THURSDAY, MAY 17, 1894.

TEXT-BOOK OF COSMICAL PHYSICS.

Joh. Müller's Lehrbuch der Kosmischen Physik. Fünfte umgearbeitete und vermehrte Auflage, von Dr. C. F. W. Peters. (Braunschweig: Friedrich Vieweg und Sohn, 1894.)

NEARLY everyone who has become at all acquainted with popular German scientific works will have at some time fallen in with this well-known book by Dr. Müller. It first appeared in the year 1856, and received particular favour, in that in the first place it was really popularly written, and secondly, that it was useful as a book of reference for many questions which dealt with every-day phenomena. The book reached its fourth edition in 1875, and since then none other has appeared, except the one that we now have under consideration. Nineteen years have thus flown by since Dr. Müller undertook the last revision, and in this period one is not at all surprised to find that accepted views on many points have undergone great changes, and in some cases entire revolutions.

For those of our readers who have not had the opportunity of examining previous editions for themselves, a few words as to the gap which the author intended that the work should fill may not be out of place. Referring, in the preface to the first edition, to the great stir Humboldt's "Kosmos" made throughout Germany, attracting general attention to the study of cosmical phenomena, he stated that he intended to produce a work, in the form of a text-book, in which the physics of the heavens and the earth should be systematically brought together. In astronomy it was true that many p)pular works were at hand, but in physical geography and meteorology they were to a certain extent wanting. With such an object in view it was necessary to keep the book within certain limits, and not to enter too far into mathematical developments: this accounts for the brevity of some parts in the astronomical and optical sections. On the whole, however, a non-mathematical reader should rest very content with what he has before him.

In this new edition, Dr. Peters, who has undertaken the revision, has not deviated from the original idea of dividing the work into four books, and they are, as formerly, devoted to (1) the movements of the heavenly bodies and their mechanical explanations; (2) cosmical and atmospheric phenomena; (3) heat phenomena on the earth's surface and in the atmosphere; and, lastly, (4) atmospheric electricity and terrestrial-magnetism.

Covering as the work does over 900 pages, a systematic treatment of each section would be impossible, so we will limit ourselves to searching out what is not in the book which ought to be there, and *vice versâ*. With regard to the latter, with the exception of what is referred to later on, there is not much that need be said, except it be that some old incidents of observed phenomena might have made place for others more recent, as, to take one example, that referred to under "Magnetische Störungen" (p. 858).

The first book, dealing with astronomical phenomena consists of over 300 pages, and is the largest of the four. This has received many and various alterations and additions; among the latter may be mentioned references to the new moons of Mars and Jupiter, the discoveries relating to the periods of rotation of Mercury and Venus (Trouvelot's work somehow being overlooked here), variable stars of the Algol type, and photographic and spectrum analysis work. Those important phenomena, the tides, receive due attention, and instead of being dismissed in two pages, as in the last edition, in this one have twelve devoted to them. In the section on time, it is a pity that more is not said about the new system of time-zones, for this is just a typical point to which an ordinary reader might wish to refer. Under the description of what we know about the planet Venus, there are several important points which do not receive mention. Thus, for instance, no reference is made to the snow-caps of which Trouvelot has published so many drawings, nor can an account be found of the curious and quick changes which have been observed to occur on the terminator and limb, and which afford strong arguments in favour of a rapid rotation of the planet. The transit of Venus, on the other hand, is fully discussed and described.

In the chapter dealing with comets, excellent descriptions are given of their gravitational motions, and of remarkable appearances, while the forms of their tails are discussed at some length. During the last few years astronomers have had many opportunities of studying these bodies, and our knowledge has very much increased. Thus we now generally suppose them to be swarms of meteorites under the influence of gravitation pursuing their course round the sun, the particles of which they are composed banging and clashing about near perihelion, and producing light and heat. One might at first be led to consider that the author had overlooked such new knowledge, as the reader is pulled suddenly up by a section on the "meteorite." It is not till after twenty-five pages have been passed over that he is informed of this suggested relation between comets and meteors, and then in only a few words. This subject is mentioned again briefly under the spectra of comets.

Coming now to the second book, our luminary the sun is the first dealt with. In this part we may mention one or two points which we think are deserving of more attention. Thus, *a propos* of sun-spots, such an absorbing question as the unequal period between a maximum and a minimum and a minimum and a maximum receives no mention, or even the important fact of the latitudinal changes that the positions of spots undergo during a period; in fact, in fifteen lines the whole reference to spot-period is treated. In the explanations given to account for spots, Zöllner's ideas are the most modern hinted at; there is no statement as to our present view, that they are caused by down-rushes of cooler matter from the upper regions of the solar atmosphere.

An interesting account of the zodiacal light is followed by a section on planetary photometry, in which G. Müller's recent work is referred to. In the section on variable stars, the Algol type is fully dealt with, but no attempt is made to explain other kinds of variables, although several plausible suggestions are at hand. Under temporary stars exactly the same is the case, in

spite of what has been recently done with regard to this most fascinating puzzle in astronomy. The remainder of this book deals briefly, among other things, with nebulæ, star clusters, comets and their spectra, spectroscopes, &c. The chapter on atmospheric light phenomena has received but little alteration; in it are described refraction, mirages, halos, twilight, &c., which call for little if any change.

In the third book we are introduced successively to chapters on the distribution of heat on the earth's surface, the pressure of, and disturbances in, the atmosphere, and hygrometry; these may be all included in the word "meteorology." In the science of meteorology very rapid advance has been made, and the last twenty years have witnessed changes which have been sweeping in their nature. Such being the case, we expect to find here considerable alterations and additions, and indeed we are not disappointed, for we find this part "zum grossen Theile gänzlich umgearbeitet." Thus, to mention one or two instances, the Ice age is dealt with at some length, and is accompanied by an excellent map showing the glacial distribution. The paragraphs on the internal heat of the earth are also likewise lengthened, and much new matter inserted. In the section on earthquakes, on the other hand, we fail to notice any reference to Prof. Milne's important work that he has been carrying out in Japan on a truly scientific basis. A brief description of this, and a few words on the seismograph, would have made an interesting addition.

The fourth and last book will be found to have received little alteration. This seems perhaps striking, in the face of the great amount of work that is now being done in this direction. There is no doubt that at present we are rather gathering facts systematically and accurately acquired, than subjecting those already obtained to detailed discussion. Nevertheless we find no changes or additions under the paragraph entitled "das spectrum des Nordlichtes," or any other explanation of this phenomenon than that of De la Rive, indicating that the work done during the last nineteen years has been void of results worthy of mention. In the part on lightning, we are rather surprised to see no reference to photography, which has enlightened us much on this phenomenon, showing us that a forked flash is by no means "instantaneous," to use a word which is rather ambiguous, but lasts, comparatively speaking, a considerable time.

We cannot conclude without referring especially to the admirable illustrations, which throughout the work form a very prominent feature. The plates at the end of the book may be said to be the same as those that appeared in the last edition, but in the case of those in the atlas which accompanies the volume many important alterations and additions have been made. Thus, to mention some of the more important. Those showing the paths of the planets have been revised and much improved. Two rather startling (as regards colour) pictures of the planet Mars (June 3 and 14, 1858), after Secchi, are inserted, also an excellent map of his surface, after Schiaparelli.

Among other very good plates is one of Jupiter and his spots (Warren de la Rue), Saturn (Trouvelot), two of the moon after negatives taken at the Lick Observatory, Mount Hamilton, a lunar crater after Nasmyth, Roberts' Andromeda nebula, and Langley's enlarged picture of sun-spots.

The maps and diagrams referring to the meteorologica and magnetical sections are as numerous as ever, and have all been carefully revised and brought up to date. New pictures of the auroræ, as observed in Kingua Fjord in 1882 and 1883, are also inserted.

In the above rapid survey of the 900 pages which this book contains, one can form an idea of the great difficulty the bringing of such a work as this up to date must have been to the reviser. Having to bear in mind that no part must be more elaborately developed than another, and that the limit of range as regards details must be restricted, Dr. Peters has had no light task before him. Cosmical physics is such a wide-spreading subject, and the information here brought together so plentiful, that the few remarks we have made above fall, for the most part, into insignificance.

As a popular treatise the work should be widely read, and the special index should considerably facilitate the utility of the work in its function as a book of reference.

W. J. LOCKYER.

ALCHEMY AND CHEMISTRY.

The Alchemical Essence and the Chemical Element, an Episode in the Quest of the Unchanging. By M. M. Pattison Muir. Pp. 94. (London: Longmans, Green, and Co., 1894.)

THIS is a very interesting book; its object is stated in a sentence printed on a fly-leaf following the title-page—"This essay is written in the hope that some of the men who exercise their 'wit and reason' in examining the problems of life may help to answer the questions that nature propounds to those of her students who follow the quest of the unchanging."

The author begins by quoting two definitions, one by an alchemist: "There abides in nature a certain form of matter which, being discovered and brought by art to perfection, converts to itself, proportionally, all imperfect bodies that it touches"; and the other by a chemist: "In chemistry we recognise how changes take place in combinations of the unchanging." It may here be said that it would often materially add to the interest of the work if the names of the authors of these and of other quotations in the book had been given.

The difficulties that many have experienced in understanding the writings of the alchemists are accounted for by showing that the names which they used, and which have survived as the names of well-known substances, were applied only to certain principles or properties that matter was supposed to possess: thus the word sulphur represents the principle of changeability, and the word mercury the principle of malleability and lustre which the metals exhibit. The alchemists used expressions of this kind partly to hide their secrets from the uninitiated, and also to preserve themselves from suspicion of dealing with the evil one, who was considered to be the possessor of the earth. The mystical language was derived, to a large extent, from theology, the science which at that time pervaded all the thoughts

of the learned. Possibly the alchemists really attached some definite meaning to the fantastical terms they used, which meanings are now lost to us.

When the use of the accurate balance was introduced into natural science, it revolutionised the methods of investigation: it now became possible to trace the changes which occur during the interaction of bodies in a way quite different from that employed in earlier times. Thus the alchemist observed only the changes of properties of the substances with which he experimented; the chemist investigates, in addition, the changes of mass which occur when alterations of matter are produced.

It must not be supposed that the early workers were ignorant of the increase of weight which occurs during the calcination, or, as we now call it, the oxidation of metals, but they gave very fanciful explanations of the fact; thus George Wilson, in his "Compleat Course of Chymistry," printed in 1721 (how many students at the present time would rejoice in a complete course of chemistry in 383 pages!) says, when writing of the calcination of lead, "It gains in weight by calcination, because a greater quantity of igneous particles insinuate themselves into the lead, than the sulphurous ones the fire drives out, for in calcination, the acid of the fire, joins itself to the alkali of the lead, and having driven away its combustible sulphur, makes a new and incombustible body."

