THURSDAY, JUNE 21, 1883

"THE NEW PRINCIPLES OF NATURAL PHILOSOPHY"

The New Principles of Natural Philosophy. By W. L. Jordan, F.R.G.S. (London: David Bogue, 1883.)

IN the Preface to this large and handsome volume we are told that "The Third Chapter, ... and more especially the first nine Parts of that chapter, are the justification for the title of this work." This sort of intimation is unusual, but timely and useful, as it enables us to go at once to the root of the m tter, and to study "*The New Principles*" in themselves, before we commence the perusal of the formidable array of arguments, examples, and demonstrations which constitutes the bulk of the volume. The chapter referred to is formally dedicated to the memory of Descartes and Newton, "as it shows the connexion between the Cartesian Vortices and the Newtonian Laws (*sic*) of Gravitation."

The peculiar employment of the definite article in the title of the work at once arrests the attention of the reader. New principles in Natural Philosophy, some of them coextensive with our whole knowledge of the subject, have been happily introduced even in comparatively recent times. The Conservation of Energy, and Carnot's principle of Reversibility, are notable examples. But such principles consist of generalisations of our former knowledge, or additions to it, and are in no way subversive of the fundamental Laws of Motion (or *Axiomata*) as they were systematized by Newton.

"*The New Principles*," however, are not of this class. They involve, essentially, somewhat extensive modifications of Newton's Laws, and the consequences we have been accustomed to draw from them. So far as we understand our author, he seems to allow that Newton and his followers have correctly deduced the consequences which follow from the assumption of the Laws of Motion and the principle of Gravitation. But the accordance of the results, so deduced, with observed facts is a remarkable coincidence only :—arising from a compensation of errors, where incorrect ideas as to the laws of motion are rectified (so far as results go) by an omission of some of the more powerful causes which are really at work. Thus the true statement of the First Law of Motion is that a body gradually comes to rest when the motive force ceases to act ; while "Gravitation is merely the act by which the material universe resists, or endeavours to resist, the motive forces acting on it. And, therefore, if matter were not inherently inert there would be no such force as gravitation" (pp. 306-7). It follows, of course, from the new principles that some cause, hitherto not taken into account, is required to explain the persistence of the earth's rotation and of its revolution in its orbit. Of course this cause must suffice for the same results in the case of each planet ; and it must also maintain the rotation of the sun itself. This is found in "Astral Gravitation." How so immensely effective a factor in all the physics of the universe has hitherto been entirely overlooked it is not for us to say. We content ourselves with a humble effort to disseminate "*The New Principle*" as widely as our circulation permits, if not as widely as its intrinsic importance demands. We would merely premise that our author distinctly points out that, after all, Astrology was wrong only because its votaries recognised "personal influences," whatever these may be, and not the gigantic physical forces exerted on us and our surroundings by the stars :—

"Reason also tells us that whatever the apparent magnitude of any given star may be, the greater its actual distance from the earth, the greater is the force which it exerts on the earth ; and therefore the argument that the stars are too far off for their power to be felt, even if it merit the designation of common sense, is absolutely refuted by reason.

"It is not possible in the present state of knowledge to make a reliable (*sic*) estimate regarding the actual force exerted by any star.

"Sir William Herschel assures us that the star Capella has an apparent diameter of 2½ seconds. Its distance as indicated by parallax is 4½ million times greater than that of the sun.

"Accepting these measurements as accurate, and supposing Capella to be of the same density as the sun, the force of gravitation which it exerts on the earth is equal to one hundredth part of that exerted by the sun. If, however, any star of equal apparent magnitude whose distance is so great as not to be indicated by parallax, be as many times more distant than Capella as Capella is more distant than the sun, then the force exerted on the earth by that star, according to the foregoing measurements, would be 45,000 times greater than that exerted by the sun."

"It is argued that none of the stars can have so great an apparent diameter as asserted by Herschel, because Huygens has estimated that the sun gives us 2,000 million times more light than we receive from Capella, and this, supposing the two bodies to be of equal brilliancy, would make Capella much smaller than estimated by Herschel. For a star of the apparent size estimated in this manner to exert as much force on the earth as is exerted by the sun, its distance would have to be 20 million times greater than the actual distance of Capella as indicated by parallax.

"Neither of these estimates can be regarded as better than vague guesses at the real size of the stars ; but when, on the one hand, we consider the evidence which seems to necessitate the existence of some great controlling force of gravitation far distant from our solar system, and, on the other hand, the fact that the laws of optics and of gravitation make it quite possible that some one of the visible stars may actually be exerting a force far more than sufficient for the purpose indicated, reason is almost forced to the conviction that stars of the requisite magnitude do exist in the heavens."

How this, and "The" other "New Principles" account for Trade Winds, Ocean Circulation, Comets, The Zodiacal Light, The Secular Acceleration of the Moon's Motion, &c., must be learned from an attentive perusal of the work itself. The careful reader will have an ample and varied treat ; for mixed with these weighty contributions to science, we have full details of a more strictly human character, such as "Replies to Critics," "Remarks on the Admiralty Current Charts," "A Public Challenge to the Council of the Royal Society," &c. We quote (from p. 365) a few words to show how very serious indeed is the state of matters with our great scientific Society.

"I last year publicly challenged the leaders of the scientific world in London to open discussion ; and, in the second of the public lectures I then gave, I made it clear that the question at issue had ceased to be merely a question of scientific opinion but had become also one of honour. And until the Council of the Royal Society take measures to refute or to atone for (!) the charges I then made, it is evident that courtesy and chivalrous conduct are at a discount in the scientific world, and it is not surprising that the deterioration of the tone of thought should be such as to have at length attracted the attention of the editor of the *Times*."

At p. 486 we have again the old question of the moon's non-rotation about its axis. This latest follower of Mr. Jellinger Symons gives a new and rather amusing argument in support of the heresy. For he says it would require us to suppose that a ship which sails round the world must have turned a complete somersault, while it is quite obvious that she has not done so!! Here we fear we must part company with our amusing instructor; and, though to many it may appear the blackest ingratitude, we must conclude with a hearty wish that Mr. Jordan's work had been published some twenty years sooner. Had it been then given to the world it would, like a fly in amber, have secured immortality in the pages of De Morgan's unique, because inimitable, *Budget of Paradoxes*.

It has many of the distinctive charms of the celebrated works of Mr. James Smith (of Liverpool), Mr. James Reddie, and Baron von Gumpach. All these great men, in their turn, tilted at Philosophers or Scientific Bodies, the Astronomer-Royal, the Royal Society, the British Association, &c., and complained, as Mr. Jordan now does, of the bigotry and malevolence in high places which depreciated the value of the gifts they were bestowing on the world. Some of them were hopelessly illogical and stupid, others merely ignorant. Mr. Jordan appears to belong to the second category. He is evidently untaught, though presumably not unteachable. But he should not attempt to teach. P. G. T.

THE BRITISH MUSEUM CATALOGUE OF BATRACHIA

Catalogue of the Batrachia gradientia s. caudata, and B. apoda in the Collection of the British Museum. Second Edition. By G. A. Boulenger. (London: By Order of the Trustees, 1882.)

THIS volume completes the second edition of the Catalogue of the Batrachians in the British Museum. The former volume, which appeared in the spring of last year, we have already noticed. The first edition (1850) was prepared by Dr. J. E. Gray, and contained descriptions of 72 species; 132 species are described in the present work, the great majority of which have been actually examined by Mr. Boulenger. The number of species of tailed Batrachians in the British Museum collection now amounts to 78 against 38 in 1850. Several of the species which are wanting in the collection are natives of America, and in the interests of science we hope some of the distinguished herpetologists of the New World will generously supply these desiderata. The number of footless Batrachians in the Collection is 19 against 5 in 1850, and in this group also nearly all the species unrepresented in the national collection are natives of America. In addition to very full synopses of the families and subfamilies, of detailed diagnoses of the genera and species with synonyms, we have appended to this volume a summary of the principal facts of the geographical distribution of Batrachians generally, which adds immensely to the value of this catalogue to the general biologist. Of the various primary geographical divisions which have been proposed, Mr. Boulenger finds that that recognised by Dr. Günther for freshwater fishes into Northern Equatorial and Southern Zones, agrees best with the facts deducible from the study of Batrachians, but with one modification, for a Southern Zone does not exist for Batrachians. Tasmania and Patagonia do not differ in any point regarding their frog-fauna from Australia and South America respectively. The following are the principal conclusions:—(1) In the Northern Zone there is an abundance of tailed and an absence of footless forms. A. In the Old World division (Europo-Asiatic or Palæarctic Region) there are numerous Salamandrinæ, with a single exception an absence of Hylidæ, but Discoglossidæ are present. B. In the North American division we find Sirenidæ, few Salamandrinæ, Plethodontinæ, Amblystomatinæ, and Hylidæ numerous, Desmognathinæ. (2) In the Equatorial Southern Zone there is an absence of tailed Batrachians and an equally characteristic presence of footless forms. Dividing (A) the Old World region into Indian and African, we find in both the frogs numerous (260 species out of 300), an absence of Hylidæ and Cystignathidæ, while in the former there are no Aglossæ or Dendrobatidæ, while in the latter there are Dactylethridæ or Dendrobatidæ. Dividing (B) the New World region into Tropical America and Australia, the former is rich in footless forms (21 species), has very many tailless forms, some small families quite peculiar to the region, but above all is it rich in the Arcifera, it has also a few tailed forms; the latter is divided into three subregions: the Australian proper is chiefly remarkable for a negative character, there are no footless or tailed forms, almost no toads or frogs, its fauna consisting mainly of the two families, Cystignathidæ and Hylidæ; the Austro-Malayan subregion presents an interesting blending of Indian and Australian forms, a curious fact is the occurrence, according to Peters, of a third species of the African genus Phrynomantis in Amboyna and Batavia, New Caledonia does not yield a single Batrachian; the third or New Zealand subregion possesses but a single species, *Liopelma hochstetteri*, very curiously a member of the family Discoglossidæ, which is otherwise restricted to the Europo-Asiatic region. The following new species are described for the first time, and there are excellent illustrations of most of them in the plates accompanying this volume: *Hynobius peropus*, China and Japan, *Spelerpes yucatanicus*, Yucatan, *Uræotyphlus africanus*, West Africa, *Hypogeophis guentheri*, Zanzibar, *Dermophis albiceps*, Ecuador, and *Chthonerpeton petersii*, the Upper Amazon.

The keeper of the Department of Zoology in the British Museum may be congratulated on the Batrachian collection having held pace with the progress made in this branch of science during the last thirty years.

OUR BOOK SHELF

The Cinchona Planter's Manual. By T. C. Owen. (Colombo: A. M. and J. Ferguson, 1881.)

FEW plants have been so fortunate or unfortunate in having so much written about them as the *Cinchonas*. Ever since their successful introduction into India, now some twenty years since, the Cinchonas have had showered upon them books and pamphlets innumerable, and where we find such voluminous writings, it would be strange indeed were there not matter of varied quality, and some that could be dispensed with altogether. Mr. Owen's book is very complete in the several branches of Cinchona literature, facts gathered from various authentic sources, such as the works of Dr. King, Dr. Bidie, Mr. McIvor, and the reports of the Indian and Javan Governments, all of which are acknowledged by the author.

The book is divided into six parts, the first part being devoted to the physiology of plants, gathered, as we are told, from Church and Dyer's "How Crops Grow." The second part treats of the alkaloids, the species and varieties, to which a large space is given, and the next part on the choice of land, felling, clearing, weeding, planting, &c. In the fourth part manuring and harvesting are considered; and in parts 5 and 6 the diseases to which Cinchonas are liable, and the estimates of Cinchona planting are digested. In all these matters careful details are given.

The book no doubt will be very useful to Cinchona planters, more particularly the practical part. Its greatest fault, perhaps, is the extent of the book, numbering 203 pages, too voluminous for many planters to wade through; but on the other hand it appeals also to those who, though not actual planters, are interested in the progress of the Cinchona culture.

Kallos, a Treatise on the Scientific Culture of Personal Beauty and the Cure of Ugliness. By a Fellow of the Royal College of Surgeons. (London: Simpkin Marshall and Co., 1883.)

THE author desires his book to be taken seriously. He shows that good looks and manners have a commercial value, since those are more likely to succeed in obtaining the prizes of life who can make favourable first impre sions than those who cannot. The first start greatly depends on patronage, and obscure youths who have won wealth and position have almost always been helped by their good looks, good address, and good voice. These are aids of considerable importance to every candidate, whether it be for a place behind a counter or for the suffrages of a constituency. The author considers from a medical point of view how ill-favoured individuals may palliate their defects. He treats ugliness as a disease, classifying its various forms and indicating such remedies as he can. His classes are coarseness, thinness, obesity, vulgarity, wrinkles, defects of circulation, of complexion, and of the hair. Then he takes the features in detail, eyes, nose, mouth, &c. His recipes are not numerous. We learn incidentally that what is sold as lime juice and glycerine for the hair contains no glycerine at all, and that a very popular dressing is castor oil and rum. This would have harmonised with the toilette of the Syrian beauty of old times, whose "garments smelt of myrrh, aloes, and cassia," a very apothecary-like fragrance. The book does not contain practical advice of much novelty, but its interest chiefly lies in directing attention to much that we already know but are too apt to forget; such as that dissipation, gross feeding, and indolent ways create ugliness of various forms. We know there are bad schools where the boys are slouching, ill complexioned, furtive in expression, and generally ugly, and we also know that there are good schools where, owing to healthy habits and keen and varied interests, the boys are bright, vivacious, and attractive. Similar differences due to different habits of life exist in men; they are pre-eminently shown by the good effect of drill on a plough-boy or street lounger. We may be sure that those who habitually cultivate a healthy mind in a healthy body, and who study how to please, cannot fail to add to the total happiness of the world and to secure for themselves a better chance of succeeding in it than their more negligent rivals.

The Nat Basket. (Printed for the Editress and Publisher, Mrs. Eleanor Mason, at the Albion Press, Rangoon, Burmah.)

WE hope that the subscribers to this extraordinary publication are content to give to it their money and nothing more. It is designed, we are told, to show the natives that there is no contradiction between Scripture and science, but if they believe that what is presented to them in the *Basket* is science they are much to be pitied. Such a medley of misstatements, absurd etymologies, and false astronomy was never before met with out of Bedlam. If this is the stuff that is taught the Burmese by our missionaries, the sooner the latter return home the better.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts, No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

Deductive Biology

IN the few remarks which I communicated to this journal (vol. xxvii. p. 554) under the above heading, I protested against the deductive method used in a purely literary manner as a mischievous way of attacking biological problems. Mr. William White objects that if I am right the deductive method must be excluded altogether "as a false and dangerous element of philosophy." I do not myself see that this necessarily follows. The pith of what I said simply amounts to this—the biological sciences not having reached the deductive stage, it is not possible to enlarge our knowledge in them by mere ratiocination. This is I apprehend no more than is laid down by Mr. Mill himself. Writing of the conditions under which the deductive method is applicable, he expressly says that without one indispensable adjunct "all the results it can give have little other value than that of guesswork" ("System of Logic," 4th ed. vol. i. p. 498). The indispensable adjunct is verification, which requires the substitution of the work-table for the desk. When the former has put the stamp of confirmation on the speculations elaborated at the latter we get a scientific result which commands attention. Without this confirmation I am still of opinion that the deductive result is only "a literary performance." It is worth noting that the able writer whose papers and method I took the liberty of criticising so far admitted the validity of what I said, that he promised to have some experiments made which would go a considerable way towards demolishing or sustaining the results at which he had so far arrived only deductively.

As it would be a rather arduous undertaking to follow Mr. White over all the other ground covered by his letter, I will only refer to one point. He asks whether "comparative embryology" is not "founded entirely upon the method of deductive analogy." I am certainly myself under the impression that it would be difficult to pitch upon any area in science in which the knowledge we possess has been more conspicuously gained by persistent investigation or one in which generalisations have more often crumbled under the pressure of fresh results of observation. It is the section-cutter, and not the desk, which has won the victories in this field. At the present moment two of the most skilled of our younger embryologists (with funds furnished by the Royal Society) are on the point of starting, one for the Cape, to study the embryology of *Peripatus*, the other to make a similar attempt in Australia on the earliest phases of the life-history of *Ornithorynchus* and *Ceratodus*. They would hardly perhaps engage in so laborious a quest if it would answer equally well to stay at home with a ream of paper, and, say—without any disrespect to the eminent author—a copy of the writings of Mr. Herbert Spencer as "a base of fundamental truth" to start from in the analogical deduction of the embryology of these organisms.

W. T. THISELTON DYER

YOUR correspondent, Mr. William White, has not, it seems to me, a correct appreciation of the words "deductive" and "induction," as used in reference to the investigation of the causes of phenomena. The mistake which he makes is a very frequent one, and is due to the ambiguity of the words themselves, and to the inaccessibility of a treatise on modern logic.

The "deductive method," as formulated by John Mill, is one method by which the mental process known as induction—"the operation of discovering and proving general propositions"—is accomplished. An "induction" may be a simple inference from an observation; it must be an inference in which the conclusion is *wider* or *more general* than the premises from which it is drawn. A "deduction" (as the term is commonly used) is a result of ratiocination solely, or, in other words, of a "train of reasoning," by which from a general proposition (not alone, but by combining it with other propositions), we infer a proposition of the *same* degree of generality with itself, or a *less* general proposition. The "deductive method" receives its name from the fact that ratiocination is combined in it with induction.

"In order to discover the cause of any phenomenon by the deductive method, the process must consist of three parts:—(1) Induction; (2) Ratiocination; (3) Verification;" or in common language: (1) A generalisation from observed facts [or a deduction from a previous generalisation]; (2) A deduction from this generalisation [or from an initial deduction]; (3) The testing or verification of the final deduction.

The "hypothetical method" is a special and very usual form of the deductive method in which in place of an induction or primary deduction we have substituted a hypothesis. Under proper safeguards this is the most valuable and fertile method of investigating the causes of complex phenomena. Hypotheses are legitimate or illegitimate. The cause suggested by the hypothesis, if not already known as existing, ought to be capable of being known, and, until the cause suggested is shown to exist, the hypothesis, although verified, constitutes only a plausible conjecture. Further, the hypothesis must be such that no other hypothesis substituted for it would lead to verification.

A hypothesis, as distinguished from a proposition resulting from a complete induction or a correctly formulated deduction, is "a supposition without actual evidence or with evidence avowedly insufficient." The whole value of a hypothesis lies in the final carrying through with it of the deductive method. It must be made the starting-point of deductions, and these must be (one or more) brought to the test of observation or experiment—the final process of verification.

So much by way of preliminary.

The objection which my friend Mr. Thiselton Dyer has made to the essay of Mr. Grant Allen upon the forms of leaves does not, it appears to me, consist in a depreciation of the "deductive method" as Mr. William White is led to believe. Nothing can be further from the real state of the case.

What Mr. Dyer objects to is that the method is *not carried out* by Mr. Allen. Mr. Allen gives us hypotheses—suppositions with insufficient evidence—and deductions from the generalisation of evolution, but he is relatively deficient in "verification." He also fails in the condition insisted on by Mill, who holds that the hypothetical method is valueless (or relatively so) unless it be proved that no other hypothesis than that formulated can be similarly verified. He further, in the case of the supposed exhaustion of the carbonic acid in atmospheric air, appears to fail in another respect indicated by Mill, in so far as he does not demonstrate the actual existence of the cause which he assumes in his hypothesis. His proposition on this head is no more than "a plausible conjecture" at the best, and is not a legitimate conclusion arrived at by the deductive method.

I do not think that there is any ground for discountenancing either a "purely deductive" or a "purely inductive" method in the treatment of biological topics, so long as the method is soundly and thoroughly carried out and its logical results truly and clearly stated. Still less is there any shadow of reason for not fully accepting *the* "deductive method" (so named) as the method of biological research. What we have to deprecate in some modern speculative essays is the tendency to put forward suppositions as though they were propositions which have been demonstrated, and to employ the printing press in launching hypotheses which are neither legitimate inductions nor deductions, and should be kept unpublished until their originator has thoroughly examined them by the accepted "deductive method."

