all heard, the horns but faintly. At 4 miles' distance, the air being very light, the sea calm, and the circumstances generally to all appearances highly favourable, we halted and listened. The horns were so heard as to render it unmistakeable that a sound was there. At 4·8 miles the sounds were faintly heard; at 5 miles an occasional murmur reached us. At 6 miles the faint hum of a horn was wafted to us at intervals. A little farther out, though local noises were absent, and though we listened with stretched attention, we heard nothing.

This position, clearly beyond the range of whistles and trumpets, was chosen with the view of making a decisive comparative experiment between horns and guns as instruments for fog-signalling. Through the courtesy of General Sir A. Horsford we were enabled to carry out this comparison. At 12·30 precisely the puff of an 18-pounder, with a 3-lb. charge, was seen at Dover Castle, which was about a mile farther off than the South Foreland. Thirty-six seconds afterwards the loud report of the gun was heard, its complete superiority over the trumpets being thus to all appearance demonstrated.

We clinched this observation by steaming out to a distance of 8½ miles, where the report of a second gun was well heard. At 10 miles the report of the gun was heard by some and not by others. At 9·7 miles a fourth report was heard by all observers.

There was nothing, so far as I am aware of, in our knowledge of the transmission of sound through the atmosphere, to invalidate the founding upon these experiments of the general conclusion that, as a fog-signal, the gun possessed a clear mastery over the horns. No observation, to my knowledge, had ever been made to show that a sound once predominant would not always be predominant; or that the atmosphere on different days would show preferences to different sounds. A complete reversal of the foregoing conclusion was therefore not to be anticipated; still, on many subsequent occasions, it was completely reversed.

On June 2 the maximum range, at first only 3 miles, afterwards ran up to about 6 miles.

Optically June 3 was not at all a promising day; the clouds were dark and threatening; and the air filled with a faint haze, nevertheless the horns were fairly audible at 9 miles. An exceedingly heavy rain-shower approached us at a galloping speed.

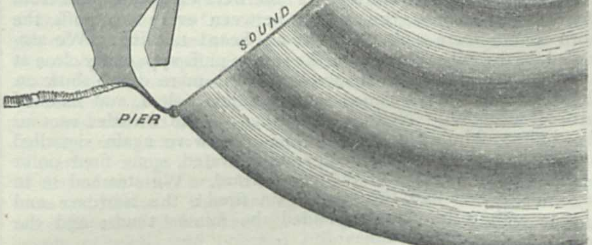


FIG. 1.

The sounds were not sensibly impaired during the continuance of the rain. This state of the atmosphere, according to hitherto

* Royal Institution, Friday evening Discourse by Prof. Tyndall, D.C.L. LL.D., F.R.S. Jan. 16.

expressed opinions, should have deadened the sound. It rather aided the sound, and this added to my perplexity.

On June 10 the maximum range was 9 miles. An extraordinary sinking of the sound was, however, noticed on the Dover side of the Foreland. At a mile's distance from the station the sounds rapidly fell. Surprised at the suddenness of the effect, and thinking it might be due to some peculiarity of the horns, at 2 miles' distance I signalled for the guns. With a 3 lb. charge not one of them was heard.

On June 11 we steamed towards the South Sound Head lightship. At the distance of 2¾ miles, and even at 2 miles and less from the station, the sounds were not so strong as at 3¾ miles. We steamed abreast of the station and on to the line joining the South Foreland to the end of the Admiralty Pier. At three-quarters of a mile from the station the sound fell, and a little farther on was scarcely audible. This weakening of the sound between the pier and the Foreland was invariable. This needs a word of explanation. The fall of the sound is not caused directly by an acoustic shadow, for it occurs when the instruments are in view, but the limit of an acoustic shadow is close at hand. A little within the line joining the Foreland and the pier end, the instruments are cut off by a projection of the cliff near the station; all the sea space between this limit and the cliff under Dover Castle is in the shadow. Into this, however, the direct waves diverge, and lose intensity by their divergence, the portion of the wave nearest the shadow suffering most. To this must be added the effect of interference.

On June 25 the range was 5½ miles. On June 26 the range was 10 miles. The former day the wind was in the direction of the sound; on the latter the wind was opposed. Plainly there must be something besides the wind which determines the sound-range. This something was now the object of search.

Is it the clearness of the atmosphere? All previous writers have extolled a clear atmosphere as best for sound; but on July 18 we steamed out to a distance of 10 miles and heard sounds, the white cliffs of the Foreland being at the same time entirely hidden in thick haze. Nay, more: we spoke the *Triton* tender on its way from the *Varne* lightship, and took the master of the *Varne* on board. He reported that the sounds had been heard at the lightship, though it is 12¾ miles from the Foreland. It was, moreover, dead to windward of the Foreland, so that both haze and wind were then in opposition; still the sound ranged at least twice as far as it had done on days when neither haze nor wind was there to interfere with the sound.

On July 2, a sudden acoustic darkness, if I may use the term, settled upon the atmosphere. The range was only 4 miles. The magnitude of the fluctuations, from 3½ to 12¾ miles, observed up to this date, was striking: but I was unable to fix upon any meteorological element that could be held accountable for them. The wind, the clearness of the air, the barometer, the thermometer, the hygrometer, gave me no help. All was perplexity. I longed for light, but saw little prospect of obtaining it.