Mr. Pattison Muir gives some illustrations of the use of the balance, but one of these seems not quite a happy example. He states that when water was evaporated in an open dish and a residue was left, the alchemist "pointed to the earthy matter in the dish as proof of the transformation of water into earth." He afterwards says that a weighed quantity of water was distilled, the distillate was weighed and was found to be less than the original water; "but the sum of the weights of the condensed water and the earthy matter was equal to the weight of the water before boiling," showing that the residue was dissolved in the water used. It is not stated by whom this experiment was made, but it is inferred that it was performed in the early days of quantitative work. As spring water rarely contains more than one-tenth per cent. of dissolved matter, it would have been interesting if the author had informed us what precautions were taken to secure such a result, which would be difficult even with our modern appliances.

By the use of the balance it was found that some substances differed from others, some being composed of different kinds of matter, and hence called compounds, whilst others could not be thus separated, and were regarded as simple bodies or elements. When an element is transformed into a compound, the latter almost invariably possesses properties very different from those of the element, and the element appears to have been destroyed; the alchemist thought that it was really destroyed, but the chemist shows that it is only hidden, and can be obtained from the compound in the same quantity that was used to prepare the compound; moreover, the weight of the compound is invariably equal to the sum of the weights of the elements composing it.

As far as we know at present the elements are unchangeable; however complex the compounds which are formed by their combination, the elements can always be obtained from them with all their original properties. Thus the formations of compounds from elements and the decomposition of compounds into elements are properly called the "changes in combinations of the unchanging." The alchemical principles could not be weighed or measured, so that it was not possible to explain the properties of bodies by the assertion—for it was nothing more—that they contained more or less of these principles.

The author next tells us that the same elements in the same proportions can form compounds with different properties, and then passes on to the laws of multiple proportions, showing how these are accounted for by the theory of atoms. The periodic law is then explained, and it is pointed out that the periodic properties of the elements and of their compounds contrast very strongly with the ideas of the alchemists with regard to the principles that were supposed to account for the different properties of substances. The striking difference between alchemical and chemical reasoning is well illustrated by the history of the theory of combustion, the escape of the principle of fire, as held by the phlogistians to be the cause of combustion, being contrasted with the combination of the burning substance with oxygen, as discovered by Lavoisier.

The author appears to be rather hard on alchemy when he says "the great business of alchemy was to prevent men from coming into close contact with external realities. Alchemy was a manufacturer of blinkers that shut off the objects on either side, and so distorted the vision." No doubt this was in some ways the result of alchemy, but it can hardly be supposed that it was its object. It is difficult to place ourselves, even in imagination, in the position of the alchemists, but we may hope that they were struggling after truth to the best of their powers, their failure being due more to their holding preconceived notions than to a desire to obscure facts.

Some may not agree with the author in classing together alchemists, spiritualists, theosophists, and theologians; though, no doubt, all have erred in making assertions with an insufficient knowledge of facts. So also it seems not quite justifiable to restrict the term science to the investigation of natural phenomena, for surely the study of the moral and spiritual actions of man are also worthy of the name of science. Some may not accept spiritual truths, considering that they are beyond their experience; but it is hardly scientific to deny their existence, any more than it was reasonable for the inhabitants of Flatland to deny the existence of space of three dimensions.

Mr. Pattison Muir's book will well repay perusal; it will appeal not only to the chemist, but also to the general reader, who cannot fail to obtain much insight into the ideas of the alchemist, and also into the accurate methods of the modern chemist. HERBERT MCLEOD.

OUR BOOK SHELF.

Principia Nova Astronomica. By Henry Pratt, M.D. (London: Williams and Norgate, 1894.)

WE confess to having read a great deal of this book, and to have wasted a corresponding amount of time,

in an unsuccessful attempt to wrestle with the novelties submitted to consideration. The only possible consolation or reward is the thought that a brief notice may prevent others from a similar distress and dissatisfaction. To say that the author does not accept the first law of motion, will perhaps serve to indicate the kind of man with whom we have to deal. After this one will be prepared to believe that any amount of curiosities and world-worn paradoxes will be met with in this collection of some two hundred quarto pages.

The feature, however, which distinguishes this production from all other works of the same character is the numerous suns which the author is obliged to introduce in order to explain the motions of the earth and moon. For those who are so benighted as to accept the gravitational theory, as developed by Newton and his school, one sun suffices; but the new Principia requires at least four. First, we have a central sun occupying "the eccentric centre of an ideal sphere." This phrase is hard to understand. It is suggested that it may mean that an imaginary sphere rotates about a point not its centre. Round this "ideal sphere" we have a so-called polar sun, circulating with its cortège of solar bodies and their satellites. This sun is called a polar sun because it revolves in a plane approximately parallel to the axis of the earth; but in what the peculiar necessity of its creation consists, we have failed to fathom with distinctness, and fear to misrepresent the ingenious author. On the surface of this ideal sphere another sun, called the equatorial, also revolves, this time from west to east, in a "mean equatorial plane." These three suns are necessarily made to be non-luminous bodies, only recognisable by the effects their "eccentric attractions and orbital revolutions" exercise on the earth and moon. Finally we have the visible sun. Of these four, the central sun is the master-key of the whole system, from which energy radiates in every direction, upholds all the members of the system, while simultaneously holding them apart. And any one who is at all accustomed to this kind of literature will conclude, without any further warning, that electricity is the energy invoked to sustain this system. It would have been distinctly disappointing not to have had electricity introduced as the mainstay.

Those who wish to see how this complication can be made to explain the precession of the equinoxes, the motion of the lunar nodes and apsides, nay, the predominance of land and water in the northern and southern hemispheres of the earth respectively, and many other strange things, must be referred to the book itself. There is, in fact, only one sentence in the book with which we can cordially and entirely agree, and that is the first "Who," says the author, "Who will believe the theory of astronomical motion set forth in the following pages? Not the astronomers, certainly." We venture to assure him that he is perfectly correct in this conjecture. W. E. P.

A Manual of the Geology of India. Second edition. Revised and largely re-written by R. D. Oldham, A.R.S.M., (Calcutta: Geological Survey Office. London: Trübner and Co., 1893.)

THE first edition of this book has been out of print for some years; meanwhile, Indian geology has greatly advanced, so that a revised and extended issue, bringing the work in line with the new results of the Geological Survey, has long been needed. Few are more capable of doing this re-writing and revision better than Mr. Oldham. He has had a wide and varied experience of survey work in India, and his acquaintance with the literature pertaining to the subject is evidenced by the "Bibliography of Indian Geology," compiled by him in 1888. Mr. Oldham has entirely altered the arrangement of the book. The original edition consisted of a series of descriptions of separate districts; but in the present volume the rocks are described in chronological order. All references to economic geology are excluded, being relegated to the works specially devoted to it, while this deals with stratigraphical and structural geology. In the detailed table of contents, the excellent plan has been followed of indicating by a different type the matter which is new or entirely re-written in the present edition. A glance at this shows at once that Mr. Oldham has produced almost a new book. Especially interesting is the chapter on the "Homotaxis of the Gondwána System." Most geologists will remember the bitter controversy that once raged over the age of this system, but which has now died out. Mr. Oldham has made a detailed study of the rock-groups of the Gondwána system, and has compared them with their representatives in Australia and Africa. He has thus been able to show the relation of the Upper Palæozoic and Lower Mesozoic rocks of India, Africa, and Australia to those of Europe. The two last chapters in the book are entirely new. One deals with the age and origin of the Himalayas, and the other with the geological history of the Indian peninsula. In both of these a number of important questions are discussed in a scientific manner. Wherever Mr. Oldham has interpolated new matter, he has done it well. Unlike many other revisers, therefore, he has produced a restoration which really improves the old structure. The result is that the manual is once more the standard work on the present state of knowledge of the geology of India.

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 intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

The Weight of the Earth.

IN a letter in this week's NATURE, signed "The Reviewer," the writer does not notice that in the English language, and in all legal and common usages of it, including that of all scientific men in speaking of their weighings by ordinary balances, *weights* mean *masses*. The fact that the weight of the earth is $6{\cdot}14 \times 10^{21}$ tons is as clear as that the weight of a parcel of tea is 3 lb. It is the *heaviness* of a weight or mass that is a property accidental to its position, being less at the equator, greater at the poles, and nothing at the earth's centre. I have never yet heard a "box of weights" called a box of masses. I don't believe even "The Reviewer" calls it a box of masses. If carried to the centre of the earth it is still a box of weights, though the heaviness of the weights is zero.

The word "weight" is often used to denote the heaviness of a weight or mass. No dictum, either of "The Reviewer" or of myself can eliminate this ambiguity from the English language. But scientific men may greatly diminish the inconvenience of it, and may even tend to eliminate it altogether, if they persistently use the word "heaviness" when they mean heaviness.

May 12. K.

"THE REVIEWER" makes a number of statements which he does not stop to prove; as, for instance, when he says that "the weight of a body would be practically nothing if the body was removed to a few million miles from the earth." But an appeal to experiment will show that the weight is unaltered. To fix the ideas, consider an astronomical or astrological chart, in which the earth is at the centre of a Zodiacal circle. Now, if a 100-ton gun is weighed in the scales of Libra, the weights required for equilibrium, as given by the lumps of metal in the other scale pan, will amount to exactly 100 tons; so that the weight of 100 tons at the distance of the Zodiacal circle, or at any other distance, is exactly 100 tons.

But if "The Reviewer" takes a ball of the mathematician's imaginary fine, weightless string, which he lets down from Libra to the surface of the earth, to the end of which weights can be attached, so as to equilibrate the 100-ton gun at the dis-

tance of the Zodiacal circle; now it is certainly true that a much smaller weight will suffice to produce equilibrium. Suppose, for instance, that the Zodiacal circle has a radius equal to the distance of the moon, or sixty times the earth's radius; then 22,400÷3600, say, 6 lb., suspended near the earth's surface at the end of the string, some 240,000 miles long, will suffice to balance 100 tons in the other scale pan, close up to the Zodiacal circle. But if the 100 tons is also lowered down by another mathematical string to the surface of the earth, then 100 tons is required to equilibrate it; and so it will for any intermediate position, when the lengths of the strings are equal; so that it does not tend to any clear or useful end to say that the weight of 100 tons at the distance of the moon is only about 6 lb. On the contrary, the weight of 100 tons is everywhere 100 tons.

The *weight* of a body is the *that which* is measured in lb., tons, kilogrammes, or other standards of weight; and these standards are certain lumps of metal licensed by Acts of Parliament, and carefully preserved against change or degradation.