E. RAY LANKESTER

11, Wellington Mansions, North Bank, N.W.

The Peak of Teneriffe *not* very Active again

WITH reference to my notice in NATURE, vol. xxvii. p. 315, stating, on the authority of a native lady in Santa Cruz, that the Peak of Teneriffe was active again, even to the extent of exuding a red-hot lava stream from near its summit, I am informed now from a higher scientific authority, viz. a Cambridge man, and high Wrangler there in his day, but since then resident in Teneriffe, near Puerto Oratava, for fifty years, that that view was exaggerated. I hasten, therefore, to present to your readers exactly what this venerable and experienced man has to say, without altering a word, so far as the extract goes:—

"The facts of the case," says he, "are simply these. On a clear day of south weather, about the latter end of December or the beginning of January last, I happened to be looking at the Peak (as I often do) and observed several distinct and very copious gushes of steam issuing from the summit. In similar weather I had often seen a similar phenomenon, but never to anything like the same extent. I watched these steam gushes several times that day, and very remarkable they were. On going down to Port the following day, I found they had been seen by several people there, who declared that the peak was pouring forth volumes of smoke and flames. The so-called smoke was simply the steam gushes I have mentioned, and what were mistaken for flames I am convinced were nothing but the same steam gushes illumined by the rays of the setting sun. All agreed that after dark nothing was to be seen there, which certainly would not have been the case had there been fire or flames. As for the lava stream, *that* was a pure fiction of an excited brain. I have looked carefully at the Peak through my telescope, and see nothing but the old, black lava streams that I have known for the last fifty years, and I have spoken with one of the guides who has been lately with a party to the summit, and he declares he saw no trace of any eruption, or of anything different from what he has always seen there."

Then follow some other topics to the end of the letter proper; but to that there is appended the following P.S., which may be interesting to intending travellers this summer:—

"Last night (May 27), about an hour and a quarter after midnight, we had a smart shock of an earthquake which woke me out of a sound sleep and rather frightened us all. However, no damage was done, but here people say that eruptions of the volcano are always preceded by earthquakes; so who knows but that our eccentric friend's vision of the three bonfires and the lava stream may come to be verified after all. If the Peak has any intention of erupting again, *I* should be personally obliged to it if it would do so while I am still in the body. It would be a grand sight from our Sitio."

To any of the previously mentioned intending visitors to the island I would beg to recommend that they carry Dr. Marcet's recent neat little book on "Southern and Swiss Health Resorts." His descriptions of Teneriffe, and especially of Guajara on the great crater, and Alta Vista on the high peak, are graphic, and true though terse. Indeed the only point of difference I have with him is his reason for there not being forthwith erected a grand hotel on the elevated Canadas, high above the summer cloud level, in the driest air, strongest sunshine, and most curative conditions for the moist kinds of consumptive disease, which the whole of this planet world has to offer. The reason he gives is, that there is nothing to interest the invalids, or ordinary lady and gentleman travellers up there.

Yet there have long been mineralogy, geology, a peculiar, though scanty, botany, meteorology of a most commanding type, and astronomy under special advantages, inviting all the readers of NATURE to go there and participate in the mental feast; while now the probabilities each morning of witnessing from a distance a little real eruption, will add an exciting topic to the breakfast conversation and the noonday ramble.

C. PIAZZI SMYTH,
Astronomer-Royal for Scotland

15, Royal Terrace, Edinburgh, June 19

"Devil on Two Sticks"

WHY a game at once so graceful and attractive should have received such a christening I do not know, and I am equally at a loss to imagine how an outdoor sport like this, requiring skill and promoting a healthful exercise of the muscles, should have passed out of sight and become almost forgotten. Like Clerk Maxwell, I have played the game many a time some twenty years since, and hasten without further preliminary to describe it.

Imagine two cones joined together at their small ends like an hourglass, and that a solid of such a shape and size is turned out of walnut or cherry or boxwood or of ebony or ivory: this is the devil. Now take the last half-yard from the taper ends of two billiard-sticks, and let them be connected from these ends by a limp silken cord or string half a yard long: these are the sticks.

To play the game hold the thick ends of the sticks one in each hand, bring the cord under the narrow neck of the solid and try to elevate it in the air: it drops directly on the grass. If a brisk rotary motion is given to it however, it will not only remain on the cord, but several dexterous manœuvres may be accomplished with it: the variety of which and the skill displayed in performing them constitute the game. To produce the revolutions the sticks are moved rapidly up and down alternately, and when the spinning is once established, "Diabolus" may be allowed to run up and down the stick, or he may be projected high up in the air, and, still spinning all the while, be caught on the cord again and again in rapid succession. Two may be engaged in the same game. It was fashionable many years since in these parts, and I recollect seeing a picture in a Tunbridge-ware shop in this place of the lords and ladies engaged in playing this game on the Pantiles at Tunbridge Wells more than half a century ago. JOHN GORHAM

Bordyke Lodge, Tunbridge, June 4

[This is a nearly complete answer to our correspondent's query. The behaviour of the "devil" is an excellent example of that property of the axis of greatest or least moment of inertia of a body which is utilised in a well-thrown quoit or an elongated rifle-bullet. The mode of producing the rotation is easy to learn by trial, but not very easy to describe. The sticks are kept moving so that one end of the cord is always at a greater tension than the other.—ED.]

Channel Ballooning

As I have shown in my pamphlet, "Les Grands Ascensions Maritimes," the British Channel is the proper field for trying maritime ascents and determining which are the best means for rendering balloons serviceable on sea as well as on land. I have had several conversations with Lhoste, my aëronautical pupil, on the circumstances of his audacious trip. I will confine myself to the scientific teaching of this expedition.

The cone anchor was lowered by Lhoste when he saw that the *Noëmi* was running after the balloon, and diminished so much the velocity of the run that it was possible to catch him with a rowing boat. But although the wind was rather mild, the balloon inclined so much that the car was plunged into the water, and the waves drenched the occupant. It is evident that in stormy weather the lowering of the cone anchor would lead to the destruction of the balloon by pressure of the wind. To avoid this it is necessary to reserve the cone anchor for ordinary winds, and to use in other circumstances guide-ropes with wooden nuts passed through them in order to increase friction as much as possible.

The balloon went to the great altitude of 15,000 feet through the activity of the sun, which can be resisted very easily by taking some litres of water out of the sea, when nearing it, with a very simple apparatus that Lhoste has invented.

Any balloon attempting to cross the Channel should be bound to take on board half a dozen carrier pigeons to indicate the place where it has anchored, or has been rescued or landed, so that help could be sent to it without any delay. With such easy precautions, and the throwing out of a sufficient number of pilot balloons, the experiments can be conducted on scientific principles, and exert the most useful influence on the study of aërial currents on these seas, where several such currents combine, and where the constitution of the air is so peculiar that mirages of every description have been frequently seen even at the present season.

Lhoste, on the morning of June 9, saw at an altitude of 1200 feet a regular halo, which surrounded the sun. The fog was so heavy that he could not see the sea, except when it was almost ready to send him to a watery grave. The steam whistling from vessels in different seaports, reached him at every altitude; but he did not know what was the cause of the extraordinary noise.

If it had not been for the fog, Lhoste would have succeeded in a scientific sport which will become fashionable, and ultimately lead astronomy to try the air, and to trust to the winds in spite of Shakespeare.

Lhoste's audacity seems to have given rise to a competition in the Mediterranean from Marseilles, but I believe that the Mediterranean must only be tried when the British Channel has been traversed without difficulty in every direction, and that this part of the ocean will play an important part in the development of aërial navigation in the second century of its existence.

Boulogne, June 17 W. DE FONVIELLE

Geology of Cephalonia

CAN any of your readers kindly inform me whether geological investigations were ever made in the island of Cephalonia, one of the Ionian Islands that were under British protection up to the year 1863?

The following are the names of the fossils that I have been able to determine out of those that were given to me and brought last year from Climatzias, Thermanti, and Leacas, localities in the neighbourhood of Mount Cephalos, in the island of Cephalonia:—

Mitra fusiformis, Brocc.
M. Bronni, Mich.
M. Michelotii, Hörnes.
Buccinum costulatum, Brocc.
B. prismaticum, Brocc.
Chenopus pes pelecani, Phil.
Triton Tarbellianum, Grat.
T. corrugatum, Lam.
Murex spinicosta, Bronn.
Murex ——
Murex ——
Fusus mitræformis, Brocc.
F. virgineus, Grat.
F. longirostris, Brocc.
Turbinella subreticulata, d'Orb.
Cerithium ——
Turritella turris, Bast.
Turritella ——
Turritella subangulata, Brocc.
Vermetus intortus, Lam.
Natica millepunctata, Lam.
Natica ——
Dentalium ——
Venus multilamella, Lam.
V. plicata, Gmel.
Chama gryphoides, Linn.
Cardita Jouanneti, Bast.
Pectunculus pilosus, Linn.
Limopsis calabra, Seguenza.

Bucuresti (Roumania), June 2 J. P. LICHERDOPOL

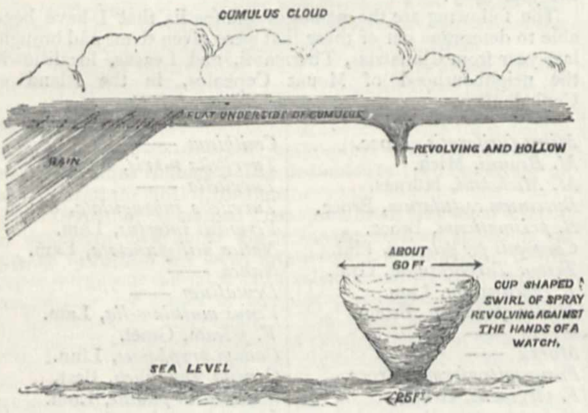
Lightning Phenomenon

WHILE watching the incessant play of vivid lightning during the progress of a thunderstorm which was raging close by in the country towards Novara, Arona being just on the northern limit, my wife observed the following curious spectacle, the account of which she wrote down immediately afterwards:—At 9.35 p.m. on Sunday, June 3, a meteor-like object was seen to pass apparently from south to north (window facing due east), coming from the side of the storm and disappearing behind a mass of cloud which capped the high hill of Monte Val Grande above Lago Varese. It was oblately spheroid in form and apparently about the size of a fire-balloon, and with the velocity of a rocket was travelling slowly, for it left no visible track. It was of a bright, clear, whitish yellow, with a bright, pale green colour showing on the northern side when it passed behind the dark cloud. It was about three times as high above the horizon as the low hills opposite Arona, and traversed an angle of 45° horizontally from the point where first seen to its disappearance. The next day (June 4) when visiting friends at the Villa Frauzosine, near Tutra, we ascertained that this meteor-like body had also been seen by two or three persons who were sitting on a terrace watching the brilliant lightning to the south; they observed it moving also from south to north, disappearing behind the mountains to the northward. W. H. GODWIN-AUSTEN

Waterspout

ON April 28 last the Cunard steamship *Servia*, in making her outward voyage to New York, fell in with several small waterspouts. Being on deck at the time I made a rough sketch and some notes of the occurrence, which I now venture to send you, having learned that many officers of these steamers have sailed the North Atlantic for years without having witnessed any similar phenomenon there. The ship's position may be easily deduced from the fact that her latitude was 42° 24′ and longitude 51° 3′ at noon on the 27th, while these were 41° 42′ and 59° 53′ respectively at noon on the 28th, at 8.30 a.m. of which day we met the waterspouts. There was hardly any wind at the time, and the sky, which had been generally overcast, was rapidly breaking up into masses of cumulus clouds separated by wide spaces of blue. About a dozen waterspouts were seen in all, the ship passing right through one of them and thus enabling me to estimate its diameter by direct comparison with the known beam of the *Servia*.

The swirls of spray rose from the sea in a cup-like shape, and revolving rapidly in a direction opposite to that of the hands of a watch. It was only after such a swirl had become well defined that the lower surface of the cumulus cloud above it began to descend as if to meet it, spinning at the same time. Indeed, so inconspicuous was this feature of the phenomenon that many of the passengers, intent on watching the spray-cups sparkling brightly in the sunshine, failed to notice it at all. In no case did the cloud swirl nearly meet the sea swirl, nor did the double-



funneled stem of whirling mist, so generally shown in books, appear. Some spray fell heavily on deck from the swirl through which the *Servia* passed, but the wind, which struck us at one moment on this, at the other on that, side of the face was not brisk enough to carry off any one's hat. The sight was remarkably beautiful whether closely or distantly viewed. In the one case the spray-cup seemed made of rustling jewels which sparkled in the bright sunshine; in the other, the sea horizon appeared as if here and there set with boiling and steaming caldrons, whose rope-like handles hung from the dark undersides of white billowy clouds. D. PIDGEON

Hartford, Mass., U.S.A., May 22

Meteors of June 3

THE large meteor seen by Mr. Hall and others (NATURE, vol. xxviii. pp. 126, 150) was also observed here by Mr. Paul Mathews and myself. We estimated the length of its path while visible as 120° with the middle part due east, the direction of its motion as parallel to the horizon, elevation as 20°, and length of tail as 25°; its apparent brilliance I put at six times, Mr. Mathews at twice, the greatest brilliance of Venus, and the pieces into which it broke up (about six in number) as equal to the brightest planets. The time I should have put at 10.50, but did not note it (Mr. Mathews 10.40 to 10.45). The colour was golden. This was moreover in a very clear and brilliant sky, as about 10 we had observed that the light in the east was so intense that it cast quite a dark shadow as we passed through a somewhat shady part of the road.

Ripon W. W. TAYLOR

IN the correspondence on the large meteor seen on June 3 I have not seen any notice of another curious meteor seen later on the same night. A flash of light in the sky drew attention to it, and when first seen it was moving in nearly a straight line from 102 Herculis to *a* Aquilæ. In five seconds it travelled slightly more than half the distance to the latter star, and then disappeared without any outburst. It was about a lunar diameter in length, and between 3′ and 4′ wide at the widest part, a point distant one-third of its entire length from the head. In fact it was not at all unlike a comet with a bushy tail tapering off to a point. The colour was a pale yellow. P. F. D.

London, W.

Intelligence in Animals

SOME years since, when calling on the late Hon. Marmaduke Maxwell of Terregles, our conversation happened to turn on the subject of intelligence and instinct of animals. Mr. Maxwell said if I would walk down to the stables with him he would show me a curious instance. On reaching the stable he pointed out an empty stall in which five well grown young rats were running about—a board had been fixed at the end of the stall to prevent the rats getting out. Some time before the cat had a litter of five kittens, *three* were taken from her and drowned; the following morning it was found she had brought in *three* young rats, which she suckled with the two kittens that had been left; a few days afterwards the *two* kittens were destroyed, and the next morning it was found the cat had brought in *two* more young rats. While we were looking at this strange foster family the cat came into the stable, jumped over the board and lay down, when the rats at once ran under her and commenced sucking. What makes the matter the more singular is, the coachman told me the cat was a particularly good ratter, and was kept in the stable for the purpose of keeping down rats.

Cargen, Dumfries P. DUDGEON

AMERICAN ETHNOLOGY[1]

UNDER the able management of Major J. W. Powell the Bureau of Ethnology, recently attached to the Smithsonian Institution, has already done much useful work in the wide field of American anthropology. This first annual report, however, of its proceedings for the year ending July, 1880, appears to be somewhat behind time for, although bearing on the title-page the date of 1881, it was not issued to the public till the beginning of the present year. But the delay is doubtless due to the large amount of preliminary work required to be got through in organising the department, and future reports may be expected to appear more punctually. The title, "Annual Report," is itself somewhat misleading, the actual report of the director really occupying no more than thirty-three introductory pages, and consisting mainly of a digest of the rich materials filling a large quarto volume of over 600 pages. Hence this is, strictly speaking, a first volume of the *Proceedings* or *Transactions* of the Bureau, and as such gives fair promise of a long and useful career in an anthropological domain which may be regarded as practically unlimited.

From the director's introductory remarks we gather that, after the fusion in 1879 of the various geological and geographical surveys in the general "United States Geological Survey," the Bureau of Ethnology was created and attached to the Smithsonian Institution for the purpose of continuing the anthropological work which had hitherto been prosecuted in a somewhat desultory way by those Surveys. The management of this newly-organised department was intrusted to Major Powell, who, as former Director of the Survey of the Rocky Mountain Region, had already shown special aptitude for ethnological investigation. The direct object of the Bureau, we are told, is to systematise anthropological research in America, and this it is proposed to effect both by the prosecution of research through the direct employment of students and specialists, and by the general encouragement and guidance of original observers co-operating throughout the continent. "It has been the effort of the Bureau to prosecute work in the various branches of North American anthropology on a systematic plan, so that every important field should be cultivated, limited only by the amount appropriated by Congress" (xiv.).

How closely this wide programme has been so far adhered to is evident from the varied contents of this

[1] "First Annual Report of the Bureau of Ethnology, Smithsonian Institution, 1879-80." By J. W. Powell, Director. (Washington Government Printing Office, 1881).

sumptuous volume, which comprises sundry contributions by the director on the "Mythology of the North American Indians," on the "Evolution of Language," on "Wyandot Government," and on "Limitations to the Use of some Anthropological Data"; a valuable and profusely illustrated treatise on the "Mortuary Customs of the North American Indians," by H. C. Yarrow; a preliminary attempt to decipher "Central American Picture Writing," by E. S. Holden; a paper by C. C. Royce on "Cessions of Land by Indian Tribes to the United States;" Col. Garrick Mallery's important treatise on "Sign Language among North American Indians," which has already appeared as a "Separat-Abdruck"; a "Catalogue of Linguistic MSS. in the Library of the Bureau of Ethnology," by J. C. Pilling; lastly, "Illustrations of the Method of Recording Indian Languages from the MSS. of Major J. O. Dorsey, A. S. Gatschet, and S. R. Riggs." Should the department continue to be administered on these broad lines and in this enlightened spirit, a school of anthropology must soon be developed in America, with which, without liberal State subvention, our European societies will find it difficult to keep pace. But with our petty rivalries, our heavy public burdens and constantly increasing armaments, the prospect of such State subvention seems at present at least somewhat remote.

The papers contributed by the director to this volume touch briefly on several important topics of a general character, and often express views regarding the origin and evolution of speech, mythologies, religious and tribal institutions, which will scarcely go unchallenged in some quarters. That these psychological phenomena have hitherto been studied from a somewhat too subjective standpoint, and that many metaphysical subtleties have consequently been grafted on the theogonies and early philosophies of savage man may readily be admitted. In a paper on the mythology of the Indian Aryans recently read before the English Folk-Lore Society, Mr. Andrew Lang dwelt on the necessity of distinguishing between the old and comparatively modern hymns in the Vedas. He pointed out that the Vedas themselves do not embody the most primitive theories on the origin of man and the universe, that they contain ideas at once very old and very new, very mythological and very philosophical, and he adduced several instances of crude and childish savage myths overlapping the more profound and advanced concepts of the Aryan Hindus. In the same way Major Powell argues that philosophy passes in its upward evolution through two stages—the mythologic, in which all outward phenomena are interpreted by analogy with subjective experience, and the scientific, in which they are treated as orderly successions of events. The mythologic necessarily precedes the scientific stage, for "without mythology there could be no science, as without childhood there could be no ultimate forms." It follows that the views of primitive men are simple, childish, and incoherent, and that it is illogical to credit his theogonies, as is often done, with profound and abstruse concepts of the universe. Here, as in all other evolutions, the progress is from the simple and homogeneous to the complex and heterogeneous; the "unknown known" of savage philosophy antedates the "known unknown" of later science. In the primitive stage all things are known, that is, supposed to be known; later on some few things are really discovered, and these when properly understood throw doubt on all the rest. The era of the known unknown is thus reached; to crude and offhand explanations succeeds the critical period of investigation and discovery; science is born; civilisation begins. This upward growth is illustrated by many examples, such as that of the rainbow—which for the Shoshoni (Snake Indian) is a beautiful serpent abrading the icy firmament to give us snow and rain; which in the Norse myth is the bridge Bifrost stretching from earth to heaven; which in the *Iliad* becomes the Goddess Iris, Messenger of Olympus; in Genesis a witness to the Covenant; in science an analysis of white light into its constituent colours.