July 3 was a lovely morning: the sky was of a stainless blue, the air calm, and the sea smooth. I thought we should be able to hear a long way off. We steamed beyond the pier end and listened. The steam clouds were there, showing the whistles to be active; the smoke puffs were there, attesting the activity of the guns. Nothing was heard. We went nearer; but at two miles horns and whistles and guns were equally inaudible. This however being near the limit of the sound shadow, I thought that might have something to do with the effect, so we steamed right in front of the station, and halted at 3¾ miles from it. Not a ripple nor a breath of air disturbed the stillness on board, but we heard nothing. There were the steam-puffs from the whistles, and we knew that between every two puffs the horn sounds were embraced, but we heard nothing. We signalled for the guns: there were the smoke puffs apparently close at hand, but not the slightest sound. It was mere dumb show on the Foreland. We steamed in to 3 miles, halted, and listened with all attention. Neither the horns nor the whistles sent us the slightest hint of a sound. The guns were again signalled for; five of them were fired, some elevated, some fired point blank at us. Not one of them was heard. We steamed in to two miles, and had the guns again fired: the howitzer and mortar with 3 lb. charges yielded the faintest thud; and the 18-pounder was quite unheard.

In the presence of these facts I stood amazed and confounded, for it had been assumed and affirmed by distinguished men who had given special attention to this subject, that a clear, calm atmosphere was the best vehicle of sound: optical clearness and acoustic clearness were supposed to go hand in hand: indeed, it had been proposed to make the one a measure of the other. But here was a day perfectly optically clear, proving itself to be a day of acoustic darkness almost impenetrable. I was driven slowly to the conclusion that all I had read upon this subject was wrong, and that for 165 years, namely since 1708, when Dr. Derham published his celebrated paper on this subject, succeeding generations of scientific men had gone on repeating the same errors. This knowledge, however, did not help me much. The problem was still there challenging solution.

I ventured, two or three years ago, to say something regarding the function of the Imagination in Science, and notwithstanding the care that I took to define and illustrate its real province, many persons, amongst whom were one or two able men, deemed me loose and illogical; in fact, merely poetic, when I referred to the imagination. The history of science, however, numbers many men of strong poetic temperament, who, in the presence of a scientific problem, became as cold and clear as the light of stars. Look at these two pieces of polished steel. Have you a sense, or the rudiment of a sense, to distinguish the inner condition of the one from that of the other? And yet they differ materially, for one is a magnet, the other not. What enabled that noble philosopher, and pure and elevated character, Ampère, to surround the atoms of such a magnet with channels in which electric currents ceaselessly run, and to deduce from these pictured currents all the phenomena of ordinary magnetism? What enabled Faraday to visualise his lines of force, to follow them through magnets and through space until his mental picture became a guide to discoveries which have rendered this place immortal? What but imagination? I have reason to know but too well the fantastic, and even scandalous use that is made of the faculty when it is divorced from the disciplined understanding and handed over to the undisciplined passions and emotions. But this is not the scientific use of the imagination.

And now to return. Figure yourself on the deck of the *Irene*, with the invisible air stretching between you and the South Foreland, knowing that it contained something which stifled the sound, but not knowing what that something is. Your senses are not of the least use to you; you are unable to see, or hear, or feel, or taste, or smell the object of your search; nor could all the philosophical instruments in the world, as it now is, render you the least assistance. You cannot take a single step towards the solution without the formation of a mental image, in other words, without the exercise of the imagination. Let me unfold my own exact course of thought and action.

Sulphur in homogeneous crystals is exceedingly transparent to radiant heat, whereas the ordinary brimstone of commerce is highly impervious to it. Why? Because the brimstone of commerce does not possess the molecular continuity of the crystal, but is a mere aggregate of minute grains not in pefect optical contact with each other. When this is the case, a portion of the heat is always reflected on entering and quitting a grain. Hence when the grains are minute and numerous, this reflection is so often repeated that the heat is entirely wasted before it can plunge to any depth in the substance. A snowball is opaque to light for the same reason. It is not optically continuous ice, but an aggregate of grains of ice, and the light which falls upon the snow being reflected at the limiting surfaces of the snow granules, fails to penetrate the snow to any depth. Thus by the mixture of air and ice, two transparent substances, we produce a substance as impervious to light as a really opaque one. The same remark applies to foam, to clouds, to common salt, indeed to all transparent substances in powder. They are all impervious to light, not through the real absorption or extinction of the light, but through internal reflection.

Humboldt, in his observations at the Falls of the Orinoco, is known to have applied these principles. He found the noise of the Falls three times louder by night than by day, though in that region the night, through beasts and insects, is far noisier than the day. The plain between him and the Falls consisted of spaces of grass and rock intermingled. In the heat of the day he found the temperature of the rock to be 30° higher than that of the grass. Over every heated rock, he concluded, rose a column of air rarefied by the heat, and he ascribed the deadening of the sound to the reflections which it endured at the limiting surfaces of the rarer and denser air. This philosophical explanation made it generally known that a non-homogeneous atmosphere is unfavourable to the transmission of sound.