The weight of the Earth, for instance, as determined by the Cavendish experiment, is about 6×10^{21} tons; and it is not necessary to dig up the Earth and to weigh the fragments at the surface of the Earth for the determination of this weight.

It is too late now to change the meaning of a word that has been in immemorial use in all languages; such a quasi-Gothic revival would have to restore all literature, as, for instance, the lines of Ovid (Art. Am. 3, 319):—

"Quæ nunc no nen habent operosi signa Myronis
Pondus iners quondam duraque massa fuit."

A. G. GREENHILL.

The Niagara River as a Geologic Chronometer.

WHEN we quote an author whose views coincide with our own, we are apt to speak of him as an authority on the subject; but when we dissent from the views we quote, we are not so apt to recognise the high authority of that author. This reflection on a phase of mental bias is suggested by a personal experience with reference to the age of Niagara Falls. The geologists and others who have discussed the length of post-glacial time may be rudely classed as minimists, maximists, and agnostics. Within the past five years I have been frequently and approvingly quoted by the minimists as estimating the portion of time consumed by the Niagara River in cutting its gorge at 7000 years, and the reputation thus acquired has not been noted without personal appreciation. But self-complaisance in that regard has been somewhat impaired by the thought that the honour is ill-founded, and that the insecurity of its foundation would sooner or later be discovered. Not less disturbing was the fear that when the maximists or agnostics took their turn at writing, I should be classed with the goats instead of the sheep. There can be no doubt that the manly and in every way proper course would have been followed had I years ago disclaimed the glory accidentally thrust upon me; but it is easy to bask in the sunshine of even unmerited applause, and conscience was too weak to determine action until another motive was added by a blow from the agnostic side. In his recent book Dr. James Geikie, after quoting me as an authority for the 7000-year estimate, adds that "all such estimates are in the nature of things unreliable." I now hasten to declare that I never said or thought that the period in question was about 7000 years. What I did incautiously say was, in effect, that the time allowance for the cutting of the gorge would be about 7000 years if the rate of the cutting were uniform, but that there was good reason to believe the rate had not been even approximately uniform.

Dropping personalities, which lack interest for your readers unless they involve principles, I beg to say a few words on the actual value of Niagara Falls as a chronometer. In 1844 James Hall made a map of the brink of the Falls, and established bench marks to which changes could be referred. Within a few years several other surveys had been made and connected with the first bench marks. It has thus become known, first, that in the middle of the Horseshoe Fall, where the principal body of water descends, the brink retrogrades at the rate of four or five feet per annum; second, that the American Fall, carrying a much thinner sheet of water, retrogrades so slowly that its rate is concealed by errors of survey. The gorge, which has been cut since the ice sheet retreated from the region, is six miles long, and the division of this distance by the annual rate determined for the Horseshoe Fall yields a period agreeable to the minimists. Had the conditions remained uniform, no fault could be found with this estimate, but there is reason to believe that the conditions have varied enormously in nearly every particular. The thickness of the resistant bed at the crest of the Falls is far from uniform, and it was altogether wanting for part of the distance. During the period of gorge-cutting, the height of Lake Ontario, which gives base-level to the river, has varied through a range of several hundred feet. The volume of the river has doubtless varied somewhat through climate, but it has probably varied enormously by reason of changes in drainage systems, resulting chiefly from differential uplift. The Niagara now carries surplus water from the basins of Lakes Erie, Huron, Michigan, and Superior. There was probably a post-glacial epoch during which three of these lakes discharged their water in other directions, and only the basin of Lake Erie fed the Niagara River. During that epoch the volume of the river was so small that canyon-cutting was effected only by the feeble process now illustrated by the American Fall, instead of the vigorous process illustrated by the Horseshoe Fall. These considerations, which the inquiring reader may find more fully set forth in the annual report of the Smithsonian Institution for 1890, tend strongly to sustain the agnostic view of the Niagara River as a geologic chronometer.

G. K. GILBERT.

Washington, April 30.

The Teeth and Civilisation.

ON the 8th inst., Dr. Wilberforce Smith read a short communication before the Anthropological Institute on the teeth of ten Sioux Indians attached to the Wild West Show. His investigation showed that in regard to molars and premolars (the only teeth examined), these Indians were wholly free from caries. In the discussion which followed the reading of the paper, it was mentioned that the same fact was revealed in the skulls of the Fourth Egyptian Dynasty brought to England by Dr. Flinders Petrie, and in some skulls examined by Dr. Wilberforce Smith himself, which were derived from the ruins of Pompeii. The teeth of the Indians, both old and young, and those in the skulls just referred to, all showed more or less wear of the cusps, which is a most unusual circumstance in the teeth of modern civilised people, and it was thought that some difference in the food, or its mode of preparation, would be required to account for the absence of signs of wear in our time.

Now, it has never been proved that the increasing prevalence of caries is due to weakness of the teeth owing to comparative disuse, but there is nevertheless great probability in the inference, especially as signs of wear and freedom from caries appear to occur together, and *vice versâ*. There is, however, a further point in regard to the existing liability to the attacks of caries which I think can be best explained by a transference of nourishment to other parts governed by the same nerves. On inquiry of several dentists, I find that the teeth most subject to decay are the molars, and of these the upper molars are more often attacked than those in the lower jaw. The molars of the upper jaw are fed by a branch of the fifth nerve, and in modern life this nerve has, perhaps, more strain put upon it than any other in the body. We use our eyes, partly supplied by the ophthalmic branch of this nerve, not at intervals, but often closely throughout a long day. And it seems, therefore, that with so many increasing calls on this bundle of nerve fibres, the filaments sent to the teeth are, by an automatic economy of expenditure, robbed of the energy necessary to perform their functions properly. The teeth through lack of use may not excite the nerves to natural action, and thus from both sides there is a failure of function, and the teeth are consequently more and more unable to resist the attacks of caries. I am disposed to attach some importance to this explanation, as I find that those who have great calls on their nervous energy are more liable to caries than people of quieter habit and slower temperament. Dr. Wilberforce Smith mentioned the alarming increase of dental decay amongst hospital nurses, whose occupation is certainly one demanding a constant drain on their nervous energy. It was also noted that people in towns lose their teeth more rapidly than those living in the country, which also bears out the idea here suggested. On the other hand, the savage is seldom required to strain his facial nerves continuously for any length of time, and in reference to general nervous expenditure he enjoys long periods of rest which are wholly denied to the civilised man in towns. No doubt in consequence of the excessive calls on our nervous energy the distribution of it is

undergoing modification in civilised man, and parts not used to any extent are being deprived of the supply necessary to healthy growth. It is much to be feared that the teeth, though so essential to the welfare of the body, are in this predicament. But we are sadly in need of more definite information than is at present available, and it is partly in the hope that some of the readers of NATURE, who have opportunities which I do not possess, may be induced to test this and other ideas relative to the increase of caries, that I have written on the subject. The whole question is at present much obscured by misconceptions due to ignorance. One fact, however, emerged only too clearly from Dr. Wilberforce Smith's investigation, namely, that while the grinding teeth of civilised men of middle age are either missing or practically useless for their purpose, the ancients enjoyed a perfect set of teeth till advanced years, and modern savages enjoy the same blessing.

Clapham, May 10. ARTHUR EBBELS.

Johannes Müller and Amphioxus.

THE story of Müller's Neapolitan visit in search of Amphioxus, as copied in NATURE (May 3, p. 14) from the *Lancet*, belongs to the category of those that are *ben trovato* or the reverse. To anyone acquainted with the works of this brilliant morphological genius the tale bears internal evidence of entire lack of foundation.

Müller's chief memoir on Amphioxus appeared in the *Abhandlungen der Berliner Akademie* 1842. If Prof. Todaro had ever read the original, or an earlier note in the *Berichte* 1839, he would scarcely have related the story. Müller's work begins with an historical summary of previous researches on the animal, and in particular he relates (*Berichte* 1839, p. 199) that the first specimens he examined were obtained from Prof. Retzius. Moreover, Costa's description, mentioned by Prof. Todaro as being the immediate cause of Müller's expeditious trip to Naples, *appeared in* 1839, *and in the same year* Müller published observations on the two specimens given him by Retzius. At this period he was in ignorance of its occurrence at Naples, for (p. 200) he says it has been found "on the English, Norwegian, and Swedish coasts." His chief work—the one before mentioned—was carried out on *living* specimens got by Müller himself near Gothenburg, on the Swedish coast, and, as is well known, and also expressly stated by himself, he worked at the microscope for twelve days in order to complete his task on the spot. The evidence goes to show that Müller obtained no Amphioxus—not even the one he is credited with!—from Naples until his work was completed; and (p. 81, foot-note) he remarks: "In Naples the capture of the animal is very easy close inshore, for it lives in great numbers in the sandy ground of Posilipo. In 1842 I brought back from Naples *over* 1000 *specimens* in spirit."

If the journey referred to ever took place, there is no record of the one specimen in any of his works, and Müller, who could sacrifice a very rare Pentacrinus to the scalpel, was not the man to spare an Amphioxus. It must indeed have been a "miraculous draught" that yielded only one specimen of Amphioxus off Posilipo.

However "interesting" and amusing the story may be to those who have a preference for fiction, it is to be regretted that, with no basis of fact to support it, a *zoologist* should have told it of one whom zoology will always rank as a chieftain amongst her greatest sons. To many of us, who regard Müller with something akin to reverence, the fable is less interesting than painful. J. B.

The Scandinavian Ice-Sheet.

IN reply to the letter of Prof. T. G. Bonney (NATURE, vol. xlix. p. 338), which I by chance have read to-day, concerning the difficulty of explaining how the Scandinavian land-ice could have crossed the deep channel of Skagerak and Kattegat, and have reached the East Anglian coasts, I should like to remark that this difficulty is not new to me, and will exist after it has been explained how the ice-stream from Norway could have crossed the named channel and extended over Denmark and North-western Germany. It is, however, an undisputed fact that certain Norwegian boulders are very common in the most northern parts of Iylland, and from there dispersed over the whole Iylland (though their rarity increases with distance from Norway), the northern parts of Fyn and Sjœlland, over Slesvig and Holstein and North-western Germany from Fehmarn towards the west, further over Dutchland and Belgium to several localities at the English east coast, under such conditions that they could not have been transported by floating ice. It is consequently a fact that the ice-stream from Norway has crossed the named channel. I think, therefore, that the best explication is that the Skagerak channel in its present condition was at first formed after or during the period of largest glaciation, to which the Norwegian ice-stream belongs, but before the Baltic ice-streams, both of which, I suppose, are posterior to the greatest extension of the land-ice. The chief reason for the formation of these ice-streams is the existence of the above-named channel, which has prevented the ice-stream from Norway from extending over Denmark for the second time.