North America, it is aptly remarked, presents a magnificent field for the study of savage and barbaric philosophies from this fresh standpoint. Formerly attention was paid almost exclusively to the more advanced peoples, Aryans, Semites, Hamites, Chinese. Now it is felt that the complex mythologic, religious, linguistic systems of these peoples are the outcome of earlier and simpler phases of thought, consequently that the study of barbarous and savage communities can no longer be neglected. But in North America alone we have our seventy-five ethnical groups speaking seventy-five stock languages and more than five hundred well-marked dialects, each linguistic stock with a philosophy of its own, or rather as many philosophic systems as it has distinct languages and dialects.

To account for this astounding diversity of speech, Major Powell holds with one or two distinguished European philologists that the fundamental languages must have been evolved in independent centres, that in fact "mankind was widely scattered over the earth anterior to the development of articulate speech, and that the languages of which we are cognisant sprang from innumerable centres as each little tribe developed its own language" (p. 28). He fails to see that this view, in itself to the last degree improbable, is wholly unnecessary and even inadequate to explain the actual conditions. It is unnecessary because the present diversity of speech may be sufficiently accounted for by its vast antiquity and extremely evanescent character. Time, acting in combination with the phonetic growth and decay inherent in all speech, must inevitably effect an indefinite amount of specific change, even supposing that all languages started from a single centre. No evolutionist can deny this, for he admits that time combined with a tendency to modification in altered environments, has brought about an indefinite amount of specific and generic change in the biological world. But animals and vegetables are certainly more persistent, *cæteris paribus*, than linguistic types. *Ergo*. The theory is moreover inadequate to explain the actual conditions in America alone. Here we have doubtless a vast number of specifically distinct languages; but the mechanism of all is very much alike; all are cast, as it were, in the same mould; all belong to the polysynthetic or at least to the agglutinating order. But if speech had in America been evolved in many different centres, it may be asked how this striking uniformity is to be explained? Why have we not here, as elsewhere, representatives of the isolating[1] and inflecting, as well as of the polysynthetic order of speech? Does not their common structure point at a common centre of dispersion, while their specific diversity within this common groove is amply explained by time and evanescence?

But if Major Powell does not always reason conclusively, he is a good observer, and describes in vivid language the scenes of savage life of which he has been a spectator, as witness the subjoined account of oral narrative in the Indian community:—

"On winter nights the Indians gather about the campfire, and then the doings of the gods are recounted in many a mythic tale. I have heard the venerable and impassioned orator on the camp-meeting stand rehearse the story of the crucifixion, and have seen the thousands gathered there weep in contemplation of the story of divine suffering, and heard their shouts roll down the forest aisles as they gave vent to their joy at the contemplation of redemption. But the scene was not a whit

[1] The Othomi of the Anahuac tableland has been cited as an instance of an isolating language in America. But M. de Charancey rightly regards Othomi rather as "une langue primitivement incorporante [polysynthetic], qui, parvenue au dernier degré d'usure et de délabrement, a fini par prendre les allures d'un dialecte à juxtaposition [isolation] ("Mélanges de Philologie," &c., p. 80, Paris, 1883).

more dramatic than another I have witnessed in an evergreen forest of the Rocky Mountain region, where a tribe was gathered under the great pines, and the temple of light from the blazing fire was walled by the darkness of midnight, and in the midst of the temple stood the wise old man, telling in simple, savage language the story of *Ta-wäts*, when he conquered the sun and established the seasons and the days. In that pre-Columbian time, before the advent of white men, all the Indian tribes of North America gathered on winter nights by the shores of the seas, where the tides beat in solemn rhythm, by the shores of the great lakes, where the waves dashed against frozen beaches, and by the banks of the rivers flowing ever in solemn mystery—each in its own temple of illumined space—and listened to the story of its own supreme gods, the ancients of time" (p. 40).

A detailed notice of the other more important papers in this volume must be reserved for a future occasion.

A. H. KEANE

THE FISHERIES EXHIBITION

WE are gratified to see the very thorough way in which the management of the Fisheries Exhibition are endeavouring to carry out their plans. It is evident that the scientific aspects of the wide and important subject will have a fair amount of attention; and we are glad to think that in this direction advice has been sought in the right quarter. In the Exhibition itself those interested in the science of the subject will find much to attract them. Last week (p. 156) we gave a list of subjects which have been settled for conferences, and among those who have consented to read papers, we find such names as Professor Huxley on Fish Diseases, Professor Ray Lankester on the Scientific Results of the Exhibition, Professor Brown Goode on the Fisheries of the United States, Professor Hubrecht on Oyster Culture and Fisheries, Sir Henry Thompson on Fish as Food, Dr. F. Day on the Food of Fishes, Mr. R. H. Scott on Storm Warnings. Further, we are glad to see that a series of handbooks has been arranged for on subjects cognate to the Exhibition. Among them are a few by men of scientific standing, and likely to be of real scientific importance; we hope it may not yet be too late to secure the preparation of a few more handbooks or reports of a similar character. Among the handbooks arranged for, six will be published this month, and the remainder in July. Those of special interest to science are, "The Life History of Fishes," by Prof. H. N. Moseley; "Fish Culture" and "Indian Fish and Fishing," by Dr. Francis Day; "Food Fishes," by Mr. G. B. Howes; "Marine and Freshwater Fishes of the British Isles," by Mr. Saville Kent; "Curious Sea Creatures," by Mr. Henry Lee.

The conferences were introduced on Monday by an interesting lecture by Prof. Huxley, a report of which we give below, and this was followed on Tuesday by a carefully prepared paper by the Duke of Edinburgh, on British Fisheries and Fishermen, read by the Prince of Wales. The real interest which the leading members of the Royal family take in the Exhibition has no doubt done much to contribute to its success. It was to be expected that the German Ambassador would show his appreciation of the importance of science to an industry of such magnitude as that of fishing, and he aptly pointed out how important was the didactic and scientific work at last commenced.

With the general concurrence of opinion in high quarters as to the value of the scientific aspects of the Exhibition, and of the great services which science may render in bringing about the practical objects which are aimed at, we of course heartily concur. It is admitted on all hands that the haphazard way in which our fisheries have hitherto been carried on has led to the worst results, the extinction almost of some important fishes and mollusks, the bad condition of others, and the dearness of what might be the cheapest and most plentiful of foods. In recent years science has done something to remedy this state of things, and it will be well for our fisheries, and therefore for the welfare of a large portion of our population, if the Fisheries Exhibition leads to still more being done in this direction. So far the Exhibition has been an immense success; half a million of people have already visited it, and thus the educational results are likely to be widespread.

Prof. Huxley, in opening the proceedings, said:—

It is doubtful whether any branch of industry can lay claim to greater antiquity than that of fishery. The origin would seem to be coeval with the earliest efforts of human ingenuity; for the oldest monuments of antiquity show us the fisherman in full possession of the implements of his calling; and even those tribes of savages who have reached neither the pastoral nor the agricultural stages of civilisation are skilled in the fabrication and in the use of the hook, the fish-spear, and the net. Nor is it easy to exaggerate the influence which the industry thus early practised and brought to a considerable degree of perfection has directly and indirectly exerted upon the destinies of mankind, and especially upon those of the nations of Europe. In our quarter of the globe, at any rate, fishery has been the foster-mother of navigation and commerce, the disseminator of the germs of civilisation. Having glanced at the development of the industries connected with fishing, more especially by the Phœnicians, he continued:—These few remarks must suffice to indicate the wide field of interesting research which fisheries offer to the philosophical historian, and I pass on to speak of the fisheries from the point of view of our present practical interests. The supply of food is, in the long run, the chief of these interests. Every nation has its anxiety on this score, but the question presses most heavily on those who, like ourselves, are constantly and rapidly adding to the population of a limited area, and who require more food than that area can possibly supply. Under these circumstances, it is satisfactory to reflect that the sea which shuts us in at the same time opens up to us supplies of food of almost unlimited extent. In reference to the relation which the fisheries bore to the total supply of food of those who had easy access to the sea, he quoted the following paragraph from the Report of the Fisheries Commissioners, 1866:—"The produce of the sea around our coasts bears a far higher proportion to that of the land than is generally imagined. The most frequented fishing-grounds are much more prolific of food than the same extent of the richest land. Once in a year an acre of good land, carefully tilled, produces a ton of corn or two or three hundredweight of meat or cheese. The same area at the bottom of the sea in the best fishing-grounds yields a greater weight of food to the persevering fisherman every week in the year. Five vessels belonging to the same source in a single night's fishing brought in seventeen tons' weight of fish, an amount of wholesome food equal in weight to that of fifty cattle or 300 sheep. The ground which these vessels covered during the night's fishing could not have exceeded an area of fifty acres." My colleagues and I made this statement a good many years ago. I have recently tried to discover what yield may be expected, not from the best natural fishing-grounds, but from piscicultural operations. At Comacchio, close to the embouchure of the Po in the Adriatic, there is a great shallow lagoon which covers some 70,000 acres, and in which pisciculture has been practised in a very ingenious manner for many centuries. The fish cultivated are eels, gray mullet, atherines, and soles; and, according to the figures given by M. Coste, the average yield for the sixteen years from 1798 to 1813 amounted to 5 cwt. per acre—that is to say, double the weight of cheese or meat which could have been obtained from the same area of good pasture land in the same time. Thus the seas around us are not only important sources of food, but they may be made still more important by the artificial development of their resources. But this Exhibition has brought another possibility within the range of practically interesting questions. A short time ago a visitor to the market might have seen fresh trout from New Zealand lying side by side with fresh salmon from Scandinavia and from the lakes and rivers of North America. Steam and refrigerating apparatus combined have made it possible for us to draw upon the whole world for our supplies of fresh fish. In my boyhood "Newcastle" was the furthest source of the salmon cried about the streets of London, and that was generally pickled. My son, or at any rate my grandson, whenever he goes to buy fish, may be offered his choice between a fresh salmon from Ontario and another from Tasmania. The fishing industry being thus important and thus ancient, it is singular that it can hardly be said to have kept pace with the rapid improvement of almost every other branch of industrial occupation in modern times. If we contrast the progress of fishery with that of agriculture, for example, the comparison is not favourable to fishery. Within the last quarter of a century, or somewhat more, agriculture has been completely revolutionised, partly by scientific investigations into the conditions under which domestic animals and cultivated plants thrive, and partly by the application of mechanical contrivances and of steam as a motive power to agricultural processes. The same causes have produced such changes as have taken place in fishery, but progress has been much slower. It is now somewhat more than twenty years since I was first called upon to interest myself especially in the sea fisheries. And my astonishment was great when I discovered that the practical fisherman, as a rule, knew nothing whatever about fish, except the way to catch them. In answer to questions relating to the habits, the food, and the mode of propagation of fish—points, be it observed, of fundamental importance in any attempt to regulate fishing rationally—I usually met with vague and often absurd guesses in the place of positive knowledge. The Royal Commission, of which I was a member in 1864 and 1865, was issued chiefly on account of the allegation by the line fishermen that the trawlers destroy the spawn of the white fish—cod, haddock, whiting, and the like. But, in point of fact, the spawn which was produced in support of this allegation consisted of all sorts of soft marine organisms except fish. And if the men of practice had then known what the men of science have since discovered, that the eggs of cod, haddock, and plaice float at the top of the sea, they would have spared themselves and their fellow-fishermen, the trawlers, a great deal of unnecessary trouble and irritation. Thanks to the labours of Sars in the Scandinavian seas, of the German Fishery Commission in the Baltic and North Seas, and of the United States Fishery Commission in American waters, we now possess a great deal of accurate information about several of the most important of the food fishes, and the foundations of a scientific knowledge of the fisheries have been laid. But we are still very far behind scientific agriculture, and, as to the application of machinery and of steam to fishery operations, in this country at any rate, a commencement has been made, but hardly more. The relative backwardness of the fishing industry made a great impression on my colleagues and myself in the course of the inquiries of the Royal Commission to which I have referred; and I beg permission to quote some remarks on this subject which are to be found in our Report issued in 1866:—"When we consider the amount of care which has been bestowed on the improvement of agriculture, the national societies which are established for promoting it, and the scientific knowledge and engineering skill which have been enlisted in its aid, it seems strange that the sea fisheries have hitherto attracted so little of the public attention. There are few means of enterprise that present better chances of profit than our sea fisheries, and no object of greater utility could be named than the development of enterprise, skill, and mechanical ingenuity which might be elicited by the periodical exhibitions and publications of an influential society specially devoted to the British fisheries." Taking this Exhibition, the third of its kind, as evidence that the public attention to fisheries for which they hoped had been attained, he remarked that the conference opened that day formed an entirely new feature of such exhibitions, and expressed a hope that there was in them a germ of that which, by due process of evolution, might become a great society, having for its object the welfare and the development of the fisheries of these islands. He presently turned to the question whether fisheries are exhaustible; and, if so, whether anything can be done to prevent their exhaustion. He did not think it possible to give a categorical answer. There were fisheries and fisheries; but he had no doubt that there were some fisheries which were exhaustible. Instancing the salmon rivers, he said it was quite clear that those who would protect the fish must address themselves to man, who was reachable by force of law; and that it not only might be possible, but it was actually practicable, to so regulate the action of man with regard to a salmon river that no such process of extirpation should take place. But if we turned to the great sea fisheries, such as cod and herring fisheries, the case was entirely altered. Those who have watched these fisheries off the Lofoden Isles on the coast of Norway, say that the coming in of the cod in January and February is one of the most wonderful sights in the world; that the cod form what is called a "cod mountain," which may occupy a vertical height of from 20 to 30 fathoms—that is to say, 120 to 130 feet, in the sea; and that these shoals of enormous extent keep on coming in in great numbers from the westward and southward for a period of something like two months. The number of these fish is so prodigious that Prof. Sars, the most admirable authority, from whom I quote these details, tells us that when the fishermen let down their loaded lines, they feel the weight knocking against the bodies of the codfish for a long time before it gets to the bottom. I have made a computation, with the details of which I will not trouble you, which leads to this result, that if you allow the fish each of them four feet in length, and let them be a yard apart, there will be in a square mile of such shoals something like 120 million fish. I believe I am greatly understating the actual number, for I believe the fish lie much closer; but I would beg your attention to the bearing of this underestimate, because I do not know that the Lofoden fishery has ever yielded more than 30 million fish in a good season; and so far as I am aware the whole of the Norwegian fisheries, great as they are, do not yield more than 70 millions. So you will observe that one of these multitudinous shoals would be sufficient to supply all the fisheries of Norway completely, and to leave a large balance behind. And that is not all. These facts about the cod apply also to the herring; for not only Prof. Sars, but all observers who are familiar with the life of the cod when it has attained a considerable size, tell us that the main food of the cod is the herring, so that these 120 million of cod in the square mile have to be fed with herring, and it is easy to see, if you allow them only one herring a day, that the quantity of herring which they will want in the course of a week will be something like 840 million. Now I believe the whole Norwegian herring fishery has never reached the figure of 400 million fish—that is to say, one half the fish which this great shoal of codfish eats in a week would supply the whole of the Norwegian fisheries. On these and other grounds it seemed to him that this class of fisheries—cod, herring, pilchard, mackerel, &c.—might be regarded as inexhaustible. But he should not venture to say this of the whole of the sea fisheries—of the oyster fisheries, for example. Here, again, the operations of man become exceedingly important. Regarding the regulation as to close time for oysters as alone absolutely futile for the purpose of protection, he urged that the more logical provisions of government supervision in Denmark, France, and elsewhere, were impracticable of application beyond the three-mile limit of this country. It was under this conviction that the Commission to which he referred recommended the abolition of all restrictive measures. In conclusion, he pointed out how heavily this question bore on the social condition of the fisherman. Every act of legislation with regard to the fisherman created a new offence. If the common welfare and the common interest, said Prof. Huxley, can be clearly shown to render such regulations desirable or necessary, then of course fishermen must put up with this as they put up with anything else—as we all put up with such restrictions. But supposing that no good case is made out, supposing that regulations of this kind are made on insufficient inquiry and based on insufficient understanding of the circumstances of the case, then I am free to confess that I think those who make such laws deserve very much severer penalties than those who break them.

THE SCIENTIFIC WORK OF THE "VEGA"[1]

THE volume we have before us—the first of a series—contains the results of the scientific observations made during the cruise of the *Vega*, and to say this is obviously to indicate that it contains a rich supply of most valuable information as to that part of the Arctic Ocean which extends along the coasts of Siberia, which appears in the shape of a series of elaborate papers on different departments of natural history of the Arctic regions. Several parts of this volume are already known. Such are the "Reports to Dr. Oscar Dickson" written by Baron Nordenskjöld during the expedition, and read throughout the civilised

[1] "*Vega*-Expeditionens Vetenskapliga Iakttagelser, bearbetade af deltagare i resan och andra forskare, utgifna af A. E. Nordenskjöld." Vol. i. Part 1. (Stockholm, 1882.)

world as soon as they reached Europe; or his paper on the possibility of navigation in the Siberian Arctic Sea; or, again, his paper on auroræ (recently summarised in the pages of NATURE). The well-known "Reports" appear as they were written on board the *Vega*, but with a map "of the northern coast of the old continent, from Norway to Bering Strait," and with several maps of separate islands and bays. The other papers are quite new, and we find in this volume a medical report, by E. Almquist, on the health of the crew; a paper by A. Lindhagen, on the determinations of latitudes and longitudes, which will put an end to the discussions as to the accuracy of the changes made in the map of the northern coast of Siberia by the astronomers of the *Vega;* a paper by H. H. Hildebrandson (in French), on the meteorological work of the expedition, being a comparison of the climate of Pitlekaj (the *Vega's* wintering station) with the climate of other Arctic stations; several papers on the Chukches; an elaborate paper by A. Stuxberg, on the invertebrate fauna of the Siberian Arctic Sea; and a series of papers by F. R. Kjellman, A. N. Lundström, and E. Almquist, on the vegetation of the region visited.

It is known that the expedition of the *Vega* was—as is, however, always the case with so experienced a traveller as Nordenskjöld, and as it was with Parry—one of the most successful Arctic expeditions with regard to the health of the crew. No death was to be regretted, and all the thirty men of the crew reached Naples in the best condition. It is true that at Pitlekai the sun did not disappear for months under the horizon, and that the crew were not worn out by long sledge journeys. But still the climatic conditions were not at all favourable, on account of the variability of the weather and strong winds which blew with a twenty miles' speed even during frosts $-30°$ strong. The precautions taken for maintaining a temperature as equal as possible in the cabins and for eliminating moisture, as well as for much exercise in the fresh air and the maintenance of cheerfulness among the crew, are not to be underrated. A daily distribution of lime-juice and of jam surely had also their importance as preservatives against scurvy, and this the more as the crew of the *Vega* had no opportunities of having supplies of fresh meat during the winter. The daily baking of fresh bread was a very good innovation; as to the preserved meat, the crew very soon had enough of it, and even salted meat was preferred to corned beef; only the finer and more expensive preserved soups and steaks were appreciated throughout the cruise.

The Chukches were of course the subject of anthropological and ethnographical studies, as far as possible. Mr. Nordquist publishes a most valuable Chukch dictionary, and Mr. Almquist communicates interesting observations on colour-blindness among the Chukches, two hundred men and a hundred women having been submitted to experiments in accordance with Prof. Holmgren's hints as to this kind of research with people whose language is unknown ("Om färgblindheten," &c., Upsala, 1877). The supposition of Helmholtz and Young as to the blindness of the lower races with regard to violet rays has not been confirmed as far as the Chukches are concerned; they certainly distinguish it, but they merely call it red. The same is true with regard to pale green and bright blue; they confound both, but the organs for green are not missing with them. Like other lower races, they use much red colour for their skins, yellow being comparatively rarely used for ornaments. It results also from M. Kjellman's paper on the culinary plants of the Chukches, that, contrary to Wrangel's assertion, they do not despise vegetable food. Their provisions of plants for the winter are as large as their provisions of meat and fat. This feature so much distinguishes them from all other inhabitants of the Arctic regions that one is inclined to admit that the time is not far removed from that when they cultivated some better situated plots of soil on the coast of the Arctic Ocean, or were compelled to leave lower latitudes which had a happier climate than that of the north-eastern extremity of Siberia. Their provisions in vegetables are a very strange mixture of various plants, among which the following are the most common:—*Cineraria palustris*, L., *Petasites frigida*, Fr., *Pedicularis sudetica* and *P. lanata*, Willd., *Rhodiola rosea*, L., *Claytonia acutifolia*, Willd., *Halianthus peploides*, Fr., *Polygonum polymorphum*, L., and *Salix boganidensis*, Trautvetter.