But what on July 3, over a calm sea, where neither rocks nor grass existed, could so destroy the homogeneity of the atmosphere as to enable it to quench, in so short a distance, so vast a body of sound? As I stood upon the deck of the *Irene*, pondering this question, I became conscious of the exceeding power of the sun beating against my back and heating the objects near me. Beams of equal power were falling on the sea, and must have produced copious evaporation. That the vapour generated should so rise and mingle with the air as to form an absolutely homogeneous mixture, I considered in the highest degree improbable. It would be sure, I thought, to streak and mottle the atmosphere with spaces, in which the air would be in different degrees saturated, or it might be displaced, by the vapour. At the limiting surfaces of these spaces, though invisible, we should have the conditions necessary to the production of partial echoes, and the consequent waste of sound.

Curiously enough, the conditions necessary for the testing of this explanation immediately set in. At 3.15 P.M. a cloud threw itself athwart the sun, and shaded the entire space between us and the South Foreland. The production of vapour was checked by the interposition of this screen, that already in the air being at the same time allowed to mix with it more perfectly; hence the probability of improved transmission. To test this inference the steamer was turned and urged back to our last position of inaudibility. The sounds, as I expected, were distinctly though faintly heard. This was at 3 miles' distance. At $3\frac{3}{4}$ miles we had the guns fired, both point blank and elevated. The faintest thud was all that we heard, but we did hear a thud, whereas we had previously heard nothing, either here or three-quarters of a mile nearer. We steamed out to $4\frac{1}{4}$ miles, when the sounds were for a moment faintly heard, but they fell away as we waited; and though the greatest quietness reigned on board, and though the sea was without a ripple, we could hear nothing. We could plainly see the steam-puffs which announced the beginning and the end of a series of trumpet-blasts, but the blasts themselves were quite inaudible.

It was now 4 P.M., and my intention at first was to halt at this distance, which was beyond the sound range, but not far beyond it, and see whether the lowering of the sun would not restore the power of the atmosphere to transmit the sound. But after waiting a little, the anchoring of a boat was suggested; and though loth to lose the anticipated revival of the sounds myself, I agreed to this arrangement. Two men were placed in the boat, and requested to give all attention so as to hear the sound if possible. With perfect stillness around them, they heard nothing. They were then instructed to hoist a signal if they should hear the sounds, and to keep it hoisted as long as the sounds continued.

At 4.45 we quitted them and steamed towards the South Sand Head lightship. Precisely fifteen minutes after we had separated from them the flag was hoisted. The sound, as anticipated, had at length succeeded in piercing the body of air between the boat and the shore.

On returning to our anchored boat we learned that when the flag was hoisted the horn sounds were heard, that they were succeeded after a little time by the whistle sounds, and that both increased in intensity as the evening advanced. On our arrival of course we heard the sounds ourselves.

The conjectured explanation of the stoppage of the sounds appeared to be thus reduced to demonstration, but we pushed the proof still further by steaming farther out. At $5\frac{3}{4}$ miles we halted and heard the sounds. At 6 miles we heard them distinctly, but so feebly that we thought we had reached the limit of the sound range. But while we waited the sound rose in power. We steamed to the Varne buoy, which is $7\frac{3}{4}$ miles from the signal station, and heard the sounds there better than at 6 miles distance.

Steaming on to the Varne lightship, which is situated at the other end of the Varne shoal, we hailed the master, and were informed by him that up to 5 P.M. nothing had been heard. At that hour the sounds began to be audible. He described one of them as "very gross, resembling the bellowing of a bull," which very accurately characterises the sound of the large American steam whistle. At the Varne lightship, therefore, the sounds had been heard towards the close of the day, though it is $12\frac{3}{4}$ miles from the signal station.

What is the full meaning of this result? Imagine a man in an anchored boat at 2 P.M. at a distance of 2 miles from the Foreland, and suppose him possessed of instruments which would enable him to measure the growing intensity of the sound. Applying the law of inverse squares, to carry the sound to six times the distance, its intensity at 2 miles would have to be augmented 36 times. But the Varne lightship is more than 6 times 2 miles from the Foreland. Supposing no absorption or partial reflection to occur, the observer would have found that by the lowering of the sun the sound at his position had at 6 P.M. risen to more than forty-fold the intensity which it possessed at 2 P.M. In reality the augmentation was still greater.

(*To be continued.*)

BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY

At the annual *soirée*, held on Tuesday, December 16, 1873, celebrating the sixteenth year of the existence of the society, Mr. W. R. Hughes, F.L.S., the president, gave, at the request of the committee, an address on "The recent Marine Excursion made by the Society to Teignmouth." After alluding to the apt and graceful remarks of his predecessor in office (Rev. H. W. Crosskey, F.G.S.) twelve months ago, on the advantages of the study of Natural History, and then describing the preliminary arrangements in connection with the excursion which have already been detailed in NATURE, vol. viii. pp. 334 and 469, Mr. Hughes stated that upwards of 20 members of the society, including several ladies, proceeded from Birmingham and assembled at the headquarters at Teignmouth on Monday, September 1, on which day the dredging operations commenced on board the yacht *Ruby* with satisfactory results. These were carried on during the week, and have already been described in NATURE; the principal feature being the capture of the pedunculate form of *Antedon rosaceus* (*Comatula rosacea*), the rosy feather star, including representatives of 12 genera of Echinodermata and about 40 species of Hydrozoa and Polyzoa, the last of which had been mounted and presented to the society by his friend and colleague, Mr. A. W. Wills, to whom the Society were also indebted for life-like drawings of the *Antedon* in various stages of development.