Copenhagen, May 2. VICTOR MADSEN.

The Earliest Mention of Dictyophora.

TWAN CHING-SHIH'S "Miscellanies," compiled in the ninth century A.D. (Japanese edition, 1697, book xix. p. 7), has the following note:—"In the 10th year of the period I (Tá-Tùng (544 A.D.) a fungus grew in Yen-hiáng Gardens owned by the Emperor Kién-Wan. It was eight inches long with a black head resembling the fruit (that is, the Torus) of *Euryale ferox*; stem hollowed through inside like the root of *Nelumbium speciosum*; skin all white except below the root, where it was slightly red. Portion like the fruit of Euryale had below a joint like that of the bamboos, and was removable; from the joint a sheet was developed, simulating a network, five or six inches in circumference, surrounding the stem in the manner of a bell, but distant and separate from it. The network was fine and lovely, and also removable from the stem. It is allied to Wei-hí-chi (the Auspicious Fungus of Graveness and Pleasure) of the Taoist writings." This description seems to have been passed over by readers as a mere fiction, but I find that it agrees very well with the figure of a Dictyophora, and may probably be the earliest mention of it. A Japanese botanist, Kōzen Sakamoto, has figured the two forms of Dictyophora in his "Monograph of Fungi" (1834, vol. ii. p. 15), but has not referred to the above-cited description. KUMAGUSU MINAKATA.

May 4.

The Scope of Psycho-physiology.

I HAVE no wish to enter into a triangular duel with Dr. Titchener and "the writer of the note" who has provoked his fire. But since my name has been introduced, a word or two of explanation seems necessary.

Some time before Dr. Titchener discharged his first barrel, I was requested by the editor of this journal to contribute a popular article on "the scope of psycho-physiology." In complying with his request, I accepted (1) the conditions implied by the word popular, which no doubt laid me open to the criticism that my "whole treatment" was "a little general and superficial"; and (2) the title suggested to me, since I regarded it as comprehensive and not specially provocative of terminological controversy. C. LLOYD MORGAN.

Bristol, May 10.

The Aurora of February 22.

THE splendid aurora of February 22-23 began on the Pacific coast of North America on the former date, extending unusually far south in California, New Mexico, and Arizona, but did not become conspicuous on the eastern half of the continent until the day following. The earth currents affecting the telegraph lines were troublesome west of Chicago exclusively on February 22 also, not being felt east of that point until the day following. This localisation of the aurora in longitude has been noted in numerous other instances as well. An arrangement has been made to secure records of the geographical distribution of earth current disturbances on the lines of the Western Union Telegraph Company, which extend very widely over the North American continent. From what appears in the case above described, such records are likely to prove to be of very great interest.

April 30. M. A. VEEDER.

THE ROYAL SOCIETY SELECTED CANDIDATES.

AS in former years, we give the qualifications of the candidates for election into the Royal Society, who were selected by the Council at its meeting on Thursday last.

WILLIAM BATESON,

M.A. Fellow of St. John's College, Cambridge. Balfour Student. Rolleston Prizeman of the University of Oxford. Distinguished as a Zoologist. Author of the following memoirs:—"The Early Stages in the Development of *Balanoglossus* (sp. incert.)" (Quart. Journ. Micros. Sci. vol. xxiv., p. 208); "The Later Stages in the Development of *Balanoglossus Kowalevskii*, with a Suggestion as to the Affinities of the Enteropneusta" (*ibid.*, vol. xxv., supplement, p. 81); "Continued Account of the Later Stages in the Development of *Balanoglossus Kowalevskii*, and of the Morphology of the Enteropneusta" (*ibid.*, vol. xxvi., p. 511); "The Ancestry of the Chordata" (*ibid.*, p. 535); "On some Variations of *Cardium edule*, apparently correlated to the Conditions of Life" (Phil. Trans., 1889, p. 297); "Notes on the Senses and Habits of Marine Animals" (Marine Biol. Assoc. Journ., new ser., vol. i., p. 211); "On the Sense Organs and Perceptions of Fishes" (*ibid.*, in the press).

GEORGE ALBERT BOULENGER,

Assistant (First Class) in the Zoological Department, British Museum. Distinguished for his knowledge of Herpetology. Author of the Catalogues of Batrachia (2 vols., 1882); of Lizards (3 vols., 1885-87); of Chelonians and Crocodiles (1889). In these volumes, which are the standard works for the study of these animals, all the species known are described, their systematic arrangement being based on a critical examination of the more recent researches into their anatomical structure and geographical distribution. He is also the author of a volume of the "Fauna of India and Burma," which is devoted to the Reptiles and Batrachians; and of a great number of memoirs and papers published in the Transactions and Proceedings of the Linnean and Zoological Societies, the Geological Magazine, Annali del Museo Civico di Genova, and others. From 1880 to 1890 he has prepared the annual reports on Reptiles, Batrachians, and Fishes for the Zoological Record.

JOHN ROSE BRADFORD,

M.D., D.Sc. Physician. Assistant Professor of Clinical Medicine at University College. Author of "Electrical Phenomena of Secretion" (jointly with Mr. Bayliss) (Proc. Roy. Soc., 1886); "Physiology of Gland Nerves" (Journ. of Physiol., 1887 and 1888); "Innervation of the Renal Blood-vessels" (Proc. Roy. Soc., 1889); "Innervation of the Pulmonary Blood Vessels" (*ibid.*, jointly with Mr. Dean); "Influence of the Kidney on Metabolism (*ibid.*, 1892), and other papers.

HUGH LONGBOURNE CALLENDAR,

Fellow of Trinity College, Cambridge. Lecturer on Physics. Has made important investigations on the measurement of temperature by electrical means. These are described in the papers:—"On the Practical Measurement of Temperature" (Phil. Trans., 1887 A, p. 161); "On the Determination of the Boiling Point of Sulphur, and on a Method of Standardising Resistance Thermometers by reference to it" (*ibid.*, 1891 A) (this paper is written in conjunction with Mr. Griffiths); "On the construction of Platinum Thermometers" (Phil. Mag., July, 1891); "Some Experiments with a Platinum Pyrometer on the Melting Points of Gold and Silver" (*ibid.*, February, 1892).

WILLIAM WATSON CHEYNE,

M.B., C.M. (Edin.). F.R.C.S. (Eng.). Joint Professor of Surgery in King's College, London. Distinguished as one who has made discoveries in Bacteriology and Pathology, and as the author of the following works and papers:—"On the Relation of Micro-organisms to Antiseptic Dressings" (Trans. Path. Soc., 1879); "Antiseptic Surgery, its Principles and Practice" (awarded the Jacksonian prize of the Royal College of Surgeons, 1882); "On Micro-organisms in Purpura Hæmorrhagica" (Trans. Path. Soc., 1884); "On *Bacillus Alvei*, the Cause of Foul-brood in Bees," in conjunction with Mr. Cheshire (Journ. Roy. Micros. Soc., 1885); "A Study of certain of the Conditions of Infection" (Brit. Med. Journ., 1886); "On Suppuration and Septic Disease" (Lectures delivered before the Royal College of Surgeons, 1887); "On the Pathology, Etiology, Results and Treatment of Tubercular Diseases of Bones and Joints" (awarded the Astley Cooper prize, open to International competition, 1889); and numerous other valuable contributions to Bacteriology and Pathology.

ROBERT EDMUND FROUDE,

Superintendent of the Admiralty Experimental Works. Associate Member of Council, Institution of Naval Architects. Distinguished for original mathematical and experimental investigations which have greatly advanced knowledge of (*a*) the resistance offered by water to the movements of ships; (*b*) the forms of ships tending to diminish resistance; (*c*) the efficiency of propellers. In these departments of inquiry, he for many years assisted his father, the late Mr. W. Froude, F.R.S. Since 1878 he has worked independently, and been in full charge of the Admiralty Experimental Works, first at Torquay and then at Haslar. The existing establishment, with its novel mechanical arrangements for experimenting with models of ships and propellers, was designed by him. His advice has been sought and given in organising similar establishments in this country and abroad. His mathematical and experimental work has had great and beneficial influence on ship-designing, primarily for the Royal Navy, but also for the mercantile marine. Under his direction the system of model experiments has been greatly extended, enabling naval architects to proceed with great certainty in dealing with problems of propulsion, and effecting large economies of engine power in steamships. He has published many original papers on these special subjects, most of them appear in Transactions of the Institution of Naval Architects. Amongst these the principal papers are: "The Leading Phenomena of Wave-making Resistance" (1881); "Screw Propellers and their Efficiency" (1883 and 1886); "Theory of the Screw Propeller" (1889 and 1892).

M. J. M. HILL,

M.A., D.Sc., late Fellow of St. Peter's College, Cambridge. Professor of Mathematics in University College, London. Eminent Mathematician. Author of the following papers on pure and applied Mathematics:—"The Steady Motion of Electricity in Spherical Current Sheets" (Quart. Journ. Math., vol. xvi.); "Some Properties of the Equations of Hydrodynamics" (*ibid.*, vol. xvii.); "On Functions of more than two Variables Analogous to Tesseral Harmonics" (Trans. Camb. Phil. Soc., vol. xiii.); "Calculation of the Equation which determines the Anharmonic Ratios of the Roots of a Quintic" (Proc. Lond. Math. Soc., vol xiv.); "On some General Equations which include the Equations of Hydrodynamics" (Trans. Camb. Phil. Soc., vol. xiv.); "On the Motion of Fluid, part of which is moving rotationally, and part irrotationally" (Phil. Trans., 1884); "On the closed Link-Polygons belonging to a System of Co-planar Forces having a Simple Resultant" (Proc. Lond. Math. Soc., vol. xv.); "The Differential Equations of Cylindrical and Annular Vortices" (*ibid.*, vol. xvi.); "On the Incorrectness of Rules for Contracting the processes of finding the Square and Cube Roots of a Number" (*ibid.*, vol. xviii.); "On the c- and p-Discriminants of Ordinary Integrable Differential Equations of the First Order" (*ibid.*, vol. xix.); "On Node- and Cusp-Loci, which are also Envelopes" (*ibid.*, vol. xxii.); "On the Locus of Singular Points and Lines which occur in connection with the Theory of the Locus of Ultimate Intersections of a System of Surfaces" (to be published in Phil. Trans.).