The most important papers in this volume are those devoted to the vegetation of the region visited, that is, to the lichens and mosses of the coast, to the algæ of the Siberian Sea, and to the phanerogamic flora of Novaya Zemlya, of the coast region, and of the Asiatic coast of Bering Strait. The lichens are comparatively rare on the coast; whole stretches are quite devoid of them, and the lichen flora is altogether poor as to the number of species. The Calicieæ are represented by but three species, and the whole group of the Sclerolichens only by five or six species, none of them being spread over the whole of the coast. The Stictaceæ are represented by a couple of species of *Nephroma*; the Pannariaceæ by five to six species; *Pyrenopsis* has but one species which is widely spread, but not very common. The character of the flora is nearly the same on the whole of the coast, but towards the south, where the country becomes inhabited, the flora undergoes a notable change. The Phanerogams become also comparatively rich towards the east, in the land of the Chukches, where the grasses appear in the shape of whole sods, without a mixture of moss. The Algæ are few in the Siberian Sea, the whole number of observed species being but twelve, that is, only one-half of the number of species that are known on the Murman coast and in the Sea of Spitzbergen. The characteristic feature of all Arctic Algæ being their large size, the Siberian Algæ seem to be an exception to this rule. The largest of them was a *Laminaria Aghardii*, 210 centimetres long and 37 cm. wide.

The papers by MM. Kjellman and Lundström on the Phanerogams of the explored region will be read with great interest both by the botanist and the geographer. They are not bare enumerations of plants, but elaborate sketches of botanical geography taking into account former botanical work in neighbouring tracts, and describing the flora in its dependence upon local conditions of climate and soil. The coast-flora of Northern Siberia is altogether poor, as it numbers but 150 species of Phanerogams; this number slightly increases, however, towards the east, where it reaches 221, as well as towards the west, 185 species being known from Novaya Zemlya. The Obi—at least as far as the coast region proper is concerned—is not a separation-line between the Arctic European and the Arctic Asiatic floras, as was expected by Hooker. Only the *Salix rotundifolia* and *Wahlbergella affinis* do not appear to the east of the great West Siberian river. Of the 150 species noticed, only one-third are Monocotyledons. This proportion increases, however, at certain places, and there are monocotyledonous species extending over large areas. However poor as to the number of species, the Siberian coast-flora still affords a variety of forms, as it has representatives of 33 different families and 93 different genera. The families which are the most represented in the coast-flora are those of Gramineæ and Cruciferæ, which number respectively 23 and 20 species. They are followed by those of the Compositæ, Saxifragaceæ, Ranunculaceæ, Cyperaceæ, and Caryophyllaceæ (15 to 11 species). The family of Saxifragaceæ is that which maintains the greatest number of species towards the north, eight species out of fourteen having been found even at Cape Chelyuskin; the Caryophyllaceæ nearly keep pace with the former; whilst the family which spreads least towards the north is that of Compositæ which was represented only by two species at the mouth of the Taimyr and none at Cape Chelyuskin. So also with the Cyperaceæ and Ranunculaceæ. *Saxifraga oppositifolia* is not the most widely-spread species on the Siberian northern coast, as is the case for other parts of the Arctic region, other species of Saxifraga being as much or more extensively spread than it. The most usual phanerogamous plants on the coast seem to be the *Luzula arcuata*, var. *hyperborea*, and *Stellaria longipes*.

We shall not analyse the valuable paper by M. Kjellman on the flora of Novaya Zemlya, which is a summary of all that is known on this subject, and we shall notice but a few facts concerning the vegetation of the Siberian coast of Bering Strait. It is represented on M. Kjellman's lists by 221 species belonging to 41 families and 109 genera. The Compositæ, Cyperaceæ, Saxifragaceæ, Caryophyllaceæ, and Gramineæ, numbering from 20 to 15 species each, are here also the richest as to the number of species. But we find on the Asiatic coast of the Bering Strait a good many plants belonging to the American flora, as also to the flora of the Altai and Baikal regions, which are not met with elsewhere on the northern coast. No less than 53 species out of 221 appear only to the east of the Kolyma, which appears thus to be, for the coast-region, a more important boundary line than the Obi. This notable increase cannot be accounted for only by the milder character of this region, but it could be explained, in our opinion, if we took notice of the orography of Eastern Siberia, which favours, by the extension of its chains of mountains from south-west to north-east, the spread of both animals and plants in the same direction.

Dredging was very diligently carried on during the whole of the cruise of the *Vega* in the Arctic Ocean; and Mr. Stuxberg's map of dredgings made during the Swedish expeditions of 1875, 1876, and 1878 to 1879, is dotted with 33 spots in the Kara Sea, and with 90 spots along the Siberian coast to Bering Strait. The temperature of water obviously was found to be very low; even at a few fathoms below the surface it was from $-0.9°$ to $-2.3°$ at a depth of 50 metres, and it had a normal specific gravity of 1.027. The most uniformly spread animals in the Siberian coast-region of the Arctic Ocean, and in the Kara Sea, are undoubtedly the Crustaceans; the Echinoderms are comparatively few, as also are the Mollusca, Bryozoa, and Hydroids. The Crustaceans *Idothea Sabinei*, *Idothea entomon*, *Diastylis Rathkei*, *Atylus carinatus*, and *Acanthostephia Malmgreni*, are the most usual. The first, as known, has been found nearly everywhere in the Arctic Ocean; whilst the second proved to be specific for the whole of the Arctic coast of the old continent, for a stretch of nearly 160 degrees of longitude; it has been found also in the lakes of Sweden and Northern Russia, even in the Caspian and Lake Aral—Lake Baikal being till now the sole explored great lake of this part of the old continent where it has not yet been found. As to the vertical distribution of the animal forms, no distinct regions can be established. It must be observed, however, that the littoral region—about 30 fathoms deep—on account of its ice and sweet water brought by rivers, is nearly quite devoid of animals; even the littoral forms go to take refuge in the sublittoral region. Not only is the Siberian Sea very rich in forms of animals (the number of described Amphipods being as much as 59 out of 114 Amphipods known in all Arctic seas together); it contains also such a number of individuals of certain species, that Mr. Stuxberg describes about 20 real "formations" (*djurformationen*), each consisting of very large quantities of individuals of one given species, with a comparatively small mixture of other species. Such are the *Diastylis Rathkei*, *Reticulipora intricaria*, *Alcyonidium mammillatum*, *Chiridota lævis*, *Echinus dröbachiensis*, *Asterias Lincki*, *Archaster tenuisbinus*, *Ctenodiscus crispatus*, *Ophiacantha bidentata*, *Ophiocten sericeum*, *Ophioglypha nodosa*, *Astrophyton eucnemis*, *Antedon Eschrichti*, *Yoldia arctica*, and *Idothea entomon*, as also Ascidiæ, Actiniæ, and Hydroids. As a whole, the Siberian basin differs very much in its fauna from the other parts of the Arctic basin, and it has no less than 16 species that are characteristic of it. Novaya Zemlya is the limit of the fauna of the Siberian Sea, being a separation-line for many species.

The foregoing notice will give a general idea of the valuable material contained in the first volume of the "*Vega's* Scientific Work," and the manner it is treated. We have but to express the wish to see, as soon as possible, the appearance of the following volumes of this series. They will surely give a new and powerful impulse to the study of Northern Siberia. P. K.

NOTES

WE are glad to learn that Mr. Spottiswoode continues to go on favourably.

STILL another well-deserved honour for Sir Joseph Hooker. The Society of Arts' Albert Medal for "distinguished merit for promoting arts, manufactures, or commerce," has been awarded to him for the present year, for the eminent services which, as a botanist and scientific traveller, and as Director of the National Botanic Department, he has rendered to the arts, manufactures, and commerce by promoting an accurate knowledge of the flora and economic vegetable products of the several colonies and dependencies of the Empire.

AMONG those to whom the Council of the Society of Arts have awarded their silver medals are Mr. Alex. Siemens and Dr. Hopkinson, for their papers on "The Transmission of Power by Electricity," and "The Portrush Railway," and to Capt. Douglas Galton for his paper on "The Economy of Sanitation." Thanks were voted to Mr. W. H. Preece, F.R.S., for his paper on Electrical Exhibitions.

A SPECIAL extra meeting of the Anthropological Institute was held at the Piccadilly Hall on Tuesday, when the Botocudo Indians and a large ethnological collection from Brazil were exhibited by the kindness of Mr. C. Ribeiro, and Prof. A. H. Keane read a paper descriptive of the Botocudos.

MR. MARK H. JUDGE has resigned his position as Secretary and Curator of the Parkes Museum.

M. DE LESSEPS has declared officially at the Academy of Sciences the intention of the Suez Company to open a new canal. During the works the maritime way will be lighted by electricity, and an appeal has been addressed to physicists to present their several systems. The work will begin as soon as possible.

WE have received a favourable report of the National Museum, Bloemfontein, Orange Free State. Considerable collections are being brought together, but the committee should not forget that the chief object of such a museum ought to be to make its collections mainly representative of the interesting country in which it is placed.

DR. KERR of Canton is publishing in Chinese a complete work on the theory and practice of medicine, compiled from European standard works upon that subject. The sections on fevers, and diseases of the stomach, have already been published, while those on affections of the heart and lungs have just been issued. Volumes on the kidneys and nervous system are in the press. The translator has omitted the discussion of all unsettled theories and disputed points. The volumes are printed from wooden blocks, clearly and evenly cut, and are sold at a price which brings them within the reach of all.

MR. J. W. TAYLOR of Leeds, who is the editor of the *Journal of Conchology*, has issued a prospectus for a "Monograph of the Land and Freshwater Mollusca of the British Fauna," and he invites the assistance of conchologists towards his proposed undertaking. According to the prospectus the work will be very comprehensive, and will include the subjects of variation, geographical and local distribution, synonomy and bibliography, "biological aspect and relation to environment." It would be desirable to add distribution in point of time or the palæontological aspect. Mr. Taylor has given specimens of the work in some of the lately published numbers of his *Journal of Conchology*, and they seem to be carefully and almost exhaustively done. We hope the cost of this work will place it within the means of the numerous and comparatively poor conchologists in the north of England, as so many manuals on the subject have already been published at very moderate prices. Great service would likewise be done to natural history by reducing the excessive number of so-called species fabricated during the last twenty years by some Continental conchologists. The judicious remark made by Hooker and Thomson in the introduction to their "Flora Indica" ought always to be borne in mind, viz. that "the discovery of a form uniting two others previously thought distinct, is much more important than that of a totally new species, inasmuch as the correction of an error is a greater boon to science than a step in advance."

THE *Union Médicale* of June 2 announces a discovery of the highest scientific interest, and which, if it turns out to be real, will show that prehistoric man is no longer a myth. On piercing a new gallery in a coal-mine at Bully-Grenay (Pas-de-Calais), a cavern was broken into containing six fossil human bodies intact —a man, two women, and three children—as well as the remains of arms and utensils in petrified wood and stone, and numerous fragments of mammals and fish. A second subterranean cave contained eleven bodies of large dimensions, several animals, and a great number of various objects, together with precious stones. The walls were decorated with designs of combats between men and animals of gigantic size. A third and still larger chamber appeared to be empty, but could not be entered in consequence of the carbonic acid it contained, which is being removed by ventilators. The fossil bodies have been brought up to the surface, and five of them will be exhibited at the *mairie* of Lens; the others are to be sent to Lille in order to undergo examination by the Faculté des Sciences. Representatives of the Académie des Sciences of Paris and of the British Museum having been telegraphed for, are expected to be present.

THE Lords of the Committee of Council on Education have sanctioned the addition of hygiene to the list of sciences in which grants are made by the Department. A syllabus has been prepared, and will shortly be issued to science schools and classes.

FROM the third Annual Report of the Hampstead Naturalists' Club we are glad to see that the society is in a prosperous condition, and is gradually getting together a useful museum.

G. P. PUTNAM'S SONS of New York have published a nicely got up and profusely illustrated Guide to the Yellowstone National Park, by Mr. H. J. Winser, which those proceeding to the States for their holiday would do well to get.

NEXT month Messrs. Williams and Norgate will publish a new work, entitled "The Natural Genesis," in two volumes, by Mr. Gerald Massey, containing the Natural Genesis and Typology of Primitive Customs; Gesture-signs, Ideographs, and Primordial Onomatopœia; Time and Numbers; the Serpent, Dragon, and other Elementaries; the Tree, Cross, and Four Corners; the Great Mother, Twins, Triads, and Trinity; the Mythical Creations; the Fall in Heaven and on Earth; the Deluges and Ark; and Equinoctial Christology.

A WRITER in a recent number of the *North China Herald*, referring to fossils in China, remarks that the Chinese have never advanced a theory to explain their existence. In their books references are made to fossil shells, crabs, fish, trees, &c., but no attempt is made to account for their occurrence in solid rock. The little that is said is mostly of the marvellous sort. Ammonites are petrified snakes; fossil brachiopods (lamp-shells) are called "stone swallows," and are said to come to life and fly from their hiding places at the approach of wind and rain, changing again to stones on the return of fair weather. Fossil fish appear and disappear at pleasure, and their appearance prognosticates a plentiful harvest and prosperous times. One author supposes that the figures of birds, beasts, and plants, which he had seen on certain slabs, must be the work of gods or devils, for no human hand could chisel anything so minute and delicate.

CRACKERS play a large part in the superstitious observances of the ordinary Chinese. It is a popular belief that the evil spirits everywhere inhabiting the air are dispersed by crackling noises, attended by fire and smoke. Accordingly crackers are used on all special occasions to frighten away the demons who are tormenting a sick person, or who crowd around the people at the beginning of the New Year. Bamboo, which when burning emits a crackling sound, is also used for the same purpose.

WE have received the Report of the West Kent Natural History, Microscopical, and Photographic Society for 1882-83. It appears to be more bulky than its predecessors, extending to 68 pp. 8vo. The President (Dr. F. T. Taylor) discourses on Bacteria and Vivisection; Mr. J. Glaisher, F.R.S., gives a very instructive paper on the extraordinary meteorological conditions between October 1881 and May 1882, illustrated by two diagrams indicating the mean daily barometric and thermometric readings, and their departure from the mean, as observed at Blackheath; Mr. J. Jenner Weir, F.L.S., discusses on the types of variation in Lepidoptera, in which is embodied much useful information; Mr. Stone alludes to certain points in the economy of wasps; Mr. Heisch's notes on "Adulteration" are of practical interest. In their next Report this old-established Society may perhaps think it advisable to give a tabular indication of the "contents"; the same remark would apply equally to the publications of other local societies.

UNDER the title of "Lantern Readings" Mr. Lant Carpenter has issued a pamphlet to be used (when necessary) with the first series of the biological lantern slides which we referred to in a recent number. These slides are now ready, and may be obtained from York and Son. The pamphlet and slides are intended to illustrate the results of the voyage of the *Challenger*. There are descriptions of forty-two slides in all, and "preliminary hints" show how the pamphlet is to be used.

THE additions to the Zoological Society's Gardens during the past week include two Malbrouck Monkeys (*Cercopithecus cynosurus* ♂ ♀) from West Africa, presented respectively by Mr. L. Morris and Mr. A. M. Moore; a Macaque Monkey (*Macacus cynomolgus* ♀) from India, presented by Mrs. E. J. H. Sprague; a Rhesus Monkey (*Macacus erythræus* ♂) from India, presented by Mr. C. T. Pollock; a Bonnet Monkey (*Macacus radiatus* ♀) from India, presented by Mr. F. Nelson; two Mauge's Dasyures (*Dasyurus maugæi*) from Australia, presented by Sir Louis S. Jackson, F.Z.S.; two Earl's Weka Rails (*Ocydromus earlii*) from North Island, New Zealand, a Black-backed Porphyrio (*Porphyrio melanotis*) from Australia, presented by Capt. R. Todd; three Common Kingfishers (*Alcedo ispida*), British, presented by the Hon. and Rev. F. G. Dutton; a Common Night Heron (*Nycticorax griseus*), European, presented by Mr. H. H. Blacklock; a King Penguin (*Aptenodytes pennanti*), two Upland

Geese (*Bernicla magellanica* ♂ ♀), two Ruddy-headed Geese (*Bernicla rubidiceps*) from the Falkland Islands, presented by Mr. R. C. Packe; three Common Pheasants (*Phasianus colchicus* ♂ ♀ ♀), British, presented by Mr. H. T. Bowes; an Indian Python (*Python molurus*) from India, presented by Mr. G. E. Shute; a Sykes's Monkey (*Cercopithecus albigularis*), a Philantomba Antelope (*Cephalophus maxwelli* ♀), an Elate Hornbill (*Buceros elatus*), a Jardine's Parrot (*Pæocephalus gulielmi*) from West Africa, an Indian Civet (*Viverricula indica*), two Wandering Tree Pies (*Dendrocitta vagabunda*), from India, a Red-sided Eclectus (*Eclectus polychlorus*) from New Guinea, five Red-bellied Conures (*Conurus vittatus*), a Giant Toad (*Bufo agua*) from Brazil, a Horned Lizard (*Phrynosoma cornutum*) from Texas, four Cornish Choughs (*Fregilus graculus*), British, purchased; a Common Rhea (*Rhea americana*) from South America, received in exchange; two Indian Pythons (*Python molurus*) from India, received on approval; a Japanese Deer (*Cervus sika* ♂), born in the Gardens.

OUR ASTRONOMICAL COLUMN

THE PARIS GENERAL CATALOGUE OF STARS.—In the last Annual Report issued by Admiral Mouchez we find particulars of the progress of formation of this extensive and important catalogue. It is intended to contain all the stars observed at Paris during the forty-five years 1837 to 1881 inclusive, about 40,000, but it is mainly the result of the revision of Lalande's stars in the *Histoire Céleste*; indeed, for several years past, the meridian instruments have been almost wholly occupied upon this work, and upwards of 27,000 observations were made during 1882, the year to which the Report refers. The entire number of observations upon which the Paris General Catalogue will be founded is about 350,000. The positions are referred to three principal epochs; 1845·0 for the years 1837-53, 1860·0 for the years 1854-67, and 1875·0 for the years 1868-82. A specimen of the form in which it is intended to print the catalogue is appended to the Report. The right ascensions and declinations are given for each principal epoch, with the number and mean year of the observations. The precessions are reckoned from the year 1875, with the term depending upon the square of the time. The magnitudes and the differences from the positions of the *Histoire Céleste* are annexed, and where a star has not been observed by Lalande a synonym in some other catalogue is given. In the first column we have the ordinal number, and in the second the star's number in the reduced catalogue of the *Histoire Céleste*. It is mentioned in the Report that M. Bossert had undertaken a new determination of the places of the stars in that work, making use of the reduction-tables of the late Doctor von Asten, which are more exact than the tables of Hansen and Nissen, employed for the catalogue published in 1847. M. Bossert has already effected the reduction of 2,300 stars, a voluntary labour which has occupied his leisure hours. It would add to the value of the columns showing the differences between the new Paris positions and those of Lalande, if the comparisons could be made with places resulting from the application of von Asten's tables, though it might be necessary to supplement M. Bossert's laudable efforts. In the last Greenwich Catalogue (1872) the precessions are given to four places of decimals in right ascension (time), and to three places in north polar distance; the Paris Catalogue gives these quantities with a figure less, which we are inclined to regard as a retrograde step.

This General Catalogue of the Observatory of Paris is to comprise two parts, which will be published simultaneously; the first part forming the catalogue proper, and the second containing details of the observations upon which the mean positions are founded. Each part will be composed of four volumes; the first volume of each is intended to appear during the year 1884.