Mr. Hughes then proceeded to speak of the moral of the marine excursion. So far as he was informed it was the first of its kind that had been undertaken by any society carrying on its operations in an inland district like Birmingham, far removed from the sea, and that point was in itself noteworthy, and might contribute to raise the status of the society and cause its example to be followed by others of a kindred nature. He thought it was pretty well agreed among the members that the excursion was attempted properly, and on the whole carried out successfully. The members who took part in it had been stimulated and encouraged in their project by the hearty and unanimous way in which it was adopted by others whose studies lay in different directions, by praise from NATURE, that most cultivated of scientific serials, and by "good words" from the local press. The results might not have satisfied all. Circumstances rendered the absence of many old supporters of the society unavoidable. It was planned a little too late in the season, and many of the microscopic animals they dredged had played their part in the great problem of life, and empty cells alone remained where many a delicate and beautiful organism had spread its feathery plumes "in the dark unfathomed caves of ocean." Too much time was devoted to the dredging, and not sufficient for subsequent investigation of the proceeds. Still the members had enjoyed the rare opportunity of examining many beautiful marine animals under the microscope which they could not have hoped for at home. And the excursion had done much to promote exchange of thought and friendliness among those taking part in it. Doubtless if a similar one were planned in 1874 the members would profit by the experience of the late one, and Mr. Hughes commended such to the consideration of the committee, and suggested that the members should make it the subject of their annual holiday, especially as ladies were now for the first time admissible as members. The President stated he could not close his remarks to an assembly composed of naturalists and those who had evinced a taste in their pursuits, without alluding to the fact that must have impressed most of them, viz.: that the study of marine zoology had in these days attained an interest second to that of no other branch of natural history, and that the existence and habits of the denizens of "the great and wide sea" were discussed as familiarly in the newspapers of the day as the events of social and political life. As further evidence, Mr. Hughes alluded to the record, almost surpassing any story in the "Thousand and One Nights" contained in that most charming of books "The Depths of the Sea," of the researches in deep-sea dredging, by Prof. Wyville Thomson, F.R.S., and Dr.

Carpenter, F.R.S., refuting the old theories of the non-existence of animal life at great depths, and bringing to light (with others) animals such as *Pentacrinus wyville-thomsoni* and *Bathycrinus gracilis*, pedunculate star-fishes allied to the *Comatula*, from 2,435 fathoms, whose very existence was unsuspected, and who were supposed "in the lapse of ages to have been worsted in the struggle for life." And following these investigations came the exploring expedition of H.M.S. *Challenger*, the most important mission of its kind that Great Britain had ever engaged in, from whence we now and then got stray tidings of yet more remarkable animals,—animals of comparatively high organisation, allied to the lobster, dredged up from 2,000 fathoms: in one individual, a gigantic amphipodal crustacean, "the eyes of the creature extended in two great facettic lobes over the whole of the anterior part of the cephalo-thorax, like the eyes *Æglina* among Trilobites" (NATURE, vol. vii. p. 388). In another, *Deidamia leptodactyle*, there were no traces whatever of eyes of sight or their pedicels (NATURE, vol. viii. p. 52). Further, from the enormous depth of 3,000 fathoms, or nearly 3½ statute miles, "a depth which does not appear to be greatly exceeded in any part of the ocean," have been taken a tube-building annelid, its tube formed of the gritty matter which occurs but sparingly in the clay at the bottom, affording, in fact, as Prof. Wyville Thomson remarks, "conclusive proof that the conditions of the bottom of the sea to all depths are not only such as to admit of the existence of animal life, but are such as to allow of the unlimited extension of the distribution of animals high in the zoological series, and closely in relation with the characteristic faunæ of shallower zones (NATURE, vol. viii. p. 53).

Contemporaneously with these expeditions and what would appear to be not an inappropriate *sequitur*, marine aquaria of extensive size, and constructed on scientific principles, had been established in some of our principal towns, thus affording a new source of enjoyment and an intellectual gratification to the people—that of the examination of living marine animals as they exist "in the depths of the sea"—and combining with this in some instances a source of pecuniary benefit to the promoters. The public interest in these establishments seemed so great that the arrival of the octopus had attracted almost as much attention as the visit of a foreign emperor, and the death of the porpoise was mourned as a national calamity.

In conclusion the president said he hoped he had said something suggested by the recent marine excursion to interest the members in marine zoology. For his own part he could say that the little attention he had been able to devote to it had been a most acceptable relief to official duties (as Treasurer of the Borough), always laborious and responsible, and at the same time it had brought him in contact with fellow-workers in natural history from whose friendship and kindly intercourse he had derived the most lasting pleasure.

Mr. Hughes ventured to express his opinion that a Marine Aquarium, if constructed properly and managed efficiently—for instance like that beautiful one at the Crystal Palace under the direction of his friend, Mr. W. Alford Lloyd, who had done more for the advancement of public aquaria than any man living—would be most acceptable to Birmingham, where the great Priestley carried on his scientific researches, and in 1773 obtained the Copley medal of the Royal Society for the discovery of the mutual dependence of plants and animals on each other—the grand principle of all aquaria. It occurred to him after much thought, and as a successful student of marine aquaria for many years, that no greater attraction or means of intellectual recreation for the working classes and their neighbours in the mining districts could be devised, because it would be so utterly different from any other exhibition now existing, and so suitable as a relief and mental refreshment for those in crowded courts to whom the sea was but a name. It was indisputable that "the sea and its living wonders" had irresistible fascination to us far away from it. The peculiar central inland position of Birmingham would be highly advantageous by allowing ready and rapid modes of conveyance of rare animals from almost any part of the coast. He commended the project to the earnest consideration of the many wealthy and intellectual men in the town, and could not help believing and hoping—although his views as a naturalist might be sanguine—that Birmingham would sooner or later possess a marine aquarium worthy of it, and follow the example of London, Brighton, Liverpool, Manchester, Plymouth, and other large towns, which, besides others on the Continent, had already taken the matter up.