JOHN VIRIAMU JONES,

B.Sc. (Lond.). Principal and Professor of Physics in the University College of South Wales and Monmouthshire. Fellow of University College, London. Distinguished for his acquaintance with physics. Engaged in the teaching of physics as well as in the organisation of scientific studies, and is anxious to promote the progress of science. Author of a memoir "On the Determination of the Specific Resistance of Mercury in Absolute Measure" (Phil. Trans., vol. clxxxi., 1890). Author also of the following papers:—"On the Calculation of the Co-efficient of Mutual Induction of a Circle and a Coaxal Helix" (Proc. Phys. Soc., vol. x.); "On the Use of Lissajous' Figures to determine a Rate of Rotation, and of a Morse Receiver to measure the Period Time of a Reed

or Tuning-fork" (*ibid.*); "Suggestions towards a Determination of the Ohm." Read before the British Association at Leeds, 1890 ("The Electrician," vol. xxv.).

AUGUSTUS EDWARD HOUGH LOVE,

Fellow of St. John's College, Cambridge. Lecturer in Mathematics. Author of the following papers of merit, connected with mathematics:—"On recent English Researches in Vortex Motion" (Math. Ann., vol. xxx., 1887); "On Dedekind's Theorem concerning the Motion of a Liquid Ellipsoid under its own Attractions" (Phil. Mag., 1888); "The small Free Vibrations and Deformation of a Thin Elastic Shell" (Phil. Trans., 1888); "On the Motion of a Liquid Elliptic Cylinder under its own Attraction," and "The Oscillations of a Mass of gravitating Liquid in the form of an Elliptic Cylinder which rotates as if rigid about its axis" (Quart. Journ. Math., 1888); "The Free and Forced Vibrations of an Elastic Spherical Shell containing a given Mass of Liquid" (Proc. Lond. Math. Soc., vol. xix., 1888); "The Oscillation of a Rotating Liquid Spheroid, and the Genesis of the Moon" (Phil. Mag., 1889); "Vortex Motion in certain Triangles" (Amer. Journ. Math., 1888); "The Motion of a Solid in a Liquid when the Impulse reduces to a Couple" (Proc. Phil. Soc., Camb., 1888); "On the Equilibrium of a Thin Elastic Spherical Bowl" (Proc. Lond. Math. Soc., vol. xx., 1889); "On Sir W. Thomson's Estimate of the Rigidity of the Earth" (Trans. Phil. Soc., Camb., vol. xv., 1890); "Note on the Present State of the Theory of Thin Elastic Shells" (Proc. Roy. Soc., vol. xlix., 1891); "Wave Motion in a Heterogeneous Heavy Liquid" (Proc. Lond. Math. Soc. vol. xxii., 1891); "On the Theory of Discontinuous Fluid Motions in two Dimensions" (Proc. Phil. Soc., Camb., vol. vii., 1891).

RICHARD LYDEKKER,

B.A. (Camb.). Formerly on the Geological Survey of India. Distinguished for his acquaintance with the science of Palæontology. Author of a series of illustrated quarto memoirs on the Tertiary and Post-Tertiary Vertebrata of India, "*Palæontologica Indica*" (Memoirs Geol. Surv. India, 1876-86); also a part of the Mesozoic Vertebrata of India (*ibid.*); of "Catalogue of the Fossil Mammalia in the British Museum," in five parts (1885-87), of "Catalogue of the Fossil Reptilia and Amphibia," now in course of publication; and of many papers on Palæontological subjects to the Quart. Journ. Geol. Soc., Proc. Zool. Soc., &c.

Supplementary Certificate.

Author of:—British Museum Catalogue of Fossil Reptiles, 4 vols.; British Museum Catalogue of Fossil Birds; Vol. II. (Vertebrates) of Nicholson and Lydekker's Manual of Palæontology. Joint author, with Sir W. H. Flower, of "The Study of Mammals"; a monograph of the Extinct Argentine Dinosaurs; Cetaceans and Ungulates in the La Plata Museum; and numerous minor papers.

FRANCIS CRANMER PENROSE,

M.A., F.R.I.B.A., F.R.A.S. Honorary Fellow of Magdalene College, Cambridge. Architect. Surveyor to the Fabrick of St. Paul's Cathedral. Late Director of the British Archæological School at Athens. Author of books or memoirs on (1) "Principles of Athenian Architecture," 1851; (2) "On the Prediction and Reduction of Occultations of Mars and Eclipses by a Graphical Process," 1869; (3) "On the Determination of the Elements of the Orbits of Comets by Graphical Processes," Monthly Notices, 1881; (4) "Two papers on the Ancient Hecatompedon, Athens," 1891 and 1893; (5) "On the Orientation of Greek Temples and the Amplitudes of Stars at the time of the Foundation of the Temples," Phil. Trans., 1893. Observer of the Total Solar Eclipses of 1870 and 1878. Inventor of Instruments for drawing the Logarithmic Spiral; for drawing the Hyperbola by continued motion parallel to the Asymptotes; for the Mechanical Solution of Spherical Triangles, &c.

DUKINFIELD HENRY SCOTT,

Ph.D. (Wurzburg). F.L.S. Honorary Keeper of the Jodrell Laboratory, Royal Gardens, Kew. Dr. Scott is a person attached to science and anxious to promote its progress. He is distinguished for his acquaintance with Botany, and has made discoveries in that branch of science which have been published in the following papers: "Entwickelungsgeschichte der gegliederten Milchröhren" (Inaug. Dissert., Wurzburg, 1881, published in Arbeiten des Bot. Instituts, Wurzburg, 1881; translation in Quart. Journ. Micros. Sci., 1882); "On the Laticiferous Tissue of *Manihot Glaziovii*" (Quart. Journ. Micros. Sci., 1884); "On the Occurrence of Articulated Laticiferous Vessels in Hevea" (Journ. Linn. Soc., Botany, 1885); "On the Nuclei of Oscillaria and Tolypothrix" (*ibid.*, 1887); with Mr. Wager, "On the Floating Tissues of *Sesbania aculeata*" (Annals of Botany, I., 1888); with Mr. Brebner, "On the Anatomy and Histogeny of Strychrios" (Annals of Botany, III., 1889); "On some Points in the Anatomy of *Ipomaea versicolor* (*ibid.*, v., 1891); with Mr. Brebner, "On Internal Phloem in the Root and Stem of Dicotyledons" (*ibid.*); "On the Secondary Tissues in Certain Monocotyledons" (*ibid.*, vii., 1893); with Miss Sargant, "On the Pitchers of *Dischidia Rafflesiana* (*ibid.*). Dr. Scott is also the author of many botanical reviews, notes, &c. He co-operated with Prof. Bower, F.R.S., in the preparation of the English edition of De Bary's "Comparative Anatomy of Phanerogams and Ferns" (Oxford, 1884); and with Prof. Howes in the preparation of the new edition (1888) of Huxley and Martin's "Elementary Biology." From 1882-85 Dr. Scott was Assistant to the Professor of Botany at University College, London, and was from 1885-92 Assistant Professor in Biology (Botany) at the Royal College of Science, South Kensington, a position which he resigned to take up that which he at present occupies at the Royal Gardens, Kew.

REV. FREDERICK JOHN SMITH,

Clergyman of the Church of England. Millard Lecturer in Experimental Mechanics, Trinity College, Oxford. Distinguished for his researches in practical mechanics and physics, and the invention of important dynamometric and integrating instruments; also of the chronograph—registering graphically periods of time from ·00005 sec. to 1·0 sec.—now used in the measurement of the flight of projectiles and in physiological research. Author of numerous papers, among which may be mentioned:—"An Experimental Investigation of the circumstances under which a Change of the Velocity in the Propagation of the Ignition of an Explosive Gaseous Mixture takes place in Closed and Open Vessels. Part I.—Chronographic Measurements" (Proc. Roy. Soc., vol. xlv., 1889); "Description of Dynamometer and Integrator for measuring the work done in Driving Dynamos and other machines" (Electrician, 1881); "Ergometer or work measuring machine" (Phil. Mag., vol. xv., 1883, and NATURE, vol. xxx.); "A new form of Electric Chronograph (Phil. Mag, vol. xxix., 1890); "On some new Methods of investigating the Points of Recalescence in Steel and Iron" (*ibid.*, vol. xxxi., 1891); "On some of the Effects of Magnetism on Rods of Iron, Nickel, and other Metals which have received a Permanent Torsional Set" (*ibid.*, vol. xxxii., 1891).

JOSEPH WILSON SWAN,

M.A. (*honoris causa*) Durham. F.C.S. F.I.C. Has devoted himself for many years with great success to experimental scientific work, chiefly in relation to Electric Lighting, the Electro-deposition of Metals, and the Improvement of Photographic Processes. His labours have resulted in material extension of knowledge, and in important inventions, among which are the Incandescent Electric Lamp, the Carbon Process, by which the first permanent photographic prints were produced and which has formed the basis of many processes of photo-mechanical engraving (in this relation the property of salts of sesquioxide of chromium to combine with gelatine and render it insoluble was discovered), the highly sensitive Gelatino-bromide Photographic Plate, the result of an original observation of the effect of heat on the gelatino-bromide of silver emulsion, the Cellular Form of Electrical Secondary Battery Plate, the production of Lamp Filaments from Solutions, Integrating Electric Meters, Safety Lamp for Miners, and an Electric Firedamp Indicator.

VICTOR HUBERT VELEY,

M.A., F.C.S. Lecturer on Chemistry. Author of the following papers: "On the Oxides of Manganese and their Hydrates" (Part I., Chem. Soc. Journ., 1880; Part II., *ibid.*, 1882); "On the Rate of Decomposition of Ammonium Nitrate" (*ibid.*, 1883); "On some Sulphur Compounds of Calcium" (*ibid.*, 1885); "On the Lime Process for the Purification of Coal

Gas" (Soc. Chem. Indust. Journ., 1885); "On some Sulphur Compounds of Barium" (Chem. Soc. Journ., 1886); "On the Conditions of Evolution of Gases from Homogeneous Liquids" (Phil. Trans., 1888); "On a Method of Investigating the Dissolution of Metals in Acids" (Chem. Soc. Journ., 1889); "On the Conditions of the Reaction between Copper and Nitric Acid" (Roy. Soc. Proc., 1889).

THE ARCTIC EXPEDITIONS OF 1894.

IT is not easy to speak definitely regarding the various Arctic Expeditions which will be in the field this year, for several of the most loudly advertised ventures have collapsed or been postponed, and it is possible that some quiet and determined explorers may set out without calling public attention to their plans. There is undoubtedly to be keen rivalry in the North Polar basin for several years to come, and even an incomplete forecast of the projected work may serve to direct notice to the regions whence good results in the way of Arctic discovery may be looked for. It is unnecessary to insist in the pages of NATURE, however needful the caution may be to the general public, that no credit for Arctic exploration can be given until the intending explorer returns, bringing with him proofs of his achievements which will bear the keenest criticism of experts.