ENCKE'S COMET IN THE YEARS 1871–1881.—At the sitting of the Paris Academy of Sciences on June 11, M. Tisserand communicated a note by Dr. Backlund, of the Observatory of Pulkowa, relative to the motion of Encke's Comet in the interval 1871–1881. To complete the theory of this comet, it has been necessary to introduce an empirical to the mean motion of the form $\mu'\left(\frac{t}{1200}\right)$. The quantity μ', which was found to be nearly constant during the period 1819–1868, appears to have undergone a considerable variation about the latter epoch. Dr. Backlund bases his calculations upon osculating elements for October 27, 1874, which he considered exact enough for his purpose: they give—

$$\mu = 1079''\cdot33355 + \mu'\tau \left(\text{where } \tau = \frac{t}{1200}\right)$$
$$\mu' = +\ 0\cdot051731$$

After having carefully reviewed the computation of perturbations by Asten, and calculated by two different methods the perturbations during the revolution 1878–1881, Dr. Backlund compared the elements with the observations made in the years 1871, 1875, 1878, and 1881. By means of this comparison, he obtains corrections to the elements, and, observing that if there exists a tangential force, which varies the dimensions of the comet's orbit, its effect is not only secular, but also periodic, the periodic terms being always very small, except in the expression for the mean anomaly. This he takes into account, and finally deduces for the corrections of the two quantities above—

$$\Delta\mu = +\ 0''\cdot004745$$
$$\Delta\mu' = -\ 0\cdot0059867$$

Hence, he says, his investigation proves that the acceleration of the mean motion in the period 1871–1881 was less than half the value found by Encke and Asten for the period 1819–1865. Aten's value is + 0·104418.

CHEMICAL NOTES

INTERESTING experiments on the luminosity of gases are described by W. Siemens in *Ann. Phys. Chim.* [(ii.) 18, 311], and by E. Wiedemann [*ib.* 509]. Gases free from solid particles do not become luminous at high temperatures, nor is the luminosity of a flame due to incandescence of the products of combustion; if the gases are strongly heated before being burnt, the flame becomes hotter and shorter than it is when the preliminary heating is omitted, and the luminous flame is seen to be distinctly separated from the non-luminous products of combustion. Siemens seems inclined to regard the chemical action which proceeds as the cause of luminosity: if the existence of an envelope of ether around the molecules is assumed, then the reaction of one molecule on another may be regarded as starting vibrations in this envelope, which vibrations give rise to heat and light rays. Wiedemann especially considers the luminosity of gases under the influence of electric discharges: he thinks that in the process of charging the electrodes the ethereal envelopes of some of the gas molecules are distorted; when discharge occurs these envelopes are set into motion, and hence the luminous effects.

SOME time ago Ostwald deduced the relative affinities of various acids in terms of nitric acid taken as 100; by relative affinity is meant the proportion in which two acids divide themselves between one base, all the reacting substances being in solution. Ostwald has recently investigated this subject by a method different from that formerly employed; he has studied the rates of action of various acids on acetamide, and from the results he has deduced the relative velocities of action, and hence the relative affinities. The following table contains the results. In column II. are placed figures representing the results of his former experiments—

	I.	II.
Hydrochloric acid ...	100 ...	98·0
Nitric ,, ...	98 ...	100
Hydrobromic ,, ...	98 ...	95
Trichloracetic ,, ...	80 ...	80
Dichloracetic ,, ...	40·8 ...	33
Monochloracetic ,, ...	13·0 ...	7
Formic ,, ...	5·2 ...	3·9
Lactic ,, ...	5·2 ...	3·3
Acetic ,, ...	2·3 ...	1·2
Sulphuric ,, ...	65·4 ...	66·7
Oxalic ,, ...	22·6 ...	—
Tartaric ,, ...	7·5 ...	5·2
Malic ,, ...	4·7 ...	2·9
Succinic ,, ..	2·5 ...	1·5
Citric ,, ...	4·0 ...	—
Phosphoric ,, ...	3·6 ...	—
Arsenic ,, ...	3·5 ...	—

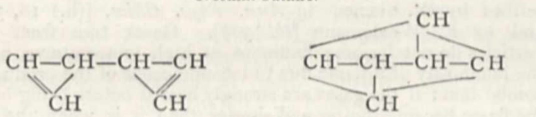
M. SPRING continues his researches into the influence of great pressure upon chemical reactions: at a pressure of about

6500 atmospheres he finds that sulphur combines with magnesium, zinc, iron, cadmium, bismuth, lead, copper, silver, tin, and antimony. Sulphur and phosphorus do not combine when compressed together (*Berichte*, xvi. 999).

BENZENE is perhaps the most important body in the whole range of chemistry, not on account of any intrinsic interest in the substance itself, but because of the immense number of its derivatives. The constitution of these derivatives must depend upon the structure of the benzene molecule itself, and this problem is therefore one of the most interesting that presents itself to the chemist. Any idea that can throw light upon this subject is worthy of attention, and the more so as long as the least doubt exists as to whether benzene can yield more than three di, tri, or tetra derivatives, or more than one mono or penta derivative, the substituting groups being the same. Again, it is possible that benzene may exist in two or more isomeric modifications (disregarding dipropargyl), and the difference found by V. Meyer (*Ber.* xv. 2893) between two samples of benzene, both presumably pure, would seem to point in this direction. The mere fact, therefore, that one formula is good and useful is no condemnation of any other formula that may be proposed. M. Mendeléeff has suggested that benzene may be regarded as a normal butane, in which six hydrogen atoms are replaced by two triad groups, CH. If we allow that benzene is best represented as containing six CH groups, and there seems as yet no reason for departing from this supposition, then this replacement may take place in two ways, as shown by the following formulæ:—

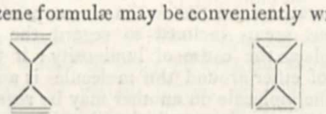
$$CH_3—CH_2—CH_2—CH_3$$

Normal butane.



Benzenes derived therefrom.

These two benzene formulæ may be conveniently written thus:—



and these expressions show at a glance the difference between them. The second is identical with Ladenburg's prism formula, the advantages of which do not need recounting. The first, so far as double and single linkings are concerned, is intermediate between the prism formula and Kekulé's. It lends itself in a particularly ready way to the expression of more complex formulæ, as of naphthaline, &c., but does not show the hexad nature of the benzene molecule. Moreover, it shows possible two mono or penta derivatives, and five each di, tri, and tetra derivatives, a capability that is not yet needed; and a formula should be a concise expression of facts, and should as far as possible show the limits of those facts. Thus, however valuable the suggestion of M. Mendeléeff may be as showing a possible method of synthesising benzene, it does not appear to be practically useful as indicating its constitution, though the future chemistry of benzene may require such a formula as the one referred to above.

PROF. MENDELÉEFF, to avoid the superheating which takes place during ordinary fractional distillation with a dephlegmator tube, has devised a modified method for the oils from Baku petroleums boiling between 15° and 150°, which consists in passing the vapours from the distilling flask by means of the dephlegmator, or delivery tube, to the bottom of a second similar flask, and from this to a third, and so on; the heated vapours from the one providing the necessary heat for the distillation of the next, &c. In this manner a great number of fractions at intervals of two degrees were obtained. By comparing boiling points and specific gravities of products the author concludes that Baku oils contain similar hydrocarbons to American petroleum, and in addition a hydrocarbon boiling at 55° and same specific gravity as hexan with the properties of an unsaturated compound. The great bulk of the Caspian petroleums appears to consist, in addition to derivatives of marsh gas, of C_nH_{2n} hydrocarbons, and also some members of the C_nH_n or acetylene series.

SOME interesting results have been obtained by Spring (*Ber. Ber.*) by washing precipitated sulphide of copper for several weeks until all traces of salts were removed. It was then found that the sulphide dissolved to a black liquid, with slight green fluorescence, in water. The solution might be boiled and evaporated without change; slight traces of salts caused precipitation. The author has also obtained sulphide of tin and oxides of antimony and manganese in a condition perfectly soluble in water. Sulphide of tin on evaporation of its solution in vacuo forms a transparent red glass.

GEOGRAPHICAL NOTES

ON June 6 Baron Nordenskjöld's Greenland expedition arrived at Reykjavik in the steamer *Sophia*. The *Sophia* lay at Reykjavik for a few days, and in the meantime Baron Nordenskjöld and the geologists of the party examined the coal deposits which occur in Bergarfiord. Dr. Arpi, a Swedish philologist, who has resided some time in Iceland and acquired a thorough knowledge of the language, accompanied the expedition thither, and will, along with two other men of science, remain in Iceland after the *Sophia* has left.

WE learn from *Science* that a party for the relief of the observers under Lieut. Greely at Lady Franklin Bay was to leave St. John's, Newfoundland, on one of the steam sealing-vessels belonging to that port, about June 15, probably accompanied by a naval vessel as tender. It will be commanded by Lieut. E. A. Garlington, U.S.A., and composed of twelve men, of whom ten are stated to be old sailors and accustomed to the use of boats. Twenty dogs, native drivers, and a supply of fur clothing, have been secured at Godhavn, Greenland. The party at Lady Franklin Bay will be reached and withdrawn if the state of the ice permits. If not, the relief party is to be landed on Littleton Island, and while part of them are engaged in preparing winter quarters, Lieut. Garlington will endeavour to open communication by sledges with Greely's people. In the failure of the first attempt, another will be made in the spring of 1884. It is to be hoped, if Greely is not reached, that an attempt will be made to leave at Cape Hawkes or Cape Sabine, if not the relief party as a whole, which would be best, at least a boat by which the open water to be anticipated between those points and Littleton Island next year (1884) may be passed by a retreating party, which might well find their own boat unseaworthy after dragging it over many miles of hummocky ice, if, indeed, they did not find themselves obliged to abandon it. Further, the schooner *Leo* is on the point of sailing for Point Barrow to withdraw the signal-service observing party under Lieut. Ray, in compliance with the act passed by the last Congress. To utilise the opportunity, Mr. Marr, of the U.S. Coast-Survey, will accompany the vessel with the design of making absolute magnetic determinations, of fixing the astronomical position of the station, and of making pendulum observations.

IN a communication from the Russian Geographical Society we are informed that Col. Prejevalsky is about to start on his fourth journey to Central Asia, accompanied by two officers and seventeen men. The Emperor has granted to the Society 43,000 roubles for the purpose of Col. Prejevalsky's journey. The Society is also sending out a new expedition under M. Potanin, who is now completing the publication of the two last volumes on his journey of 1879–80. He will start in July for South-East Mongolia and the adjacent parts of China; he will be accompanied by a naturalist and M. Skassi, the companion of Severtzov in his exploration of the Pamir. The funds are being supplied partly by the Society and partly by M. Sookachef, a Siberian merchant.

IN the same communication we are informed that the average temperature of January and February at the Russian Polar station at Sagastyr, on the mouth of the Lena, was about –50° C. Thanks to the Governor-General of Eastern Siberia there has been organised a special postal service between Jakutsk and Sagastyr once a month. The observing party will most probably remain at the station up to the end of October, *i.e.* until the river is frozen.

THE last number of the *Zeitschrift der Gesellschaft fur Erdkunde zu Berlin* (Bd. 18, Heft 2) contains a paper by Herr van Langegg, entitled "Nara eine alte Kaiserstadt," describing the town of Nara, not far from Kioto, in Japan, at one time the capital of the country, and still much renowned for its temples. The celebrated colossal statue of Buddha there is fully described. The following figures give some notion of its dimensions:—Its weight is 500,000 kilog.; 3,000,000 kilog. of wood were consumed in making the bronze, which consists of 250 kilog. of gold, 8413·5 of tin, 977 of mercury, and 493 of copper. The present image only dates from 1801.

WE have received a German pamphlet by Herr Max Buch, on "Finland and its Nationality Question," being a reprint of papers which have appeared in recent issues of the *Ausland*. In the limited space of seventy-four pages the author gives a short but correct description of Finland, of the prehistoric Finns, according to Ahlquist's researches, of the history of the country, and of the present state of the "national question." He summarises the excellent researches by Retzius on the race-characters of the Finns—as far as can be done in a few pages—and dwells upon the recent efforts of Finnish writers towards the development of the Finnish language and literature as a reaction against the former supremacy of the Swedish language and influence. We notice the interesting fact that although only 7·5 per cent. of the Finns can now read and write, and 70 per cent. read, primary instruction has taken during the last few years a great extension. The number of State schools being too limited, they are supplemented by private instruction. Thus, of the 342,836 children from seven to sixteen years old of the Lutheran Finnish population, only 6983 had not received primary instruction in 1877 (1801 of them on account of disease). But only 26,900 went to the State schools, whilst 116,201 children received primary instruction in private ambulatory schools, and 177,925 at home.

THE last number of the *Izvestia* of the Russian Geographical Society contains several interesting papers. M. Veselago gives a sketch of the life and work of the late Count Lütke. Prof. Fr. Schmidt discusses again the claim of Wrangel to the discovery of the land situated north of the Cape Yakan. He tries to prove, against Nordenskjöld, that Wrangel was right in denying the existence of a land which Andréeff said he saw from the fifth island of the Medvyejiy Archipelago; but he did not deny the existence of a land situated north of Cape Yakan. Prof. Schmidt admits, however, that even with regard to this land, Wrangel wrote "in different parts of his report with a varying degree of certainty as to the probability of its existence." M. Karzin, an official of the Verkhoyansk district, having been struck with the terrible fate of De Long, publishes a most valuable list of all settlements and places where human beings can be met with at different seasons on the coast of North-Eastern Siberia. M. Andréeff publishes a brief account of his hydrographical researches in the White Sea and on the Murman coast during the last three years. The flora of the coast becomes very poor north of Archangel. At the Svyatoy Noss lighthouse it consists only of lichens, mosses, and creeping brushes of *Betula nana*. It improves, however, west of Kildin and especially west of the Ribachiy peninsula, offering excellent forests and meadows at the new colony at Pechenga. The yearly average temperature, which is but $-0°·6$ Celsius at Archangel, and $-2°·4$ at the Svyatoy Noss lighthouse, reaches $-1°·1$ at Kola, and $+1°·4$ at Vardö. This increase of temperature is due, as is known, to the warm current which flows along the coast. Thus, at Svyatoy Noss, during the hottest days, the temperature of water does not exceed 6°·9; and during the autumn it reaches but 1°·9. To the west of 30° 6′ it suddenly becomes double that. In the spring the warm streamlets reach 4°·3, whilst the cold ones, flowing close by, reach but 1°·9; and during the summer the warm streamlets reach 12°·5, whilst the cold ones, close by, reach 6°·9 to 7°·5. It appears thus that one isolated measurement of temperature of water is of little value, the warm current being not so compact along the Murman coast as elsewhere. Under 33° 6′ E. long. it leaves the coast and flows towards the north-north-east. The positions taken by the warm current at the Murman coast vary with the seasons, and depend upon the prevailing winds. From April to August it touches the coast, but later on it is driven north by the southern winds; in October it already flows off Vardö. Its position varies also for different years, depending upon the prevailing winds. The richness of the fishing depends entirely upon the position taken by the warm current. In 1881, the Norwegians, owing to the current flowing in their waters, had the richest prey, whilst in 1882, the richest prey for a twenty years' series was given by the warm current to the Russian fishers. The same number of the *Izvestia* contains the first sheets of M. Polakoff's reports on his researches in Sakhalin, and M. Mezhoff's bibliographical index of the Russian geographical literature for the year 1880.

M. THOUAR, the French traveller, has written a letter from Chili, in which he says that several members of the exploring party under Dr. Jules Crevaux, who was massacred with most of his followers in the early part of last year by Indians while making explorations along the Bolivian part of the Pilcomayo, are believed to be still alive, but prisoners in the hands of the Indians.

THE CAUSE OF EVIDENT MAGNETISM IN IRON, STEEL, AND OTHER MAGNETIC METALS[1]

Neutrality

THE apparatus needed for researches upon evident external polarity requires no very great skill or thought, but simply an apparatus to measure correctly the force of the evident repulsion or attraction; in the case of neutrality, however, the external polarity disappears, and we consequently require special apparatus, together with the utmost care and reflection in its use.

From numerous researches previously made by means of the induction balance, the results of which I have already published, I felt convinced that in investigating the cause of magnetism and neutrality I should have in it the aid of the most powerful instrument of research ever brought to bear upon the molecular construction of iron, as indeed of all metals. It neglects all forces which do not produce a change in the molecular structure, and enables us to penetrate at once to the interior of a magnet or piece of iron, observing only its peculiar structure and the change which takes place during magnetisation or apparent neutrality.

The induction balance is affected by three distinct arrangements of molecular structure in iron and steel, by means of which we have apparent external neutrality.

Fig. 1 shows several polar directions of the molecules as indicated by the arrows. Poisson assumed, as a necessity of his theory, that a molecule is spherical, but Dr. Joule's experimental proof of the elongation of iron by 1/720,000th of its length when magnetised, proves at least that its form is not spherical; and as I am unable at present to demonstrate my own views as to its exact form, I have simply indicated its polar direction by arrows—the dotted oval lines merely indicating its limits of free elastic rotation.

In Fig. 1, at A, we have neutrality by the mutual attraction of each pair of molecules, being the shortest path in which they could satisfy their mutual attractions. At B we have the case of superposed magnetism of equal external value, rendering the wire or rod apparently neutral, although a lower series of molecules are rotated in the opposite direction to the upper series, giving to the rod opposite and equal polarities. At C we have the molecules arranged in a circular chain around the axis of a wire or rod through which an electric current has passed. At D we have the evident polarity induced by the earth's directive influence when a soft iron rod is held in the magnetic meridian. At E we have a longitudinal neutrality produced in the same rod when placed magnetic west, the polarity in the latter case being transversal.

In all these cases we have a perfectly symmetrical arrangement, and I have not yet found a single case in well-annealed soft iron in which I could detect a heterogeneous arrangement, as supposed by Ampère, De la Rive, Weber, Wiedermann, and Maxwell.

We can only study neutrality with perfectly soft Swedish iron. Hard iron and steel retain previous magnetisations, and an apparent external neutrality would in most cases be the superposition of one magnetism upon another of equal external force in the opposite direction, as shown in B, Fig. 1. Perfectly soft iron we can easily free, by vibrations, from the slightest trace of previous magnetism, and study the neutrality produced under varying conditions.

If we take a flat bar of soft iron, of 30 or more centimetres in length, and hold it vertically (giving while thus held a few torsions, vibrations, or, better still, a few slight blows with a wooden mallet, in order to allow its molecules to rotate with perfect freedom), we find its lower end to be of strong north polarity, and its upper end south. On reversing the rod and repeating the vibrations, we find that its lower end has pre-

[1] Paper read before the Society of Telegraph Engineers and of Electricians, on May 24, 1883, by Prof. D. E. Hughes, F.R.S., Vice-President Continued from p. 162.

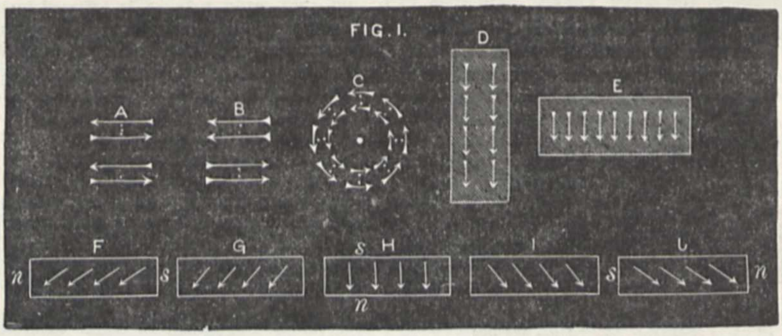
cisely a similar north polarity. Thus the iron is homogeneous, and its polarity symmetrical. If we now magnetise this rod to produce a strong south pole at its lower portion, we can gradually reverse this polarity, by the influence of earth's magnetism, by slightly tapping the upper extremity with a small wooden mallet. If we observe this rod by means of a direction needle at all parts, and successively during its gradual passage from one polarity to the other, there will be no sudden break into a haphazard arrangement, but a gradual and perfectly symmetrical rotation from one direction to that of the opposite polarity.