We understand that Mr. Hughes' suggestion has been acted upon, and that an influential committee has since been appointed to make inquiries with the view to the promotion of an efficient marine aquarium for Birmingham.

SCIENTIFIC SERIALS

Astronomische Nachrichten, No. 1,969, Jan. 9.—This number contains a paper by Prof. Spoerer on M. Faye's theory of solar spots. He refers to M. Faye's statement that spots are below the surface of the sun, and to his reliance on his treatment of Carrington's observations; for if a spot be observed for two or more revolutions its distance from the limb can be calculated on the assumption that the spot is on the surface of the sun. Should, however, the observed plan of the spot not agree with the calculated position, the assumption will be that the spot is below or above the vurface of the sun. Prof. Spoerer informs us that, on the whole, his observations show that the observed distance from the limb of the sun are too great; this he ascribes to the effect of refraction altering the position of the sun's limb to a greater degree than that of the spot.—On the identity of Coggia's Comet of Nov. 10, with Comet 1818 I. by Prof. Weiss. In this paper the author gives the elements of Coggia's comet as lately determined, together with the recorded observations of Comet 1818 I. from which he considers the two comets to be identical.—In a second paper by Prof. Weiss he gives elements calculated on a parabolic orbit and on two elliptic orbits of 55·82 and 6·9775 years respectively, being on the assumption in the first case thai one revolution has happened since 1818, and in the other that eight have taken place.—Observations on variable stars, by G. T. G. Schmidt. From observations up to the end of 1873, given at length in his paper, we extract the epochs of maxima and minima of the following stars:—

		Max.		Min.	
Mira Ceti	about	May 25		Jan. 30·5, 1873, mag. 9·5	
S Scorpii	,,	Sept. 13, mag. 10		—	,,
R Scorpii	,,	Aug. 27, mag. 10·8		—	,,
R Bootis	,,	Sept. 15,	—	—	,,
R Virginis	,,	July 27,	—	May 13	,,
S Coronæ	,,	July 6,	—	—	Period, 363 days.

	Max.	Min.	
R Leonis	May 18	—	
R Leporis	—	Jan. 29	
χ Bygni	Oct. 5	—	Period 404·7 days.
RScuti ...	May 13	June 16	
	July 9	Aug. 21	
	Sept. 20	Oct. 13	
	Nov. 4	—	

Wilhelm Schur gives an opposition ephemeris for Arethusa. The opposition happening Jan. 21, the R. A. being then

8 . 2 . 52.78 and Dec. + 4 . 1 . 54

The fourth line of the spectrum of the nebula in Orion, by D'Arrest. The author refers to a note on this line by Dr. Vogel in Astron. Nach., No. 1963, mentioning the fact that the fourth line of the nebula coincided with Hγ, and goes on to mention that this line was known to Huggins in 1864, and by Capt. Herschell in 1868, and was brought to the notice of the Royal Society in 1872 by Huggins. Its wave-length he gives as 4343. The author also mentions a peculiarity in the spectrum of B. Durchm + 22° 4203.—Mr. J. Birmingham states in a note that he believes that 252 Schjellcrup has disappeared, and he thinks this star a remarkable variable.

Medizinische Jahrbücher: k.k. Gesellsch. d. Aerzte: Vienna, 1873, Heft 3 and 4.—The last two issues of this quarterly journal for 1873 contain the following papers of scientific interest:—Researches into the minute structure of the Tendon, by Arnold Spina, with an illustration; the Nerves of the Knee-joint in the Rabbit, by Dr. C. Nicoladoni (with a figure); contributions to the Anatomy of the Human Bladder, by Dr. Gustav Jurie; Quarantine in Cholera, a report to the International Medical Congress, by Dr. Oser.

SOCIETIES AND ACADEMIES

LONDON

Zoological Society, Jan. 20.—Prof. Newton, F.R.S., vice-president, in the chair.—Mr. Sclater exhibited two skulls of Baird's Tapir (*Tapirus bairdi*) received from Mr. Constantine

Rickards, of Oaxaca, Mexico. The receipt of these specimens proved that this Tapir extended from Panama through Central America into Southern Mexico, and was probably the only species of this genus to be met with in America, north of the Panamanic Isthmus.—Mr. Sclater also exhibited and made remarks on skulls of *Ovis arkar*, from the Altai Mountains, and the stuffed skin of a specimen of the Wild Ibex of Crete.—Mr. E. Ward exhibited two feet of a Fawn, the mother of which had had double hind feet, and had for several years brought forth fawns having the same malformation.—A communication was read from Dr. O. Finsch containing a description of an apparently new species of Parrot from Western Peru, which was proposed to be called *Psittacula andicola*.—A second paper by Dr. Finsch contained the description of a new species of Fruit Pigeon from the Pacific Island of Rapa or Opara. This unique specimen had been sent to the author by Mr. F. W. Hutton, of Otago, New Zealand, after whom it was proposed to name the bird *Ptilonopus huttoni*.—A note was read by Major O. B. C. St. John, on the locality of the Beatrix Antelope (*Oryx beatrix*), which was believed to be the south of Muscat.—Mr. Edward R. Alston read the description of a new Bat of the genus *Pteropus*, which had been sent to him from Samoa for identification by the Rev. S. J. Whitmee. Mr. Alton proposed to call this species *Pteropus whitmeei*.—A communication was read from Mr. A. G. Butler, containing a list of the species of *Fulgora*, with descriptions of three new species in the collection of the British Museum.—A communication was read from Mr. Herbert Druce, containing an account of the Lepidopterous Insects collected by Mr. E. Layard, at Chentaboon and Mahconchaisee, Siam, with descriptions of new species.