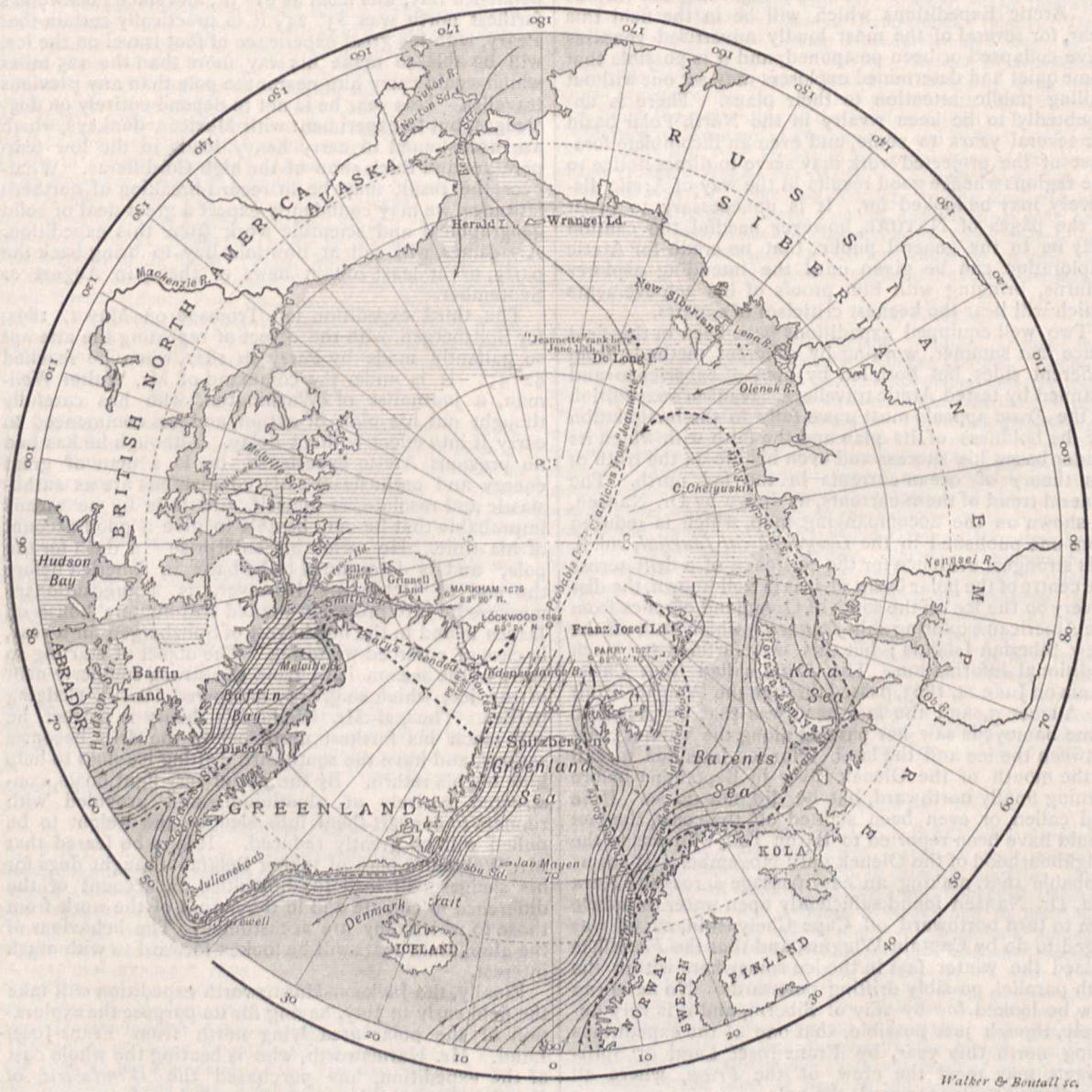
Two well-equipped expeditions have been in the field since last summer, working by different methods, from different sides, but both led by men of experience and manned by tested Arctic travellers. Nansen's expedition in the *Fram* appeals most powerfully to the imagination for the boldness of its plan and the faith with which its leader bases his success and even his life on the truth of his theory of ocean-currents in the far north. The general trend of these currents, as drawn by Dr. Nansen, is shown on the accompanying map, which is reduced from one published in the *Geographical Journal*, vol. ii. His strongest evidence for the existence of a drift across the centre of the polar basin was, as is well known, the discovery on the ice off the south of Greenland of relics from the American exploring ship *Jeannette*, which sank off the New Siberian Islands; but this was fortified by much additional information. The *Fram* sailed from Christiania on June 24, 1893, passed through the Waigatz Strait on August 3, and the last news was that on August 6 some Samoyeds saw her passing along the Yalmal coast between the ice and the land. Nansen intended to call at the mouth of the Olenek River in September before turning finally northward, but he did not do so. If he had called, or even been sighted off the coast, the fact would have been reported to Baron Toll, who was in the neighbourhood of the Olenek until November. It seems probable that, making an easy passage across the Kara Sea, Dr. Nansen found sufficiently open water to induce him to turn northward off Cape Chelyuskin, as he was urged to do by Captain Wiggins, and that the *Fram* has passed the winter fast in the ice somewhere within the 80th parallel, possibly drifting polewards. No news can now be looked for by way of Siberia, and it is very unlikely, though just possible, that one of the expeditions going north this year, by Franz-Josef Land or Spitzbergen, may meet the crew of the *Fram*, where all meridians converge towards the pole.

Mr. Peary, after raising the necessary funds in America by writing and lecturing, returned to the scene of his former triumphs at Independence Bay on the north-east coast of Greenland. He and his party landed at Bowdoin Bay on Inglefield Gulf in Smith Sound on August 3, 1893, and established themselves there for the winter, being comfortably settled when the steamer left on August 20. Sledging parties were at once despatched to *cache* provisions at convenient depôts on the inland ice on the way to Independence Bay. Mr. Peary intended to commence his main journey about the middle of March this year, and to reach Independence Bay in the first week of May. Here the party will divide, three men being despatched to sledge south-eastward and survey the coast along the quite unknown stretch to Cape Bismarck, returning thence across the ice-cap to Inglefield Gulf. The other party will push northward from Independence Bay, and endeavour to completely survey the land which was seen across the strait last year, at the same time trying to attain the farthest north. The position of Navy Cliff, on the south side of Independence Bay, was fixed as 81° 37′, and since Lockwood's farthest north was 83° 24′, it is practically certain that Peary, with his great experience of foot-travel on the ice, will be able to make his way more than the 125 miles which would carry him nearer the pole than any previous traveller. This year he is not to depend entirely on dog-sledges, but to experiment with Mexican donkeys, which are accustomed to carry heavy loads in the low temperature and thick snow of the high Cordilleras. Whatever the result may be in record-breaking of northern latitudes, we may confidently expect a great deal of solid geographical and scientific work from this expedition. A steamer will call at Bowdoin Bay to bring back the party, or at least obtain news of them, in August or September.

The third expedition left Tromsoe on May 1, 1894, for Spitzbergen, with the object of repeating the attempt so gallantly made by Parry in 1827, when he reached 82° 45′. It is under the command of Mr. Walter Wellman, a journalist of Washington, who has carefully thought out his plan of action, and has commenced to carry it into effect without delay. Although he has had no previous Arctic experience, he is a man of great energy and enthusiasm; his companions are as enthusiastic and resolute as himself, and it is by no means improbable that he may be able to give a good account of his time. He terms his enterprise "a dash for the pole," and is determined to be back in America before the end of October. However, as a precautionary measure he is to provision the old seal-hunters' house on Danes Island in the north-west of Spitzbergen for a year, in case of enforced wintering. The object of starting so early in the season is to avoid the strong southerly drift of the ice, which so greatly hampered Parry's sledging parties. Thus, if Mr. Wellman's theory is correct, he will reach his farthest north before the drift becomes serious, and have the southward drifting ice-floes to help him on his return. By the use of very light boats, constructed entirely of aluminium, and provided with runners to convert them into sledges, the weight to be pulled will be greatly reduced. It is to be feared that Mr. Wellman's plan of taking Belgian draught dogs for his sledges will lead to difficulties on account of the difference in climate and in the nature of the work from those to which they are accustomed. The behaviour of the aluminium boats will be looked forward to with much interest.

Finally, the Jackson-Harmsworth expedition will take the field early in July, having for its purpose the exploration of the polar area lying north from Franz-Josef Land. Mr. Harmsworth, who is bearing the whole cost of the expedition, has purchased the *Windward*, of Peterhead, a well-known steam whaler of 320 tons, to take the party out to Franz-Josef Land, but the exploration will be conducted by land or across the ice. Mr. F. G. Jackson, the originator and leader of the expedition, has long thought over this matter, and devoted most of his time for two years to the study of Arctic problems. He spent a great part of last winter in the north of Russia, testing sledges and other appliances for ice-travel and practising surveying on the little-known Waigatz Island. Like Peary, he intends to try the endurance of stronger animals than dogs in Arctic work, proposing to take a number of Russian ponies. The *personnel* of the expe-

dition, although probably not exceeding six, will include trained specialists and collectors, who will map their route, make meteorological and magnetic observations, and collect geological, botanical, and zoological specimens. After calling at Archangel, in the end of July, to take on board a Russian log-house, and then at Khabarova to ship West Siberian dogs and drivers, the *Windward* will proceed to Franz-Josef Land and make a landing somewhere in the south of that region, the exact spot depending on the state of the ice. The route to



North Polar Map to illustrate projected Polar Expeditions.

and his companions will spend the winter at their base, where the conditions of life were found to be quite endurable by Mr. Leigh Smith when he was compelled to spend a winter there, with very poor accommodation and equipment, after the wreck of his yacht, the *Eira*, in 1881. Early in the spring of 1895 the expedition would push northward, moving very slowly because of the necessity of traversing the distance several times over in order to carry the quantity of stores necessary to establish a depôt every thirty or forty miles along the

Franz-Josef Land will thus be due north from near Kolgueff Island, instead of north-eastward from Norway as shown on the map. The wooden house will be erected on a secure and sheltered site, and stocked with the necessary stores for four years, after which the ship will return. If, as seems possible from Payer's observations, Austria Sound should be found open, provisions will be carried north along it in a steam-launch and *cached* for subsequent use. Mr. Jackson route. This slow progress will, of course, give an opportunity for repeating observations for position, and so add to the accuracy of the map. The direction of advance will probably be along Austria Sound and across Petermann Land, the farthest north sighted by Payer in the Austro-Hungarian expedition, and lying in 83° N. Should Petermann Land extend to the north, Mr. Jackson intends to proceed along it, mapping his route as he goes. Boats would be carried for crossing

open water, and if oceanic ice intervenes, it would be traversed as rapidly as possible, and a return made to the farthest north point on solid land, where winter-quarters could be established; but should this be impracticable, the retreat would be continued to the base, where the second winter would be spent. In the spring of 1896 the party would turn northward again, the chain of depôts accelerating their progress. In the summer of 1896 the ship will return with additional stores and men, and to obtain news; but it does not appear to be Mr. Jackson's intention to return, unless he is satisfied that his work is final, until 1897. This expedition ought certainly to extend our knowledge of the most northerly land known, and if fortune favours it, the advances made may be great. Its equipment is of the very best, and no excuse of bad material can be brought forward to explain unsatisfactory results.