If this rod is placed east and west, having first, say, a north polarity to the right, we can gradually discharge or rotate the molecules to zero, and as gradually reverse the polarity by simply inclining the rod so as to be slightly influenced by earth's magnetism; and at no portion of this passage from one polarity to neutrality, and to that of the opposite name, will there be found a break of continuity of rotation or haphazard arrangement. If we rotate this rod slowly, horizontally or vertically, taking observations at each few degrees of rotation of an entire revolution, we find still the same gradual symmetrical change of polarity, and that its symmetry is as complete at neutrality as in evident polarity.

In all these cases there is no complete neutrality, the longitudinal polarity simply becoming transversal when the rod is east and west. F, G, H, I, J, Fig. 1, show this gradual change, H being neutral longitudinally, but polarised transversely. If, in place of the rod, we take a small square soft iron plate and allow its molecules freedom under the sole influence of the earth's magnetism, then we invariably find the polarity in the direction of the magnetic dip, no matter in what position it be held, and a sphere of soft iron could only be polarised in a similar direction. Thus we can never obtain complete external neutrality whilst the molecules have freedom and do not form an internal closed circle of mutual attractions; and whatever theory we may adopt as to the cause of polarity in the molecule, such as Coulomb's, Poisson's, Ampère's, or Weber's, there can exist no haphazard arrangement in perfectly soft iron, as long as it is free from all external causes except the influence of the earth; consequently these theories are wrong in one of their most essential parts.

We can, however, produce a closed circle of mutual attraction in iron and steel, producing complete neutrality as long as the structure is not destroyed by some stronger external directing influence.

Oersted discovered that an external magnetic needle places itself perpendicular to an electric current; and we should expect that, if the molecules of an iron wire possessed inherent polarity and could rotate, a similar effect would take place in the interior of the wire to that observed by Oersted. Wiedermann first remarked this effect, and it has been known as circular magnetism. This circle, however, consists really in each molecule having placed itself perpendicular to the current, simply obeying Oersted's law, and thus forming a complete circle in which the mutual attractions of the molecules forming that circle are satisfied, as shown at C, Fig. 1. This wire becomes completely neutral, any previous symmetrical arrangement of polarity rotating to form its complete circle of attractions; and we can thus form in hard iron and steel a neutrality extremely difficult to break up or destroy. We have evident proof that this



neutrality consists of a closed chain, or circle, as by torsion we can partially deflect them on either side; thus, from a perfect externally neutral wire, producing either polarity, by simple mechanical angular displacement of the molecules, as by right- or left-handed torsion.

If we magnetise a wire placed east and west, it will retain this polarity until freed by vibrations, as already remarked. If we pass an electric current through this magnetised wire, we can notice the gradual rotation of the molecules, and the formation of the circular neutrality. If we commence with a weak current, gradually increasing its strength, we can rotate them as slowly as may be desired. There is no sudden break or haphazard moment of neutrality: the movements to perfect zero are accomplished with perfect symmetry throughout.

We can produce a more perfect and shorter circle of attractions by the superposition of magnetism, as at B, Fig. 1. If we magnetise a piece of steel or iron in a given direction with a strong magnetic directing power, the magnetism penetrates to a certain depth. If we slightly diminish the magnetising power, and magnetise the rod in a contrary direction, we may reduce it to zero by the superposition of an exterior magnetism upon one of a contrary name existing at a greater depth; and if we continue this operation, gradually diminishing the force at each reversal, we can easily superpose ten or more distinct symmetrical arrangements, and as their mutual attractions are satisfied in a shorter circle than that produced by electricity, it is extremely difficult to destroy this formation when once produced.

The induction balance affords also some reasons for believing that the molecules not only form a closed circle of attractions, as at B, but that they can mutually react upon each other, so as to close a circle of attractions as a double molecule, as shown at A. The experimental evidence, however, is not sufficient to dwell on this point, as the neutrality obtained by superposition is somewhat similar in its external effects.

We can produce a perfectly symmetrical closed circle of attractions of the nature of the neutrality of C, Fig. 1, by forming a steel wire into a closed circle, 10 centimetres in diameter, if this wire is well joined at its extremities by twisting and soldering. We can then magnetise this ring by slowly revolving it at the extremity of one pole of a strong permanent magnet; and, to avoid consequent poles at the part last touching the magnet, we should have a graduating wedge of wood, so that whilst revolving, it may be gradually removed to greater distance. This wire will then contain no consequent points or external magnetism: it will be found perfectly neutral in all parts of its closed circle. Its neutrality is similar to C, Fig. 1; for if we cut this wire at any point we find extremely strong magnetic polarity, being magnetised by this method to saturation, and having retained (which it will indefinitely) its circle of attractions complete.

I have already shown that soft iron, when its molecules are allowed perfect freedom by vibration, invariably takes the polarity of the external directing influence, such as that of the earth, and it does so even with greater freedom under the influence of heat. Manufacturers of electromagnets for telegraphic instruments are very careful to choose the softest iron and thoroughly anneal it; but very few recognise the importance as regards the position of the iron whilst annealing it under the earth's directing influence. The fact, however, has long since been observed.

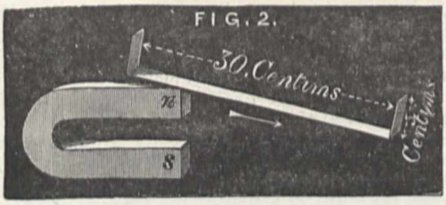
Dr. Hooke (1684) remarked that steel or iron was magnetised when heated to redness and placed in the magnetic meridian. I have slightly varied this experiment by heating to redness three similar steel bars, two of which had been previously magnetised to saturation, and placed separately with contrary polarity as regards each other, the third being neutral. Upon cooling, these three bars were found to have identical and similar polarity. Thus the molecules of this most rigid material, cast steel, had become free at red heat, and rotated under the earth's magnetic influence, giving exactly the same force on each; consequently the previous magnetisation of two of these bars had neither augmented nor weakened the inherent polarity of their molecules. Soft iron gave under these conditions by far the greatest force, its inherent polarity being greater than that of steel.

I have made numerous other experiments bearing upon the question of neutrality, but they all confirm those I have cited, which I consider afford ample evidence of the symmetrical arrangement of neutrality.

Superposed Magnetism.—Knowing that by torsion we can rotate or diminish magnetism, I was anxious to obtain by its means a complete rotation from north polarity to neutrality, and from neutrality to south polarity, or to completely reverse magnetic polarity by a slight right or left torsion.

I have succeeded in doing this and in obtaining strong reversal of polarities by superposing one polarity given whilst the rod is under a right elastic torsion, with another of the opposite polarity given under a left elastic torsion, the neutral point then being reached when the rod is free from torsion. The rod should be very strongly magnetised under its first or right-hand torsion, so that its interior molecules are rotated, or, in other words, magnetised to saturation; the second magnetisation in the contrary sense and torsion should be feebler, so as only to magnetise the surface, or not more than one-half its depth: these can be easily adjusted to each other so as to form a complete polar balance of force, producing, when the rod is free from torsion, the neutrality as shown at B, Fig. 1.

The apparatus needed is simply a good compound horseshoe permanent magnet, 15 centimetres long, having six or more plates, giving it a total thickness of at least 3 centimetres. We need a sufficiently powerful magnet, as I find that I obtain a more equal distribution of magnetism upon a rod or strip of iron by drawing it lengthwise over a single pole in a direction from



that pole, as shown in Fig. 2; we can then obtain saturation by repeated drawings, keeping the same molecular symmetry in each experiment.

In order to apply a slight elastic torsion when magnetising rods or wires, I have found it convenient to attach two brass clamp keys to the extremities of the rods, or simply turn the ends at right angles, as shown in the following diagram, by which means we can apply an elastic twist or torsion whilst drawing the rod over the pole of the permanent magnet. We can thus superpose several and opposite symmetrical structures, producing a polar north or south as desired, greatly in excess of that possible under a single or even double magnetisation, and by carefully adjusting the proportion of opposing magnetisms so that both polarities have the same external force, the rod will be at perfect external neutrality when free from torsion.

If we now hold one end of this rod at a few centimetres distance from a magnetic directive needle, we find it perfectly neutral when free of torsion, but the slightest torsion right or left at once produces violent repulsion or attraction, according to the direction of the torsion given to the rod, the iron rod or strips of hoop-iron which I use for this experiment being able, when at the distance of 5 centimetres from the needle, to turn it instantly 90° on either side of its zero.

The external neutrality that we can now produce at will is absolute, as it crosses the line of two contrary polarities, being similar to the zero of my electric sonometer, whose zero is obtained by the crossing of two opposing electric forces.

This rod of iron retains its peculiar powers of reversal in a remarkable degree, a condition quite different to that of ordinary magnetisation, for the same rod, when magnetised to saturation under a single ordinary magnetism, loses its evident magnetism by a few elastic torsions, as I have already shown; but when it is magnetised under the double torsion with its superposed magnetism, it is but slightly reduced by variations or numerous torsions, and I have found it impossible to render this rod again free from its double polar effects, except by strongly remagnetising it to saturation with a single polarity. The superposed magnetism then becomes a single directive force, and we can then by a few vibrations or torsions reduce the rod to its ordinary condition.

The effects of superposed magnetism and its double polarity I have produced in a variety of ways, such as by the electro-magnetic influence of coils, or in very soft iron simply by the directive influence of the earth's magnetism, reversing the rod and torsions when held in the magnetic meridian, these rods when placed magnetic west showing distinctly the double polar effects.

It is remarkable, also, that we are enabled to superpose and obtain the maximum effects on thin strips of iron from a quarter to half a millimetre in thickness, whilst in thicker rods we have far less effect, being masked by the comparatively neutral state of the interior, the exterior molecules then reacting upon those of the interior, allowing them to complete in the interior their circle of attractions.

I was anxious to obtain wires which would preserve this structure against the destructive influence of torsion and vibrations, so that I could constantly employ the same wires without the comparatively long and tedious process of preparation. Soft iron soon loses the structure or becomes enfeebled under the constant to and fro torsions requisite where we desire a constant change of polarity, as described later in the magnetic bells. Hard steel preserves its structure, but its molecular rigidity is so great that we obtain but mere traces of any change of polarity by torsion. I have found, however, that fine cast drill steel, untempered, of the kind employed by watchmakers, is most suitable: these are generally sold in straight lengths of 30 centimetres. Wires 1 millimetre in diameter should be used, and when it is desired to increase the force, several of these wires, say nine or ten, should be formed into a single rod or bunch.

The wire as sold is too rigid to give its maximum of molecular rotation effect. We must therefore give it two entire turns or twists to the right, and strongly magnetise it on the north pole of the magnet whilst under torsion. We must again repeat this operation in the contrary direction, after restoring the wire to its previous position, giving now two entire turns to the left and magnetising it on the south pole. On restoring the wire to its original place it will be extremely flexible, and we may now superpose several contrary polarities under contrary torsions, as already described.

The power of these wires, if properly prepared, is most remarkable, being able to reverse their polarity under torsion, as if they were completely saturated; and they preserve this power indefinitely if not touched by a magnet. It would be extremely difficult to explain the action of the rotative effects obtained in these wires under any other theory than that which I have advanced; and the absolute external neutrality that we obtain in them when the polarities are changing, we know from their structure to be perfectly symmetrical.

I was anxious to show, upon the reading of this paper, some mechanical movement produced by molecular rotation, consequently I have arranged two bells that are struck alternately by a polarised armature put in motion by the double polarised rod I have already described, but whose position, at 3 centimetres distant from the axis of the armature, remains invariably the same. The magnetic armature consists of a horizontal light steel bar suspended by its central axle; the bells are thin wine glasses, giving a clear musical tone loud enough, by the force with which they are struck, to be clearly heard at some distance. The armature does not strike these alternately by a pendulous movement, as we may easily strike only one continuously, the friction and inertia of the armature causing its movements to be perfectly dead-beat when not driven by some external force, and it is kept in its zero position by a strong directive magnet placed beneath its axle.

The mechanical power obtained is extremely evident, and is sufficient to put the sluggish armature in rapid motion, striking the bells six times per second, and with a power sufficient to produce tones loud enough to be clearly heard in all parts of the hall of the Society. As this is the first direct transformation of molecular motion into mechanical movement, I am happy to show it on this occasion.

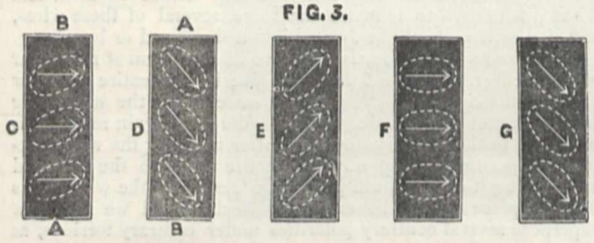
There is nothing remarkable in the bells themselves, as they evidently could be rung if the armature was surrounded by a coil, and worked by an electric current from a few cells. The marvel, however, is in the small steel superposed magnetic wire producing by slight elastic torsions from a single wire, 1 millimetre in diameter, sufficient force from mere molecular rotation to entirely replace the coil and electric current.

Elastic Nature of the Ether surrounding the Magnetic Molecules.—During these researches I have remarked a peculiar property of magnetism, viz., that not only can the molecules be rotated through any degree of arc to its maximum, or saturation, but that, whilst it requires a comparatively strong force to overcome its rigidity or resistance to rotation, it has a small field of its own through which it can move with excessive freedom, trembling, vibrating, or rotating through a small degree with infinitely less force than would be required to rotate it permanently on either side. This property is so marked and general that we can observe it without any special iron or apparatus.

Let us take a flat rod of ordinary hoop-iron, 30 or more centimetres in length. If, whilst holding this vertically, we give freedom to its molecules by torsions, vibrations, or, better still, by a few blows with a wooden mallet upon its upper extremity, we find, as is well known, that its lower portion is strongly north, and its upper south. If we reverse this rod, we now find it neutral at both extremities. We might here suppose that the earth's directing force had rotated the molecules to zero or transversely, which in reality it has done, but only to the limit of their comparatively free motion; for if we reverse the rod to its original position, its previous strong polarity reappears at both extremities, thus the central point of its free motion is inclined to the rod, giving by its free motion great symmetrical inclination and polarity in one direction, but when reversed the inclination is reduced to zero.

In Fig. 3 D shows the bar of iron when strongly polarised by earth's magnetic influence, under vibrations, with a sufficient

FIG. 3.



force to have rotated its elastic centre of action. C shows the same bar with its molecules at zero, or transversal, the directing force of earth being insufficient without the aid of mechanical vibration to allow them to change. The dotted lines of D suppose the molecule to be in the centre of its free motion, whilst at C the molecules have rotated to zero, as they are prevented from further rotation by being at the extreme end of its free motion

If, now, we hold the rod vertically, as at C, giving neutrality, and give a few slight blows with a wooden mallet to its upper extremity, we can give just the amount of freedom required for it to produce evident polarity, and we then have equal polarity no matter which end of the bar is below, the centre of its free rotation here being perfect, and the rod perfectly neutral longitudinally when held east and west. If, on the other hand, we have given too much freedom by repeated blows of the mallet, its centre of free motion becomes inclined with the molecules, and we arrive at its first condition, except that it is now neutral at D and polarised at C. From this it will be seen that we can adjust this centre of action, by vibrations or blows, to any point within the external directing influence.

We can perceive this effect of free rotation in a limited space in all classes of iron and steel, being far greater in soft Swedish iron than in hard iron or steel. A similar phenomenon takes place if we magnetise a rod held vertically in the direction of earth's magnetism. It then gives greater polarity than if magnetised east or west, and if magnetised in a contrary sense to earth's magnetism, it is very feebly magnetised, or, if the rod is perfectly soft, it becomes neutral after strong magnetisation. This property of comparative freedom, and the rotation of its centre of action, can be demonstrated in a variety of ways. One remarkable example of it consists in the telephone. All those who are thoroughly acquainted with electro-magnetism and know that it requires measurable time to charge an electro-magnet to saturation (about one-fifteenth of a second for those employed in telegraphy), were surprised that the telephone could follow the slightest change of timbre, requiring almost innumerable changes of force per second. I believe the free rotation I have spoken of through a limited range explains its remarkable sensitiveness and rapidity of action, and, according to this view, it would also explain why loud sounding telephones can never repeat all the delicacy of timbre that is easily done with those only requiring a force comprised in the critical limits of its free rotation. This property, I have found, has a distinct critical value for each class of iron, and I propose soon to publish researches upon the molecular construction of steel and iron, in which I have made use of this very property as a guide to the quality of the iron itself.

The elastic rotation (in a limited space) of a molecule differs entirely from that known as mechanical elasticity. In perfectly soft iron we have feeble *mechanical* elasticity, whilst in tempered steel we have that elasticity at its maximum. The contrary takes place as regards *molecular* elasticity. In tempered steel the molecules are extremely rigid, and in soft iron its molecular elasticity is at its maximum. Its free motion differs entirely from that given it by torsion or stress. We may assume that a molecule is surrounded by continuous ether, more of the nature of a jelly than of that of a gas: in such a medium a molecule might freely vibrate through small arcs, but a rotation extending beyond its critical limit would involve a much greater expenditure of force.

The discovery of this comparatively free rotation of molecules, by means of which, as I have shown, we can (without in any degree disturbing the external mechanical elasticity of the mass) change the axes of their free motion in any direction desired, has led me into a series of researches which have only indirectly any relation with the theory of magnetism. I was extremely desirous, however, of finding an experimental evidence which in itself should demonstrate all portions of the theory, and the following experiment, I believe, answers this purpose.

Let us take a square soft iron rod, 5 millimetres in diameter by 30 or more centimetres in length, and force the molecules, by aid of blows from a wooden mallet, as previously described, to have their centres of free motion in one direction, the rod will (as already shown) have polarity at both ends, when held vertically; but if reversed, both ends become completely neutral.

If now we turn the rod to its first position, in which it shows strong polarity, and magnetise it whilst held vertically, by drawing the north pole of a sufficiently powerful permanent magnet from its upper to its lower extremity, we find that this rod, instead of having south polarity at its lower portion, as we should expect from the direction of the magnetisation, is completely neutral at both extremities, but if we reverse the rod, its fullest free powers of magnetisation now appear in the position where it was previously neutral. Thus, by magnetisation, we have completely rotated its free path of action, and find that we can rotate this path as desired in any direction by the application of a sufficient directing power.

If we take a rod as described, with its polarities evident when held vertically, and its neutrality also evident when its ends are reversed in the same magnetic field, we find that its polarity is equal at both ends, and that it is in every way symmetrical with a perfect magnet. If we *gradually* reverse the ends and take observations of its condition through each degree of arc passed over, we find an equal symmetrical diminution of evident external polarity until we arrive at neutrality, when it has no external trace of inherent polarity, but its inherent polarity at once becomes evident by a simple return to its former position. Thus the rod has passed through all the changes from polarity to neutrality, and from neutrality to polarity, and these changes have taken place with complete symmetry.

The limits of this paper do not allow me to speak of the numerous theoretical evidences as shown by the use of my induction balance. I believe, however, that I have cited already experimental evidences to show that what has been attributed to coercive force is really due to molecular freedom or rigidity; that in inherent molecular polarity we have a fact admitted by Coulomb, Poisson, Ampère, De la Rive, Weber, Du Moncel, Wiedermann, and Maxwell; and that we have also experimental evidence of molecular rotation and of the symmetrical character of polarity and neutrality.

The experiments which I have brought forward in this paper, in addition to those mentioned in my paper read before the Royal Society, will, I hope, justify me in having advanced a theory of magnetism which I believe in every portion allows at least experimental evidences of its probable truth.

THE REDE LECTURE

THE following abstract report of Prof. Huxley's Rede Lecture given on Tuesday week in the Cambridge Senate House, to a crowded audience, has been revised, to the extent of removing any errors of importance, by the author. We understand that a full report of the lecture will shortly be published in a separate form.