Meteorological Society, Jan. 21.—Dr. R. J. Mann, president, in the chair.—The date of the annual meeting having been altered in June last to January, the report of the Council was shorter than usual. The Council have been making efforts to render the operations of the Society more extended. They took advantage of the presence of their foreign secretary, Mr. Scott, as one of the delegates from this country, at the Meteorological Congress at Vienna, to request him to represent the Society. The congress was duly held from September 1st to 16th, when Mr. Scott presented a report on the replies received in answer to a series of questions which the Council issued to the Fellows on several important points in connection with the hours of observation, instruments, &c., and which has been printed in the report of the Congress. The report concluded by stating that the Council have to mark, with some measure of satisfaction, the maintenance of the numbers of the Society during a somewhat critical and transitional period in its history, when changes of detail have been entered upon with a view to increased energy of action, and when the beneficial results of the alterations have not yet had time to be practically felt. The president then delivered his address. After alluding to the loss which the Society had recently sustained in the death of Mr. Beardmore, and marking the place that gentleman had filled as president at the transition era of the Society's history, the president drew attention to a misconception that is largely entertained of the primary aims of meteorological science, and pointed out that desirable as a comprehensive and reliable theory is, the immediate object of observational work is none the less certainly the determination of climate in different regions of the earth, and the investigation of the method by which the action of the great natural forces that determine temperature, direction and force of wind, and rainfall, is influenced by physical conditions. This argument was supported by evidence of the valuable practical results that are secured in these particulars by the labours of meteorologists. The address then proceeded to note briefly the chief landmarks that had marked the yearly progress of meteorological science since the period of Mr. Beardmore's presidency, when the Society, in its remodelled form, had just reached the half-way stage of its history. From this review it appeared that the photographic method of record has been largely extended; that the discussion of the Greenwich observations from 1848 to 1868 is being steadily pursued; that the influence of meteorological conditions upon the public health is carefully investigated in the metropolitan district; that telegraphic intercommunication of meteorological aspects is now regularly made throughout the United States of America; and from the Meteorological Office of London through England, and through France to the shores of the North Sea and Baltic in one direction, and to Corunna in the other; and that storm-warnings are displayed and fishermen's barometers maintained at 129 coast stations. The methodical investigation of the connection of sun-spot periods with atmospheric phenomena, such as rainfall, auroræ, and magnetic storms and earth-currents was also alluded to. Among other topics of special interest connected with the recent progress of meteorological science, the president dwelt with special favour and affection upon the discovery and establishment of Buys Ballot's law and Mr. T. Stevenson's barometric gradient; the extension of the influence which indicates this law to the great vertical circulation of the oceans, traced out by Dr. Carpenter and Prof. Wyville Thomson; the marine charts, and especially the mapping out of the mid-Atlantic area of the Doldrum calms, by Capt. Toynbee; Mr. Meldrum's Mauritius investigations of the movements of the cyclones of the Indian Ocean; the daily weather charts of the Meteorological Office; the deleterious physiological influence of the recent heavy fog in London; Mr. Symond's examination of the rainfall of the British Islands, with a volunteer staff of 1,700 observers systematically distributed; Mr. Draper's deductions as to the invariability of the climate of the United States, and to the orderly progress of storms across the entire breadth of the Atlantic; the establishment and work of International Meteorological conferences; and the barometric compensation of clock-rates for altering pressure and resistance of the atmosphere.—The following gentlemen were elected officers and council for the ensuing year:—President—R. J. Mann, M.D., F.R.A.S. Vice-Presidents—C. Brooke, M.A., F.R.S.; G. Dines; H. S. Eaton, M.A.; Lieut.-Col. A. Strange, F.R.S. Treasurer—H. Perigal, F.R.A.S. Trustees—Sir Antonio Brady, F.G.S.; S. W. Silver, F.R.G.S. Secretaries—G. J. Symons; J. W. Tripe, M.D. Foreign Secretary—Robert H. Scott, F.R.S. Council—Percy Bicknell; A. Brewin, F.R.A.S.; C. O. F. Cator, M.A.; R. Field, B.A., Assoc. Inst. C.E.; F. Gaster; J. K. Laughton, F.R.A.S.; R. J. Lecky, F.R.A.S.; W. C. Nash; Rev. S. J. Perry, F.R.A.S.; Capt. H. Toynbee, F.R.A.S.; C. V. Walker, F.R.S.; E. O. Wildman Whitehouse, Assoc. Inst. C.E.