The expedition for the exploration of Ellesmereland, to which reference has several times been made in NATURE, planned by Mr. Robert Stein, of the U.S. Geological Survey, has been postponed; we hope only until next season. Still efforts will be made this summer to clear up the fate of the unfortunate young Swedish naturalists, Björling and Kalstennius, with their mate, Gilbert Dunn, and cook, Herbert MacDonald, of whom the last news received was that they intended to seek shelter with the reported Eskimo of Ellesmere Land. Mr. Elis Nilson has been sent out by the Swedish Anthropological and Geographical Societies, on the Dundee whaler *Eclipse*, to visit the Carey Islands and Clarence Head, if the ice permits, and search for any relics of the missing party, whose fate, after two years without supplies, can scarcely be considered doubtful. Baron Nordenskjöld has interested himself particularly in the search, and will probably arrange for other whalers to deviate from their course in order to obtain information.

Dr. F. A. Cook, the ethnologist on Peary's former expedition, has issued a prospectus of a pleasure trip which he is to conduct up Baffin's Bay to Smith Sound, with the opportunity of a slight change of route should any of the passengers desire it. This would, if the state of the ice permitted, render it possible to call at Clarence Head and the Carey Islands, and make at least a hasty search for the missing party; but a pleasure trip scarcely lends itself to serious Arctic exploration.

Prophecy with regard to the results of geographical exploration is too uncertain to be indulged in by modern critics, and in Arctic exploration particularly the conditions are so difficult to predict that success may attend the most inexperienced and worst equipped, while experience and all the resources of wealth and science would struggle in vain against adverse conditions. There are certain remarkable features about the new expeditions which distinguish them from most of the earlier efforts. Each has been planned and is being carried out by a man who is thoroughly in earnest, and whose reputation rests on his success. This is widely different from the case of a commander "ordered" to carry out the plans of others. Each expedition is small; Nansen's, which is the largest, comprises only thirteen men. Two of those which have already faced the awful monotony of the Arctic night, have appliances for dissipating the darkness by the electric light, an advantage which can hardly be over-estimated in its effect on the spirits of the men. Provisions and equipments have been greatly improved, even since the time of the *Alert* and *Discovery* and of the *Jeannette*. Most important of all, three of the expeditions are free from the responsibility of a ship. In all these ways the four serious attempts of this year have elements of success never combined previously. Their results will not be known for some time. News of Mr. Peary will certainly be received this autumn by the vessel to be sent up to Inglefield Gulf to bring him home if he considers his work satisfactorily finished. It is probable that Mr. Wellman also will return; but unless he should by some scarcely credible good fortune meet the crew of the *Fram* at his farthest north, we cannot hope to hear of Nansen for another year at least; and Mr. Jackson's scheme provides for a possible absence on his part for four years, though progress should be reported before the end of next year.

HUGH ROBERT MILL.

THE CRINOIDEA OF GOTLAND.[1]

THIS is the first instalment of a memoir based on a revision of the specimens of crinoids in the Angelin collection at Stockholm. It is published in English, and is illustrated by Mr. G. Liljevall, who has produced 382 remarkably beautiful figures upon ten quarto plates. Their accuracy may be relied on by those who know Mr. Bather's own scrupulous carefulness as an artist.

The author commences by pointing out the need for a thorough re-examination of the Stockholm specimens, the drawings in Angelin's "Iconographia Crinoideorum" being so frequently misleading, and having been in many cases produced by a union of several distinct individuals. The older palæontologists certainly had not that reverence for type-specimens which now very justly prevails among curators; they brought out, as they thought, the salient points of their specimens, filled in a sort of fancy groundwork of rock around the drawing, and left students to search in vain in the collection for the exact object that had thus been honoured above the others.

The classification of the Crinoidea undergoes considerable changes with each new descriptive paper, and Mr. Bather's works are a healthy example of receptivity and indifference to precedent. We read each in the light of the glossary appended to it, ridding our minds as far as possible of the technicalities that we have previously learned. We must confess that such changes in nomenclature are based on observation and on additions to our knowledge, and we need only quarrel with the terminology when it is reduced to algebraic symbols.

The abolition of the Fistulata and the Larviformia as sub-orders of the Inadunata (p. 8), and the substitution—quite temporarily—of divisions based on the presence or absence of infrabasals, may be hailed as a simplification, allowing more latitude in the association of the several genera. But the value of such close and detailed work as that of the present memoir will depend in no way upon the stability of the classification utilised. Mr. Bather (p. 19) can thus treat even the Inadunata as a convenient portmanteau, soon to be worn out; and specialists will turn with pleasure to the critical descriptions of individual specimens in the collections.

A fine example of how the collation of specimens, year after year, will add profoundly to our knowledge of ancient life upon the earth, is to be found in the story of *Herpetocrinus* (pp. 36–45). The crown of this genus was detected in certain Dudley specimens by Mr. Bather himself, Salter's opinion being thus amply verified; and the coiled stem, often supposed to be an arm, is now shown to have had a permanent tendency (p. 45), by its very structure, to bend round in one direction, while it could probably be uncoiled "by the simple contraction of the large musc'es on the outer part of the articular surface." With a quaintness of expression now familiar to us, our author proceeds: "It is very probable that the animals usually broke off any rooted attachment they may have formed, and that they clung to corals or other submarine objects by their cirri." It is further suggested that they could move from one spot to another.

[1] "The Crinoidea of Gotland." Part i. The *Crinoidea Inadunata*. By F. A. Bather, M.A., F.G.S. (Stockholm: Kongl. Svenska Vet.-Akad, Handl. Bt. 25. 1893.)

The extraordinary difficulties surrounding this genus are illustrated by the fact that Mr. Bather himself at one time described the arm of a *Streptocrinus* as the stem of *Herpetocrinus* (p. 176).

Controversial matters are treated in this paper with the delicacy of the duellist rather than with the tactics of the football-field; and Mr. Bather may be congratulated on the position he has gained among the exponents of intricate research. We look forward with keen interest to the completion of this handsome memoir.

G. A. J. C.

A DEDICATORY NUMBER OF THE QUARTERLY JOURNAL OF MICROSCOPICAL SCIENCE.

A SPECIAL complimentary number of *The Quarterly Journal of Microscopical Science* has been issued, dedicated by his colleagues to Prof. E. Ray Lankester, F.R.S., in celebration of the completion of twenty-five years of editorship. The *Journal* contains contributions by Dr. E. Klein, F.R.S., Prof. A. G. Bourne, Mr. Adam Sedgwick, F.R.S., Mr. W. C. McIntosh, and Prof. A. A. W. Hubrecht, of Utrecht University. It is prefaced by the subjoined historical sketch, signed by Mr. Sedgwick and Prof. Weldon.

It is now five-and-twenty years since Prof. Lankester first undertook the task of editing the *Quarterly Journal of Microscopical Science*, and by issuing the present number his colleagues desire to mark the occasion, and at the same time to take the opportunity of offering to him their hearty congratulations on the success which has attended this quarter of a century of effort on his part.

The *Journal* was founded in the year 1853 by the publisher, Mr. S. Highley, and was edited by Dr. Edwin Lankester and Mr. George Busk. In 1856 the publisher's business was transferred to Mr. John Churchill, with which firm it has remained ever since. Up to 1868 the *Journal* published the "Transactions of the Royal Microscopical Society of London," but in 1869 the Society started its own publication, and a new editorial arrangement of the *Journal* was made. Mr. George Busk retired, and Mr. Ray Lankester, who had lately taken his degree at Oxford, joined his father in the editorship.

Mr. Ray Lankester's connection with the *Journal* began in 1863 with the publication of a paper on "Our Present Knowledge of the Gregarinæ," followed in 1864–5 by a memoir, in three parts, on "The Anatomy of the Earthworm." In 1865 he suggested the publication of a quarterly chronicle of the progress of histology and microscopic investigation, and joined Mr. Busk in its preparation. Curiously enough, this feature has been abandoned since 1872, whilst the Royal Microscopical Society has taken the task in hand, and produces an admirable and extensive record.

In 1872 Ray Lankester's father ceased to take part in editing the *Journal*, and was succeeded by Dr. J. Frank Payne. Lankester and Payne added Mr. Thiselton Dyer (now Director of Kew Gardens), to their editorial body in 1873, and he was succeeded in 1876 by Mr. Archer, of Dublin, the Secretary of the Dublin Microscopical Club, and the author of so many interesting discoveries among freshwater Rhizopoda. In 1877 Dr. Payne retired, and Dr. Klein joined the editorial staff.

In 1878 a further change was made. Prof. Lankester became sole editor, with the co-operation of Archer, Francis Balfour, and E. Klein. This arrangement has continued ever since, with various changes in the list of those co-operating. Thiselton Dyer returned for a few years as one of those giving his co-operation; and Moseley and Milnes Marshall have in turn assisted in the conduct of the *Journal*, and have published in it many of their most important papers, inducing their pupils to adopt the same mode of publication.

The number of contributions which this energetic policy attracted to the *Journal* soon made it necessary to enlarge it; and the term of Lankester's editorship has been marked by a continuous increase in the amount of letterpress and in the number and excellence of the plates. This has of necessity been accompanied by a rise in price. The original price was four shillings per number—the numbers being issued quarterly. At that time the volume consisted of some eight-and-twenty demy octavo sheets and twenty plates, mostly also octavo. The last volume contained thirty-six royal octavo sheets and forty-two plates, many of which were coloured, while the majority were of quarto size. The change from demy to royal octavo was effected at the commencement of 1883, and in 1890 the strict quarterly publication of the *Journal* was abandoned, so that more than four numbers could be issued in the year. During the eleven years which have elapsed since 1883, sixty-one numbers, divided into fifteen volumes, have been issued; so that the increase in size and price has not only affected the magnitude of each number, but has been accompanied by an increased rapidity of publication.