Professor Huxley said he had undertaken to treat in the course of such time as custom and the patience of his audience might permit, on a very great subject, no less a subject than the origin of all those forms of animal life which at present existed. It had behoved him to restrict what he might lay before them to those considerations which were absolutely essential for his purpose, and he should endeavour to lay before them facts of such an order as appeared to him to be of most importance in reference to his argument. Although he might fail to put those facts before them as clearly as they presented themselves to his own mind, the reasonings which might be based upon them were of so simple an order that he should consider his task performed if he gave them a tolerably clear conception of what those facts were, for he did not think it was the business of a man of science to use the arts of rhetoric or endeavour to procure persuasion. His sole business was to place the facts before those whom he wished to teach, and to leave it to their reason to form such judgment upon those facts as they might think fit. In the present case he should point out to them what judgments such facts had forced upon his mind, but he must leave it entirely to their responsibility to say what judgment they might constrain them to give in their case. They might assume this position at starting, that, whatever in such a matter was true for one animal, was true for the infinite series of the whole animal world; and as he was extremely anxious to avoid everything speculative, everything that could not be directly led back to the matters of fact upon which it was based, he proposed to select one animal particularly, and to put before them facts and arguments by the help of which they might form some probable conclusion as to the origin of that object. He took it for granted that, if the evidence inclined towards a particular conclusion in the case of that animal, they might assume that it would incline in the same direction with regard to all. He had no doubt that a great many of his audience were familiar at any rate with the shell of the animal about which he was going to speak, namely, that of the pearly nautilus, from which, or parts of which, very beautiful ornaments were fabricated. At the present time the nautilus inhabited the warmer parts of the Indian and Pacific Oceans, living at considerable depths and preying upon the hard shelled crustaceans and mollusks that crept along the bottom, and which it found in its way. For that end it was provided with a very curious beak, shaped like that of a parrot, but with each portion covered with a hard calcareous deposit, and which enabled it to be an efficient instrument for crushing its prey. If he were to touch upon the morphological problem which here presented itself, he could occupy far more time than they had at their disposal with the consideration of a multitude of interesting peculiarities which the nautilus presented, for it was one of those forms which at present stood almost isolated and alone in the animal world, separated by a wide gulf from its nearest allies, those animals which they knew as squids and cuttle-fishes. It held the middle place between sea-snails and the group of the cuttle-fishes. It would be, however, entirely out of place at present, and a purposeless waste of time if he were to touch upon any peculiarities except those which would be needed during his further argument. The only points to which he would direct their attention for that purpose were the facts which related to the structure of the shell. There was a diagram beside him showing a part of the nautilus shell in section, but he thought it possible that he could make the matter clearer by roughly sketching on the board the main points as he went on.—Prof. Huxley here described, with the aid of diagrams, preserved specimens, and models, the complicated structure of the shells of the pearly nautilus, or *Nautilus pompilius*. The animal itself was contained in the spacious chamber in the outer part of the shell, which was divided from the rest of the shell by a partition. The rest of the shell resembled a long cone closely coiled up, and divided by partitions at regular intervals into other chambers, which succeeded one another, and in the full-grown animal were full of air. From the hinder part of the animal's body a long tube, the siphuncle, was carried backwards through the whole of the shell, and as it completely filled up the openings in the partitions through which it passed there was no communication between one chamber and another. The first point to be considered was as to what was the origin of the particular nautilus in the bottle before him. Happily there was no dispute upon that point. The female nautilus contained eggs exactly as the hen did. These eggs were small masses of protoplasmic matter, each containing a nucleus in its centre, which was all that was essential. They knew that that pearly nautilus with all its complicated organism, and fitted with the complicated shell he had described, did, in some way or other, proceed from that relatively structureless body which they called the egg or the ovum. As fate would have it, up to the present they had known nothing from direct observation of the process by which that particular animal was produced from this microscopic particle. But they had so large a knowledge of the process in other animals of every description that there was no doubt whatever as to the nature of the process, which he would try to describe to them as briefly as possible, by reference to the process which took place in the case of the domestic hen. Neither by the highest powers of the microscope, nor by other means of investigation which they had at present, could they trace anything in the slightest degree resembling either the chick, which under certain circumstances proceeded from that egg, or the tissues of the chick. There was, however, one spot on the yolk of the egg, a little careful observation of which would show a clear space, which might be a fifth of an inch in diameter. It was very well known by the name of the cicatricula, or little scar. He would suppose that twenty-one eggs were placed together under the hen. If they took one egg day by day and examined it they would know what took place as if they had watched continuously, for what happened in any one egg happened also in the others. That was a process—the wonder of which he must confess never staled in his mind—by which the chick was gradually fashioned out of that transparent rudiment. They saw it make its appearance in the first place on the surface of the yolk, and to the naked eye it looked like a white streak. That white streak gradually assumed the appearance of a sort of elongated body, and that body shaped itself so that it could be seen that it was going to be an animal of some kind, it having a large head, and the rudiments of eyes and vertebræ. On the fifth day they could clearly see what they were going to have. Gradually, step by step, and moment by moment, new differences made their appearance from the original foundation, and until many days before hatching there was an unmistakable bird, and at the twenty-first day there emerged from the shell an animal endowed with all a bird's capacities and structures. That process was the process of development. If they inquired into the nature of the cicatricula, they would find that that was merely a double layer of minute nucleated cells. They would find that that resulted from the splitting up of a protoplasmic mass that had been there before. They could trace the process back into the body of the hen until they came down to a simple nucleated cell, so that it was a matter capable of demonstration that in that nucleated cell which formed a part of the egg organ of the hen—in that particle of, for morphological purposes, structureless jelly, were the same characteristics which were possessed by the very lowest forms of animal life which were known. They knew that in that particle resided a potentiality, capable of developing itself through the stages he had roughly indicated, until it became not only a machine of the highest order from a physiological point of view, but a very remarkable work of art. That particle of protoplasmic matter did that in virtue of the powers inherent in its material nature. That was the point he wished to put before them as clearly and definitely as he could, because it would be fundamental in all further discussion. For it was to the process he had briefly described that the great discoverers of the last two centuries applied the name of "evolution." Singularly enough the persons who first used that name did not use it in that sense in which it was universally used now, because they were under a mistake as to the exact nature of the process. But the whole conception of evolution was now based upon ascertained facts, showing the process of development of the most complicated animal out of a relatively structureless particle, which had no higher organisation than that of the lowest animal they knew, a process which progressed step by step by means of the gradual addition of small differences, until the animal attained its perfect form. That was what was meant by the process of evolution. At this point he thought it might be desirable that he should deal with what he might speak of as the *a priori* objections to the doctrines of evolution. He had had opportunities of making extensive acquaintance with those objections during the past twenty years or so. He divided them into three categories: (1) That evolution was impossible; (2) that it was immoral; and (3) that it was opposed to the argument of design. Now that was a very heavy indictment, but he thought they must plead "not guilty" upon all three counts. It required no great amount of reasoning to convince one that that which happened could not be impossible; that that which happened thousands and millions of times every hour and every minute in this world as it now was, under certain conditions, could not be held without further evidence to be impossible under somewhat different conditions. Secondly, with regard to the question of morality. He had never understood that argument, and had always been disposed to reply that the morality which opposed itself to truth committed suicide. With regard to the argument of design he would not discuss that point himself, but would beg them to listen for a moment to words that would carry far more weight than any of his own could carry on that topic:—"The philosopher beholds with astonishment the production of things around him. Unconscious particles of matter take their stations and severally range themselves in an order so as to become collectively plants or animals, *i.e.* organised bodies with parts bearing strict and evident relation to one another and to the utility of the whole; and it should seem that these particles could not move in any other way than they do, for they testify not the smallest sign of choice, or liberty, or discretion. There may be particular intelligent beings guiding their motions in each case, or they may be the results of trains of mechanical dispositions fixed beforehand by intelligence or appointment and kept in action by a power at the centre." They might imagine, and not unreasonably, that those were the words of some ultra-evolutionist of the present day who desired to set himself right with the argument from design; but they were not so. They were more than eighty years old, and they were contained in the 23rd chapter of a book which was very much talked about, but, he was afraid, very little read, namely, the "Natural Theology" of Archdeacon Paley. When he was a boy that book was a very great favourite of his, partly for its own merits, and partly because it was one of the few books he was allowed to read on Sundays. He found it much more entertaining than most of the books included in that category. But from what had been since said of the Atheistic tendencies of the doctrine of evolution he began to think that he stood before them a miserable example of the manner in which a man's mind might be poisoned by early instruction, and that his incapacity to understand the force of the arguments against evolution arose from the circumstance that in his early childhood he was indoctrinated with the reasonings of a great divine of the Church.—Professor Huxley now proceeded to consider the next point, the coming into existence of the nautilus species in contradistinction from the origin of a particular nautilus as an individual. He showed that, according to all the evidence that could be gathered, there was every reason to believe the forms of animal life five thousand years ago were practically the same as they were now. If there were no other means of knowing anything about the history of animal life, undoubtedly this experience, resting upon a duration of five thousand years, would have furnished an apparently sufficient basis for a generalisation, tending to the conclusion that the forms of animal life had not changed during that period. Not only had that generalisation been made, but it had been concluded that the forms of animal life were unchangeable, a totally different proposition, the validity of which rested, among other things, on the proportion between our actual experience, supposing it to extend over that time, and our possible experience of the duration of life on the globe. It would, he thought, be absolutely impossible for any of them, however good their vision, to say from actual observation of the hour hand of a watch for four seconds that it had moved during that interval, and in point of fact the space over which it would move was so minute as to be indiscernible, even through a magnifying glass. Yet they knew very well that it had moved, and if they watched it for four or five minutes, the evidence of its movement would be perfectly obvious, even to the naked eye. They would observe, therefore, that a period of observation which extended over the nine-hundredth part of an hour, would give them no conception from which it would be possible to draw a conclusion as to what had happened during the total period. Now geologists told them that the whole depth and extent of the fossiliferous rocks, which composed a considerable portion of the earth's crust, represented a period of time at least one thousand times as great as the historical period. That was a point upon which there could be no room for hesitation. Hence it followed that when they acquainted themselves with the succession of animal forms which were embedded at different depths in the earth's crust, they did exactly what the observer of a watch did when he kept his eyes fixed on it, not for four seconds but for an hour, in which latter case the movement was not only conspicuous, but such as commonly served to indicate the lapse of time. If that analogy held good, the slow procession of events which might be absolutely indiscernible in the course of 5,000 years, would become obvious and plain when the period of observation was extended to a thousand times that period. And that was exactly what happened, for if they went back in the series of stratified rocks they found the genus nautilus, which in the present day was represented by one or two species, represented in the long period of its history by many other species. As far back as the Upper Silurian formation the genus nautilus was represented by an abundant number of shells fabricated by animals having all the essential peculiarities which he had described. In the geological specimens before him, and which were taken from the rich collection in the Woodwardian Museum, there were forms of nautili which no one doubted were to all intents and purposes the same in their general structure as the pearly nautilus of the present day, although they were at least 5,000,000 years old. Now came the main question: were those nautili whose history extended back through such a prodigious range of time identical in character with the modern species? So far as he knew there was nothing in the nature of things to show why a succession of generations which remained unchanged through 5,000 years should not remain so for 50,000 or 50,000,000 years. The facts, however, showed that there had been rather more than 100 distinct species of nautilus, each having as good a title to be called a species as *Nautilus pompilius* itself. No one of these species had endured for more than a portion of the duration of the whole genus, and many species had existed contemporaneously, those species, however, except perhaps two, were now extinct, so that now they were brought face to face with the heart of the question: by what hypothesis could they account for those phenomena? They were driven into hypothesis of some kind or other, because it was impossible to have any evidence of contemporary witnesses of facts which went so far back into the past. So far as he knew there were only two possible alternative hypotheses by which they could pretend to account for those facts. One of these hypotheses was what he ventured to call the hypothesis of construction. That hypothesis was that every one of those species was put together. It was making a needless difficulty to suppose that each species came out of nothing, because they knew that the body of the nautilus was made up of materials which were familiar to them in an inorganic state on the earth's surface; so that by the hypothesis of construction some agency had put together those materials a hundred times or so during the period that had elapsed from the formation of the Silurian rocks to the present day, as an artist constructed his work, or as a mechanician put together the parts of his machine. That was one hypothesis. For his part, he had not a word to say *a priori* against the possibility of that hypothesis. It was certainly conceivable and therefore, according to Hume's maxim, it was possible. But they must bring it, like all other hypotheses, to the test of facts and inquire how far it stood that test. He thought the hypothe is of construction presented two large and almost insuperable difficulties. The one was that it was absolutely opposed to everything that they had received traditionally concerning the origin of animal forms, and the second was that it was no less opposed to every doctrine which might reasonably be held upon grounds of sane science. It stood to reason and common sense that they could have recourse only to those causes for the assumption of which there was some ground of analogy. The business of science would be extremely easy if for every event one were permitted to invent special causes having no analogy in nature. The difficulty of science was in tracing every event to those causes which were in present operation. That difficulty was being so constantly overcome that it had become a canon of physical science no less than it was a canon of historical science that speculation should confine itself to construing past events by the analogy of those of the present time. The hypothesis of construction seemed to him unacceptable, because it led them into contravention of tradition on the one side and into contravention of scientific logic on the other. The only other alternative hypothesis was that of evolution, which meant that the different forms of animal life had not arisen independently of each other in the great sweep of past time, but that the one had proceeded from the other; and that that which had happened in the course of past ages had been analogous to that which took place daily and hourly in the case of the individual. That was to say that just as at the present day in the course of individual development the lower and simple forms, in virtue of the properties which were inherent in them, passed step by step by the establishment of small successive differences into the higher and more complicated forms, so, in the case of past ages, that which constituted the stock of the whole ancestry had advanced grade by grade and step by step until it had attained the degree of complexity which was seen at the present day. No objection could be brought against this hypothesis on the ground of analogy, because in putting it forward they were not bringing in any kind of causation which was not abundantly operative at the present time. The question was whether the history of the globe in past time coincided with this hypothesis, and to that point he would next address himself. What did they find if they considered the whole series of these forms? Unquestionably, as he had said, nautili were found as far back as the Upper Silurian age. Before that time there were no nautili, but there were shells of the *Orthoceratidæ*—of which there were magnificent examples before him—which resembled those of the nautili in that they were chambered, siphoned, &c., with the last chamber of such a size that it obviously sheltered the body of the animal. He thought no one could doubt that the creatures which fabricated these still earlier shells were substantially similar to the nautili, although their shells were straight, just as a nautilus shell would be if it were pulled out from a helix into a cone. Then came the forms known as the *cyrtoceras*, which were slightly curved. Along with these they had the other forms which were on the table, and in which the shell began to grow spiral. The next that came were forms of nautilus, which differed from the nautilus of to-day in that the *septa* were like watch-glasses, and that the whorls did not overlap one another. In the next series, belonging to the later palæozoic strata, the shell was closely coiled and the *septa* began to be a little wavy, and the whorls began to overlap one another. And this process was continued in later forms, down to that of the present day. Looking broadly at the main changes which the nautilus stock underwent, changes parallel with those which were followed by the individual nautilus in the course of its development, he considered that there could be no doubt that they were justified in the hypothesis that the causes at work were the same in both cases, and that the inherent faculty, or power, or whatever else it might be called, which determined the successive changes of the nautilus after it had been hatched, had been operative throughout the whole continuous series of existence of the genus from its earliest appearances in the later Silurian rocks up to the present day. What the whole question, in whatever way it might be put, came to, was this: Successive generations of animals were so many cycles of evolution that succeeded one another. Within the historical period, there was no doubt that, speaking roughly, those succeeding cycles had been identical, that was to say, without discernible difference. But when the period of observation became proportional to the slow rate of change they found, so to speak, that the hour hand had moved; for, in the successive cycles of evolution which had occupied the whole period, successive cycles had differed from one another to a slight extent. If they might assume that, then the whole of the phenomena of palæontology would fall into order and intelligibility. If not, they had to adopt an hypothesis which, as he had pointed out, had no support in tradition, and which was absolutely contradicted by every sound canon of scientific research. This was his case for evolution, which he rested wholly upon arguments of the kind he had adduced. From the time when he first read Charles Darwin's "Origin of Species," now some twenty-four years ago, his mind had fixed itself upon the tenth chapter of that book, which treated of the succession of forms in geological times, for it appeared to him that that was the key of the position; that if the doctrine of evolution was correct, the facts of palæontology, as soon as they became sufficiently known, must bear it out and verify it in every particular. On the other hand, he believed that, if the facts of palæontology or the historical facts of life on the globe were against evolution, then all the rest of the argumentation in its favour would be vain and empty, because the difficulty of adopting it would be in that case absolutely insuperable. He would venture to repeat that the occurrence of evolution was a question of history. He did not know whether Sir Henry Maine was not more competent to speak on that point than he was. It was a question as to whether they would interpret the facts of animated nature scientifically, or whether they would open the door to every description of hypothetical vagary. He came to the conclusion that that was a point worth testing in every possible way, and for some twenty years he had given what leisure he had been able to beg, borrow, or sometimes steal, to the investigation of these questions. He had endeavoured to ascertain for himself how the doctrine of evolution fitted with the facts of palæontology with regard to the higher vertebrated animals, and with regard to the chief varieties of invertebrate animals, and all he could tell them was that the farther his own investigations had gone, the more complete had appeared to be the coincidence between the facts of palæontology and the requirements of the doctrine of evolution. The conclusion he had come to was that at which every competent person who had undertaken a similar inquiry had arrived, and if they would pay attention to the writings of such men as Gaudry, Rütimeyer, Marsh, Cope, and others, who had added materials upon which to form a judgment such as were not dreamt of when Darwin first wrote, they would find that they all without hesitation attached themselves to the doctrine of evolution as the only key to the enigma. In deciding the issue between the two hypotheses, serious inquirers would not trouble themselves about any collateral points as to the how and the why, or as to any of the subordinate points at issue. He thought he was entitled to entreat those who by their calling or by their position in society, or by the fact that they possessed any influence, might be led to express an opinion upon this matter, to look into the arguments which formed the foundation of the case for evolution. Happily, he might address that recommendation to members of the University of Cambridge with a perfectly good conscience, for at this present time he knew not where in the world any one could find better means of passing through all those preliminary studies which were essential to a comprehension of this great question, or where any one could find more amply displayed the means of testing the arguments which he had laid before them. He ventured to say that the members of this University were without excuse if they gave opinions on this question of evolution without having prepared themselves, by as diligent study as they would for the purpose of approaching questions of literary or theological criticism, to express an opinion upon it. These were the considerations which he had wished to set before them that day. It would be understood that they would not suffice to enable any one to form a judgment upon the doctrine of evolution, but he hoped that they had sufficed, brief and insufficient as they were, to show that if judgment on this question was to be worth anything intellectually, if it was to be creditable to the moral sense of those who formed it, it would first be necessary that the facts should be clearly comprehended, and that the conclusion—whatever it might be—should be one which right reason would admit might be justly and perfectly connected with the facts.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE

OXFORD.—The term that has just concluded has been chiefly noticeable for the interest drawn towards Oriental studies in the University by the building of the new Indian Institute. The visit of the Prince of Wales to the Chancellor of the University served to draw national attention to the work which Oxford, and especially Balliol College, has undertaken in respect to the training of the selected candidates for the Indian Civil Service. In spite of the failure of the late attempt to induce the University to relax its rule requiring three years' residence as a qualification for a B.A. degree in the case of the Indian Civil Servants, a considerable proportion of the selected candidates come into residence at the University; Balliol, by providing teachers and tutors in Oriental subjects, attracts by far the greatest number.

With the exception of two debates there has been little excitement during the term in the Convocation House. The two questions that roused general interest were, first, the proposal that examiners in the Pass Schools should allow merit in one subject to compensate for a deficiency in another; and secondly, the decree to grant 10,000*l*. to Prof. Burdon Sanderson for the equipment of the new Physiological Laboratories. In the first debate the proposal was only carried by the casting vote of the Vice-Chancellor, and some doubt has since been raised on the qualification of one of the voters. In the second debate the opponents of vivisection, allied with those who oppose any large expenditure by the University on economic grounds, sought to throw out the decree and force the University to make special provision against the Professor experimenting on living animals. Prof. Burdon Sanderson in his speech disclaimed any intention of introducing vivisection into his courses or demonstrations, but declared that he would experiment on living animals in his own researches if he deemed it necessary for the discovery of truth. The decree was carried in a large house by 88 votes to 85.