Entomological Society, Jan. 5.—Prof. Westwood, president, in the chair.—Mr. Meldola exhibited some photographs of minute insects taken with the camera-obscura and microscope.—Mr. McLachlan called attention to a paper in the last part of the "Annales de la Soc. Ent. de France," by M. Bar and Dr. Laboulbène on a species of moth belonging to the *Bombycidæ*, described and figured by M. Bar as *Palustra laboulbenei*, and of very extraordinary habits, the larva being aquatic, living in the canals of the sugar plantations in Cayenne, and feeding upon an aquatic plant. The hairy larva breathed by means of small spiracles, a supply of air being apparently entangled in its hairs.—Mr. Butler remarked that Mr. J. V. Riley, in the *Journal* of the St. Louis Academy of Sciences, had alluded to *Apatura lycaon* Fab. and *A. hyrse* Fab. as distinct species, whereas he believed them to be identical with the *A. alicia* Edwards.—A letter from M. Ernest Olivier stated that he had recently come into possession of a portion of the collection of his grandfather, the celebrated French coleopterist, and that he would be happy to show it to any entomologist who might desire to examine the types.—Mr. Smith communicated a paper on the hymenopterous genus *Xylocopa*; and Mr. D. Sharp a paper on the *Pselaphidæ* and *Scydmænidæ* of Japan, from the collections of Mr. George Lewis.

EDINBURGH

Royal Society, Jan. 19.—Principal Sir Alex. Grant, vice-president, in the chair.—The following communications were read:—Additional remarks on the fossil trees of Craigleith quarry, by Sir Robert Christison, Bart.—On a method of demonstrating the relations of the convolutions of the brain to the surface of the head, by Prof. Turner.—On some peculiarities in the embryogeny of *Tropæolum speciosum*, Endl. and Poepp., and *T. peregrinum*, L., by Prof. Alex. Dickson.—Notes on Mr. Sang's communication of April 7, 1873, on a singular property possessed by the fluid enclosed in crystal cavities. (1) By Prof. Tait; (2) By Prof. Swan.—Preliminary note on the sense of rotation, and the function of the semicircular canals of the internal ear, by Prof. Crum-Brown.

DUBLIN

Royal Zoological Society of Ireland, Jan. 13.—His Excellency, Earl Spencer, president, in the chair.—The report was read by the Rev. Prof. Haughton, M.D., secretary, who referred, among other matters, to the loss by death of an old pelican (*Pelicanus onocrotalus*) "who had been domiciled in the Gardens for forty-two years. He was supposed to have been eight years of age upon his admission, so that he was a bird of over fifty at the time of his death.—Every effort was made to prolong his valuable existence by feeding him on live eels and whisky punch; but old age prevailed, and he died peaceably on the approach of the cold weather. He drank the punch with great relish; in fact he had resided so long in Dublin that it must have come naturally to him, and this and the live eels prolonged his life for at least a fortnight." We are sorry to see the funds of the society are not in a very thriving condition.

VIENNA

I. R. Geological Institute, Nov. 18.—The director, F. v. Hauer, stated that towards the end of the international exhibition he had asked almost all Austrian and a great many of the foreign exhibitors of ores, coals, or other useful minerals, to present these objects to the museum of the Institute. This request was very successful, more than a hundred exhibitors have offered the whole or parts of their expositions to the Institute, and the number of the donators is increasing still every day. Out of the objects obtained in this way will be formed a particular collection of useful minerals from Austria and from abroad, embracing ores, coals, salts, building-stones, all sorts of useful clays, limestones, &c., minerals used for colours, for dung, &c. This collection, which will contain generally specimens of large size, will form quite a new and, as he hopes, very interesting branch of the museum.—Dr. R. v. Drasche: Geological observations on a journey to the west coast of Spitzbergen during the summer of 1873. The journey was made in a schooner chartered especially for the purpose. Dr. Drasche left Tromsöe on June 30, went to the north till Amsterdamö in 79° 45′ N. lat., and returned to Hammerfest on August 27. Many very interesting observations and large collections of rocks and fossils are the fruit of the expedition. Here we will give only a few particulars: On the flat land which forms the eastern part of Danskö and Amsterdamö, Dr. Drasche found very large masses of erratic boulders, which consist partly of certain varieties of granites, syenites, and gneiss, unobserved till now on the shores of Spitzbergen. Probably they are brought down by glaciers out of the interior of the island. The Hekla Hook formation (Nordenskiöld), which is probably Devonian, is formed in the Belsund by black limestones and chloritic slates, which resemble very much the Taunus-slates. The mountain limestone formation is developed in large masses and with many fossils in the Belsund and on the island of Azelö. On Cape Staratschin the mountain limestone alternates with very fine Hyperith. The Triassic formation was accurately studied on Cape Thordsen; it contains here many Ceratites, Nautilus, Halobia, &c., besides which were found the remains of a saurian. The Jurassic and the Tertiary formation are formed by marly beds in the Ice-fiord, and can scarcely be separated from each other whenever they do not contain fossils. On the Goose Island in the Ice-fiord Dr. Drasche found proofs of a very recent levation of the ground. From 8 ft. to 10 ft. above the highest level of the sea the ground is covered with shells of *Mytilus edulis*, which have preserved perfectly well their bluish colour.—M. Niedzwiedzki has examined the microscopical structure of a large number of the eruptive rocks of the Banat which by Prof. Cotta had been united under the name "Banatites." He found that the mineral which mostly prevails is a plagioklastic feldspar out of the Andesin series. He concludes therefore that the rocks from Dognacska, Oravitza, and Csiklova, which hitherto generally had been called Syenites, are rather to be considered as quartz-bearing Diorites. The basalt, which transverses in small veins the "Banatite" from Moldova contains, besides a vitreous ground-mass, only Augite, Olivine, Biatite, and Magnetite, and therefore cannot be united with any one of the great divisions of the basalt rocks.

PHILADELPHIA

Academy of Natural Sciences, Sept. 23.—"Exceptional Conditions in the Vegetation of Forest Seed," by Mr. Thomas Meehan.—Mr. T. Meehan also presented some specimens of a malformed clover, *Trifolium pratense*.—Mr. Gentry made the following remarks regarding the nest of *Vireo solitarius* (Vieil). Audubon, in describing the nest of *Vireo solitarius* (Vieil.) affirms it "is prettily constructed and fixed in a partially pensile manner between two twigs of a low bush, on a branch running horizontally from the main stem, and formed externally of grey lichens, slightly put together, and lined with hair chiefly from the deer and racoon." My experience has been quite different. I have five nests of this species, four of which are perfectly similar in structure; the remaining one formed of the culms of a species of *Aira*, constituting an exceptional case, and the only one that has ever fallen under my notice. They are all shallow, loose in texture, scarcely surviving the season for which they were designed, and placed between two twigs of a cedar or a maple tree at a considerable elevation from the ground, on a branch nearly horizontal to the main axis. They are built entirely of clusters of male flowers of *Quercus palustris*, which, having performed their allotted function, don their brownish hue at the very period when they can be utilised. Here is evidently a change within a moderately short period, rendered necessary by external causes. This necessity may have grown out of inability to procure the favourite materials, or a desire for self-preservation. I am satisfied, however, that the former has not been the leading one, but that self-preservation has operated in this case for individual and family good.

PARIS

Academy of Sciences, Jan. 19. — M. Bertrand in the chair.—The following papers were read:—On the theory of shocks, by M. H. Resal.—Memoir on the temperatures observed by means of electric thermometers, at the Jardin des Plantes, from the surface of the ground to a depth of thirty-six metres during the meteorological year 1873, by M.M. Becquerel and E. Becquerel.—On the formation, in the gaseous state, of the oxides of nitrogen from their elements by means of heat, by M. Berthelot. The paper dealt with the thermal phenomena accompanying these formations.—On the discovery of a deposit of bismuth in France, by M. Ad. Carnot.—On organogenesis compared with androgenesis, &c., by M. Ad. Chatin.—On the geometrical properties of rational fractions, by M. F. Lucas.—On the vibratory movement of an elastic wire fastened to a tuning-fork, by M. E. Gripon.—On the measurement of the magnetic movement in very small magnetised needles, by M. E. Bouty.—On the modes of forming black phosphorus, by M. E. Ritter. The author stated that certain samples of phosphorus refuse to blacken when heated to 70°, while others show that property. The latter contain a trace of arsenic, and to arsenide of phosphorus the author attributed the blackening. He gave analysis of the arsenide which agree with the formula As_2P.—On the existence of two isomeric modifications of anhydrous sodic sulphate, by M. L. C. de Coppet.—On the solubility of succinic acid in water, by M. E. Bourgoin.—On a new cause of spontaneous gangrene accompanied by obliteration of the capillary arteries, by M. L. Tripier.—On the pathological development of the eye in the so-called telescope fish, by M. G. Camuset.—During the meeting, the places of MM. Petit and Valz, in the Astronomical section, were filled up. For the first, Dr. Huggins obtained 38 votes, M. Stéphan 2, and Mr. Newcomb 1; for the second, Mr. Newcomb obtained 46 votes, and M. Stéphan, 1; Messrs. Huggins and Newcomb were accordingly elected.

CONTENTS

PAGE
THE DUTY OF ELECTORS 237
PHYSICAL GEOGRAPHY 238
ANIMAL MECHANICS 239
POLAR EXPLORATION 240
OUR BOOK SHELF 241
LETTERS TO THE EDITOR:—
Prof. Barrett and Sensitive Flames.—Prof. J. Tyndall, LL.D., F.R.S. 241
Remarkable Fossils.—T. W. COWAN 241
Earthquake in Argyllshire.—T. STEVENSON 242
Telegraphing Extraordinary.—R. S. CULLEY 242
Echo at Maidenhead 242
Flight of Birds.—HORACE B. PORTER 242
Vivisection.—Dr. C. M. INGLEBY 242
Instinct of Monkeys 243
VIVISECTION 243
AMERICAN SCIENTIFIC ENTERPRISE 243
TUBES FOR SILENT ELECTRICAL DISCHARGES (*With Illustrations*) . 244
HAECKEL ON INFUSORIA 247
LECTURE EXPERIMENT (*With Illustration*) 247
A SCIENCE LECTURE AT THE CHARTERHOUSE 247
NOTES 248
THE ACOUSTIC TRANSPARENCY AND OPACITY OF THE ATMOSPHERE. Royal Institution, Friday Evening Discourse by PROF. TYNDALL, F.R.S. (*With Illustration*) 251
BIRMINGHAM NATURAL HISTORY AND MICROSCOPICAL SOCIETY . . 253
SCIENTIFIC SERIALS 254
SOCIETIES AND ACADEMIES 255