The Commemoration in the Sheldonian Theatre passed off with less uproar this year. Among the recipients of honorary degrees Lord Rayleigh and Sir Frederick Abel represented Science.

In November next Balliol and Christ Church will hold examinations for electing to Natural Science Scholarships. The subjects at both colleges will be Chemistry, Physics, and Biology, with an essay and an optional paper in Mathematics.

CAMBRIDGE.—The Senior Wrangler in the Mathematical Tripos (Parts I. and II.) is Mr. Mathews, of St. John's College; Mr. Gallop is second; Mr. Lachlan, third; Messrs. Chevallier and A. N. Whitehead, bracketed fourth—all of Trinity College. One lady, Miss Perrin, of Girton, is placed between the 20th and 21st Wranglers. Three ladies are senior optimes; one is junior optime.

The Special Board for Mathematics have recommended that the Smith's Prize be awarded for the best essay on any subject in Mathematics or Natural Philosophy, to be sent in about a year and a half after the candidates are of standing for Parts I. and II. of the Mathematical Tripos; and that the adjudicators be the Vice-Chancellor, the Mathematical Professors, and the Cavendish Professor.

Prof. Foster has given notice of a revision class in Physiology during the Long Vacation, to be held at the Physiological Laboratory.

The proposed regulations for the Balfour Fund have been formally adopted by the senate.

The annual report of the Observatory states that, owing to the great progress made with the zone observations it has been possible to give much attention to the comets of recent years, and important contributions to the computations of their orbits have been made by the Observatory.

The General Board of Studies have published their recommendations with regard to new teachers, buildings, and appliances, and it is at once evident that several times the whole amount of the new income of the University could readily be spent in supplying the distinct wants of the several departments. They confine their recommendations as to Readerships within narrow limits owing to the extreme pressure upon University Funds, but they recommend the appointment of the present Readers in Indian Law, Classical Archæology, and Talmudic Literature as University Readers at 300*l*., not 400*l*. as proposed by the Statutes, a Reader in Comparative Philology at 300*l*. and a Reader in Botany at 100*l*. a year, tenable with a College Lectureship. As to University Lecturers, that is College Lecturers who throw open some of their lectures to the University and give advanced lectures, they recommend, as regards Medicine, four University Lecturers; Mathematics, five; Biology —one in Botany, one in Zoology; three in Physiology; two at least in Geology; and others in other departments.

More Demonstrators, the senior to be better paid than at present, are further recommended to be appointed in various departments of Natural Sciences.

The appointment of a Professor of Pathology is again pressed as urgent; provision to be made for a temporary laboratory.

As to buildings, the Board have placed among urgent requirements the extension of the buildings for Physiology and Comparative Anatomy, Chemistry, Botany, Mechanism, and for Geology, to be partly supplied by the Sedgwick Memorial Fund. As extra to the latter fund, 10,000*l*. is asked.

A special grant of 500*l*. for physiological apparatus is recommended. Further, the Museum and Lecture Rooms require at least 350*l*. more annually from the new funds, in addition to 500*l*. asked for from the ordinary income of the chest.

The cost of a chemical laboratory is provisionally estimated at 15,000*l*., and the purchase of Prof. Stuart's plant, with which he has at his own risk developed the flourishing school of engineering in the University, at 2,500*l*. Then permanent buildings for the school of Mechanism would cost 3,500*l*. more.

The recommendations of the General Board, after sifting and reducing the recommendations of the Special Boards, will entail annual charges of 4,360*l*., in addition to at least 2,500*l*. required by new professorships or new elections to existing professorships.

Capital expenditure will be required for buildings 31,200*l*., and for special grants other than building, 4,810*l*.; but it is proposed to borrow for these purposes. The Board have been informed that the special sum (500*l*.) asked for physiological apparatus will be provided by the liberality of a private donor who wishes to remain anonymous.

No voting can take place on these proposals till next term.

The special reports, on which the detailed Report of the General Board of Studies is founded, contain much interesting information about the present state of Natural Science studies in the University.

The Medical Board ask for provision for teaching in Medical Jurisprudence, Sanitary Science, Mental Diseases, and Elementary Medical and Surgical Methods. The number of students at present is about 200.

The report of the Classical Board contains an elaborate account of the present provision for studying Philology, Antiquities, Ancient Art, Topography, &c. which we cannot here reproduce.

The Board of Oriental Studies ask for University Lectures in Hebrew and Sanskrit, and for a Reader in Syriac, and that the Lord Almoner's Professor of Arabic be secured, if possible, as a resident professor by the augmentation of his stipend. They also urge the importance of establishing teaching in the departments of Egyptology and Assyriology.

The Mathematical Board estimate the resident students for Mathematical Honours as between 300 and 400. There are thirty-four College Lecturers in Mathematics, much of whose time is occupied in preparing candidates for the pass examinations. It will be impossible to secure adequate teaching of the subjects of Part III. of the Mathematical Tripos unless at least University Lecturers are appointed, and the Board ask for five at 50*l*. a year, two courses of advanced lectures being required from each lecturer every year.

The Board for Physics and Chemistry in addition to the laboratory claims press for additional means of catechetical teaching in Chemistry and instruction in Technical Electricity; in Mechanism a Superintendent of the Workshops, and in Mineralogy a Curator of the Museum. The number of students in Chemistry in the University is nearly 200; in Physics (Cavendish laboratory only), average for last two years, 54; Mechanism 42; Mineralogy 9.

The Board urge the advisability of Colleges permitting their lecturers in Chemistry and Physics to lecture in the University lecture rooms and laboratories, to allow more efficient organisation of teaching, as well as economy in expenses.

Lord Rayleigh asked for 600*l*. additional for Demonstrators in Physics, but the General Board of Studies have only recommended 220*l*. to be granted.

Professor Stuart's workshop has not more than half supported itself by fees of students as yet, but by employing the workmen in the manufacture of apparatus, &c., for other University departments after their hours of teaching, he has made a profit sufficient to pay the deficit, except the cost of demonstrators. A superintendent of the workshops is absolutely necessary if the University keeps up the school of Engineering, and a demonstrator in each department. Thus the Professor would not as now, be required to teach in the workshops and act as general manager as well as demonstrator. A considerably larger foundry is required, as the department has proved most useful.

The Board for Biology and Geology recommend the appointment of a Professor of Animal Morphology, and, failing this, three University Lecturers in this subject, one of whom shall direct the laboratory.

In relation to Physiology, Dr. Foster made an elaborate report, describing the organisation of, and work done in, his laboratory. He asked for a head demonstrator and four assistant demonstrators. As to advanced lectures, mention was made of the very largely unpaid work undertaken by Dr. Gaskell (entirely unpaid), and Messrs. Langley and Lea, and University recognition of their work was asked for. Elementary Biology and Physiology of the Senses were also mentioned as needing a special lecturer.

With regard to Botany, teaching in Vegetable Morphology and in Physiology is urgently required, with lecture rooms and laboratories.

It is further asked that University teachers be eventually appointed in Agriculture, Anthropology, Geography, Metallurgy, and Mining.

In Geology it is pointed out that since Prof. Bonney left Cambridge, no College has given any assistance towards geological teaching, and that Dr. Roberts and the other demonstrators have received no University or College payments for the continued work they have done in lecturing and demonstrating.

The average number of students at present in the various departments of Biology and Geology is—Botany, 80; Geology, 40; Zoology, 75; Physiology, 120; Human Anatomy, 100 each term.

Donald MacAlister, M.D., M.B., Fellow and Medical Lecturer of St. John's College, Cambridge, was on Thursday, June 14, elected a member of the Council of the College.

The following awards have been made at St. John's College for proficiency in Natural Science:—Foundation Scholarships to Andrews, Kerr, Phillips (R.W.); Exhibitions to Goodman (already Scholar), Cooke, (E. H.), Fenton, Jones (H. R.), Watts; a Proper Sizarship to Gepp. Goodman obtains a Wright's Prize with augmentation of emoluments to 100*l*., and a Hughes' Prize, as one of the two most distinguished third-year students in the College. The Open Exhibition was awarded to Rogers.

MR. J. V. JONES, Principal of Firth College, Sheffield, has been elected by the Council to be the first Principal of the University College for South Wales and Monmouthshire.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, May 24.—"The Effects of Temperature on the Electromotive Force and Resistance of Batteries, II." By William Henry Preece, F.R.S.

In the discussion on the previous paper read on February 22, 1883, it was suggested that observations should be made on the influence of temperature to the case of secondary batteries. One of Mr. Tribe's cells was used.

The negative element of this cell consisted of pure peroxide of lead in the form of a plate 4 inches square carried in a grooved frame, from one end of which projected the necessary conductor. This element was placed between two plates of finely divided lead likewise 4 inches square. These were joined together, and formed the positive element of the cell. Each half of the positive plate was about a quarter of an inch distant from the negative, and all three plates were incased in a thin specially prepared fabric. The elements were contained in a leaden case, and the liquid was sulphuric acid of the strengths given in the various experiments. This cell was placed inside the cylindrical copper vessel used in the previous experiments, and precisely the same method of observation was adopted. The influence of heat on secondary cells was the same in kind as in the Daniell cell, but it differs very much in degree. The electromotive force practically remains constant for all degrees of temperature, but the internal resistance diminishes as the temperature increases at a very steady rate, increasing again as the temperature is lowered. The effect of varying the percentage of acid in solution is not very marked, though as might have been anticipated from Kohlrausch's observations, the 30 per cent. proportion gives the lowest resistance. The mean average reduction in resistance between 0° and 100° C., is 59·6 per cent.

Chemical Society, June 7.—Dr. Perkin, president, in the chair.—The following papers were read:—Laboratory notes by J. H. Gladstone and A. Tribe: (1) On the action of light and heat on cane and invert sugars; cane sugar solution, when heated, forms a small quantity of a substance which is not alcohol, but which gives the iodoform reaction. (2) On hydroxylamine; the copper zinc couple reduces this substance, ammonia being formed. (3) On the recovery of iodine from organic iodide residues; the residues are poured on to an excess of the couple, and the iodide of zinc formed, extracted with hot water; iodine is obtained in the free state by the action of hydrochloric acid and bleaching powder on the iodide. (4) A residual phenomenon of the electrolysis of oil of vitriol; the formation of Berthelot's persulphuric acid was noted. (5) On an alleged test for alcohol; Davy suggests that alcohol can be detected by the blue colour produced with a warm solution of molybdic anhydrid in oil of vitriol. The authors find that other reducing substances and sugar give the same reaction. (6) Reaction of the couple on nitric oxide; ammonia is formed, but no protoxide. (7) On the reducing action of spongy lead.—Note on a basic ammonio-copper sulphate, by S. U. Pickering.—Notes on Loew and Bokorny's researches on the probable aldehydic nature of albumin, by A. B. Griffiths.—Note on the action of sulphuric acid, sp. gr. 1·84, upon potassium iodide, by H. Jackson. The author has investigated this reaction quantitatively; he finds that two reactions occur, one with an excess of sulphuric acid when iodine and sulphur dioxide are formed; the second when just sufficient sulphuric acid is used to satisfy the potassium iodide; iodine and sulphuretted hydrogen are then liberated.—The action of nitrous anhydride on glycerin, by O. Masson. The author obtained the trinitrite of glyceryl; it is an amber-coloured liquid boiling at 150°, burns with a white flame, but does not explode under the hammer. It is decomposed by water, and cannot be preserved. In sealed tubes it generates sufficient gas to shatter the glass.

Linnean Society, June 7.—Sir John Lubbock, Bart., president, in the chair.—Mr. R. J. Clarke and Mr. Frank Matthews were elected Fellows of the Society.—Mr. W. T. Thiselton Dyer exhibited a series of Copals: some from Inhambane, near Mozambique, the product of *Copaifera Gorskiana* of various sorts, with a melting point from 310° to 360° Fahr.; others from Lagos (obtained by Capt. Moloney), used by the natives for burning, and powdered by the women as a body perfume. These last are supposed to be from a species of *Daniellia*, the native name being "Ogea."—Mr. Hiern drew attention to specimens of *Quercus Ilex*, var. *Fordii*, from Barnstaple, Devon, showing remarkable alteration in the leaves after pruning. There was exhibited for Mr. Stansfield R. Rake a burdock leaf with numerous excrescences, supposed to be the result of insect irritation.—Mr. G. Murray exhibited specimens of dace killed by the fungus disease (*Saprolegnia ferax*), the result of inoculation, and said to be the first recorded experimental proof of the communicability of the disease to those fish.—Dr. Cobbold showed shrimps sent by Dr. Burge of Shanghai. They contained immature flukes, which it was thought might prove to be the larval state of one or other of the three species of human fluke known to infest man in eastern countries. He proposed to call the parasite *Cercaria Burgei*.—A paper was read by Mr. H. N. Ridley, on new and rare monocotyledonous plants from Madagascar, among which may be mentioned species of *Drimia* hitherto only known from Africa, several curious orchids, one remarkable for possessing only one or two very large, handsome green, white, and purple flowers. Of Cyperaceæ one form well known as an Indian plant, another of the genus *Fintelmannia*, supposed to be confined to Brazil; he also describes a new genus, *Acriulus*, allied in some respects to *Cryptangium*.—A communication was read from Mr. George Lewis, on Japan Brenthidæ and notes of their habits. These beetles form part of the collection made by the author in his visit to Japan during the summers of 1880-81. He observes that there is no geographical barrier sufficient to exclude tropical forms from Japan, but their environment, when they reach it, prevents them from establishing themselves, to any great extent at least, in the northern parts. In the southern islands of the Japanese Archipelago the warmer climate enables a fair number of beetles of a truly tropical type to exist. The fact that each genus is only represented by one species nevertheless points to some physical check in their spread and numbers. A new genus, *Higonius*, is characterised, and several species of this and other genera described and illustrated.—Mr. T. H. Corry read a paper on the fertilisation of the Asclepiads, chiefly bearing out views noticed on a former occasion.—A short record of observations on the White Ants (Termites) of Rangoon, by Dr. Robert Romanis, was read by the Secretary. He details what he saw in what may be termed the swarming of a nest.

EDINBURGH

Royal Society, June 4.—Mr. Thomas Gray, vice-president, in the chair.—Mr. Buchan read a second paper on the oscillations of the barometer, the conclusions of which were based largely on the *Challenger* observations. It appeared that the greatest diurnal oscillation occurred in regions over the sea where the air was very moist, being least indeed in those oceanic regions north and south of the equator where the average height of the barometer was greatest; whereas over land the contrary was the case, the greatest oscillations occurring where the air was driest. The explanation given was that over the ocean, whose surface changes very slightly in temperature throughout a whole day, the main effect results from the direct heating of the air and its contained moisture; while over the land the effect due to surface changes preponderates, being less, of course, the better the air acts as a screen to the solar rays, that is, the moister it is. Mr. Buchan then proceeded to account for the double maximum in the diurnal oscillations of the barometer. Beginning at six o'clock in the morning, an hour at which in general the barometer shows its daily mean, we find that the first effect of the sun is to heat the air, which tends to expand and rise. This tendency is of course somewhat resisted, so that the pressure is in the first instance increased; but by and by this resistance is overcome, the air flows freely upwards, the morning maximum is reached, and the pressure begins to fall. After noon this diminution in pressure is accelerated by the cooling of the air, for the same reason that the first effect of heating is to increase the pressure. Hence the barometer falls to its afternoon minimum. But as this is going on the region to the west is in its turn being heated, and an eastward movement of air overhead takes place towards the first locality, arresting the diminution of pressure, and then bringing it to a second maximum. This action, however, ceases as midnight comes on, the cooling of the air being then left to have its own effect, and the pressure falling to its second minimum till the approach of the sun on the east makes itself felt, and the same cycle of operations begins again. The modifications introduced by special conditions, such as the distribution of land and water, were also discussed, and explanations given of the retardation in certain places of the maxima and minima in time, and of the very slight, almost imperceptible, second minimum which in such cases frequently is found.—In presenting the last report of the Boulder Committee, Mr. Milne Home, the convener, intimated that the Committee purposed giving a general report in a form in which it could be readily compared with the British Association reports.—Mr. W. E. Hoyle read a paper on a new Entozoon from the mesentery of *Proteles cristatus* (Spairman). It is closely allied to *Pentastomum Diesingii* described by Van Beneden, belonging indeed to the same genus, but distinguished by its size, the number of its segments, and a slight difference in shape. The most curious point in its anatomy is that when the animal is encysted in the mesentery of its host the cirrus-sac is empty, and there is a stoppage in the vas deferens. The name proposed for the parasite is *P. Protelis*.

Mathematical Society, June 8.—Mr. J. S. Mackay, F.R.S.E., president, in the chair.—Mr. Thomas Muir, F.R.S.E., communicated some mathematical notes of interest to teachers and a new proof of Prof. Tait's problem of arrangement.—Mr. A. Y. Fraser read a paper on the fundamental notions of the differential calculus; and Dr. C. G. Knott, F.R.S.E., discussed the singularities of plane curves.

Berlin

Physiological Society, May 11.—Prof. Brieger reported on the further results of his study of the violent poisons formed by decomposition of animal bodies. In continuation of the communication he made a short time ago to the Society he described the process by which he had obtained from decomposing masses of flesh a substance which crystallised in acicular forms, and which he obtained by repeated crystallisation in such a degree of purity that he was able to analyse it. It afforded the empirical composition $C_5H_{14}N_2H_2Cl_2$, and consequently was a hydrochloric salt of a new base, which did not in its constitution resemble any known combination. This diamin-base had no longer the toxic properties of the extracts of the decomposition products. It was extremely easily decomposed, and could only be prepared from decomposing meat, and could neither be obtained in the later stages of putrescence nor from decomposing fibrin or other albuminous substances. Neither could it be demonstrated to be a constituent of meat. A second substance was obtained from the mother-liquor that remained after the crystallisation of the diamin-salt. This body, after purification by recrystallisation, showed the composition of $C_5H_{11}NCl$. This base proved to be a very virulent poison; 1 mg. in solution injected subcutaneously into a rabbit very soon produced the set of symptoms characteristic of fish-poison, *i.e.* salivation, quickened respiration, and diarrhœa, followed in a short time by death in convulsions. Even after the isolation of these exceedingly poisonous bases the mother-liquor contained other bases which have as yet not been more closely studied, and which belong to the group denominated by Prof. Brieger, "peptotoxine." They are more or less poisonous in their action upon the living organism, are decomposed with extraordinary facility, and are not only formed in the first stages of decomposition of masses of flesh, but are also contained in neurin in peptones.—Dr. George Hoppe-Seyler, who was present as a visitor, reported the results of the experiments that he made, starting on the basis of the chemical relation of nitrophenylpropiolic acid to indigo, which was studied by Herr Baeyer, in order to determine the physiological action of this acid, hoping thus to advance a step in the comprehension of the formation of indol and oxindol in the living organism. He found that oxindol appeared in the urine of rabbits into whose stomachs he had introduced solutions of nitrophenolpropiolate of soda, the animal in the meantime evincing no morbid symptom. When the solution was subcutaneously injected, blood appeared in the urine along with the oxindol, and when the treatment was continued for some time the constitution of the rabbits was injuriously affected so that they finally died, without, however, manifesting any characteristic symptoms. Dogs behaved quite otherwise when even a third part of that which the rabbits bore without inconvenience was introduced into their stomachs, increasing quantities of albumen and sugar appeared in their urine, and the animals succumbed to emaciation and loss of power. This very remarkable difference in the action of nitrophenylpropiolic acid on dogs and rabbits was not conditioned by the different diet, because when rabbits were driven to take to albuminous diet, by inanition or milk diet, until the reaction of the urine was acid, or when, on the other hand, the urine in dogs was made alkaline by giving them acetate of soda, the differences of the action remained unaltered, and their study promises a key to the comprehension of the origin of albuminuria and glycosuria.

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