Every reader will remember that Prof. Lankester's energy has by no means been exhausted in merely editing the *Journal*, for besides his many writings elsewhere, he has published more than sixty memoirs in the pages of this *Journal* alone; and we may, perhaps, be permitted to mention a few of the more prominent of these—such as that on "The Development of the Pond Snail" (1874), which marks the starting-point of his well-known investigation of the development of Mollusca; the "Notes on the Embryology and Classification of the Animal Kingdom" (1877), which exercised so great an influence upon the whole tendency of morphological speculation; the descriptions of Limnocodium (1880); the series of memoirs on Apus and Limulus (1881–1884), and on Rhabdopleura (1884); the first description of the atrio-cœlomic funnels in Amphioxus (1875), and the subsequent memoir on the anatomy of the same animal, together with the account, commenced in conjunction with his pupil, Mr. Willey, and continued by Mr. Willey alone, of the later history of its remarkable larva.

It would be useless to enumerate all the naturalists who have contributed to the *Journal* since Prof. Lankester's successful enterprise has made it the chief medium of publication for English morphological work; but it is interesting to notice that the contributors have constantly included foreign naturalists of distinction, including E. van Beneden, Bowditch, Carrière, Claparède, Dollo, Giard, Hubrecht, Iijima, Ischikawa, Kingsley, Mitsukuri, H. F. Osborn, Oudemans, Packard, Patten, Pelseneer, Pouchet, Ranvier, Whitman, and others. Some of these have taken the opportunity, by contributing to the present number, of joining in the hearty congratulation on his past achievement, and sincere good wishes for the future, which Prof. Lankester's associates now offer to their chief.

NOTES.

THE following fifteen candidates were selected on Thursday last by the Council of the Royal Society, to be recommended for election into the Society:—Mr. W. Bateson, Mr. G. A. Boulenger, Dr. J. R. Bradford, Mr. H. L. Callendar, Prof. W. W. Cheyne, Mr. R. E. Froude, Prof. M. J. M. Hill, Prof. J. V. Jones, Mr. A. E. H. Love, Mr. R. Lydekker, Mr. F. C. Penrose, Dr. D. H. Scott, Rev. F. J. Smith, Mr. J. W. Swan, and Mr. V. H. Veley. We print their qualifications in another column.

THE "Ladies' Conversazione" of the Royal Society is announced for Wednesday, June 13.

THE death is announced of Dr. E. H. Vinen, at the age of sixty-nine. He was a Fellow of the Linnean Society, and well known among botanists and geologists.

WE regret to learn of the following deaths among scientific men abroad:—Dr. Louis von Uslar, Professor of Pharmacy in the University of Göttingen; Dr. A. Schmidt, Professor of Physiology in the University of Dorpat (or Jurieff); and Prof. Thomas Morong, the well-known botanist.

THE Council of the British Medical Association are prepared to receive applications for grants in aid of researches for the advancement of medicine and the allied sciences. Applications for sums to be granted at the next annual meeting must be made on or before June 15 in writing, addressed to the General Secretary, at the office of the Association, 429, Strand, W.C. They must include details of the precise character and objects of the research which is proposed. Reports of work done by

the assistance of Association grants belong to the Association. Instruments purchased by means of grants must be returned to the General Secretary on the conclusion of the research in furtherance of which the grant was made. The Council of the Association are also prepared to receive applications for one of the three Research Scholarships which is vacant, of the value of £150 per annum, tenable for one year, and subject to renewal by the Council for another year.

A LECTURE on "Recent Discoveries at Koptos," with illustrations, will be delivered by Prof. Flinders Petrie at University College, Gower Street, on Saturday, May 26, at 2 p.m. These discoveries include the long-sought rise of Egyptian art, and the prehistoric remains of the race on entering Egypt. The lecture will be free to the public without ticket.

AT the annual general meeting of the British Ornithologists' Union, held on Wednesday, the 9th inst., Lord Lilford was re-elected President, and Mr. F. D. Godman Secretary, for the ensuing year, and Lieut.-Colonel L. H. Irby and Mr. W. T. Blanford, F.R.S., were placed on the committee in lieu of two retiring members. It was agreed that a new (seventh) series of *The Ibis* should be commenced in 1895 with the thirty-seventh volume, and that Dr. P. L. Sclater, F.R.S., and Mr. Howard Saunders should be appointed as joint editors of it.

IT is impossible to speak too highly of the part taken by the Smithsonian Institution in diffusing knowledge. Not the least important of the methods adopted to make the works of men of science known unto the ends of the world, is the inclusion of miscellaneous reprints of memoirs in the annual reports of the Institution. A report just received shows the operations, expenditures, and condition of the Institution in 1892, and contains an appendix of the kind referred to. Therefore it is useful and interesting to all engaged in the promotion of knowledge. Of the thirty-three papers appended to the report, six have been reprinted from NATURE, and, we need scarcely say, proper acknowledgment of the source is given in each case. There are several translations of important papers, among them being Prof. J. A. Palmén's report on the migration of birds, presented to the second International Ornithological Congress in Budapest in 1891; and translated extracts from an ornithological essay on the flight of birds, by M. L. P. Mouillard, published in Paris in 1881 under the title "L'Empire de l'Air." Other contributions calling for special mention refer to the geological history of the Yellowstone Park, Mr. W. Woodville Rockhill's explorations in Mongolia and Thibet, and the progress of astronomy during 1891 and 1892.

THE recent publication of several important works has brought into prominence the subject of the theory of functions. Those who are interested in this branch of mathematical science will therefore be glad to know that Messrs. Mayer and Müller, of Berlin, intend to publish, in about eight volumes, the collected papers of Herr Karl Weierstrass, who has been termed the creator of the modern theory of functions. The work will be issued under the auspices of the Königlich Preussischen Akademie der Wissenschaften, and it is with the sanction of Prof. Weierstrass himself that this edition of his collected mathematical works is allowed to see the light. Messrs. Mayer and Müller rightly ground the importance of this publication on the name of the author. The first part is to contain memoirs already published, or which are ready for publication, in three volumes, the papers being printed in chronological order. The series is to open with "the development of the modular functions" which was presented to the Prüfung's-Commission at Münster in 1841. This part also contains the Braunsberg School programme, the fundamental importance of which in the theory of the Abelian functions is well known. The second part is to consist of five volumes, and will include the greater part of the lectures delivered in the University of Berlin. In the first volume of this part is the lecture based on "the Theory of the Elliptic Functions," which was delivered for the first and only time in the Professor's sixtieth year (*cf.* Forsyth, cap. v.-vii.) The theory is here established on Euler's Addition-theorem. The lecture closes with an application to several geometrical and mechanical problems. A later volume contains "the general Elliptic Transcendents," as well as a detailed discussion on the transformation of elliptic functions. The theory of the Abelian functions occupies the remaining volumes, one of which is devoted to a special discussion of the theory of the so-called hyperelliptic functions. The lectures are to be edited by a former pupil of Prof. Weierstrass, who, however, will himself supervise the publication. The work is to come out in quarto volumes, and great care is to be bestowed on their production. It is expected that all the volumes will be issued in a few years.

PROF. W. C. MACKENZIE, of the College of Agriculture, Ghizeh, has sent us some interesting information with regard to the existence of nitrate of soda in Egypt. It appears that the natives of Upper Egypt, from Keneh to Esneh, are in the habit of carrying a substance called "tafl," from the hills on the east side of the river, to manure their fields, especially the maize crop. That this was done seems to have been well enough known to many people in the habit of spending some time there, but beyond a casual knowledge of the fact that the "tafl" was used as a manure, no further interest seems to have been taken. What the valuable ingredient was, does not seem to have been known, and the name "tafl" was used indiscriminately for clay for pottery and clay for manure. Analyses of several samples of this substance showed, however, that they contained nitrate of soda from 2 per cent. to 18·5, mixed with varying proportions of chloride and sulphate, as well as calcium carbonate and clay. Further examinations of other samples did not show such a high percentage, the richest containing only 4 per cent. Prof. Mackenzie visited the deposit in the hills east from Luxor, and some eight miles distant from the town across the desert, and there found the "tafl" right on the face of a limestone hill, apparently cropping out of the rock. Samples taken at different heights gave percentages varying from 2 to 9·5 of nitrate of soda. On sending in a report about this nitrate, Nubar Pasha, the present Prime Minister, arranged to send up Mr. E. A. Floyer and Prof. Sickenberger to investigate the whole question, and endeavour to estimate the quantity. The investigation will no doubt throw considerable light on the origin of this curious occurrence of nitrate. Prof. Mackenzie thinks that the idea that the clay has simply acted as an absorbent for nitrates got from accumulations of potsherds, &c., does not seem possible, for at Luxor there is no evidence of this whatever, the deposit of nitrate-bearing clay being at the foot of a limestone cliff, and no appearance of potsherds anywhere. He believes that more probably caves or swallow-holes in the limestone cliffs have collected clay and organic matter from the river, and the nitrification of this organic matter has produced the nitrate where it is now found. Messrs. Floyer and Sickenberger's report will, however, no doubt clear this point up.

AMONG the shorter contributions in the May number of the *Psychological Review* is one by Prof. W. O. Krohn on the relation of sensation-areas to movement. He had the opportunity of testing the sensitivity of the skin of a man who had had his left forearm encased in a plaster-of-paris case for a period of three months. During this entire period the forearm could not be moved either at the wrist or at the elbow. Prof. Krohn compared the sensitiveness of the skin of the uninjured right forearm with that of the left forearm of the same person, after the plaster case had been removed, by means of the usual

æsthesiometric tests. He found that on the latter forearm the one so long unmovable, when the two points of a pair of dividers or compasses, touching the skin at a given locality, were separated by as much as fifty-five millimetres, they were felt as one instead of two; while on the right forearm they only had to be about twenty millimetres apart in order to be perceived as two. On the back of the left arm, at a different locality from that just mentioned, it was found that even when the two points of the dividers were seventy-five and eighty milllmetres apart, they were felt as one; while at a corresponding locality on the right arm the skin was so sensitive that points but 17 mm. apart could be felt as two. It should be mentioned that the subject was practically ambidextrous before meeting with the accident which led to the casing of his arm in plaster. Prof. Krohn thinks, therefore, that the sensitivity of the skin over the injured forearm was lost simply because that member was for so long a time immovable. He points out that this has an important bearing upon the principle that "the localising power is delicate in proportion as the skin covers a movable part of the body."

AN "Atlas of the French Lakes" has been in progress since 1886, under the auspices of the Ministry of Public Works in France. It is now completed, and published in ten sheets, with coloured contour-maps of the French lakes, great and small. Lake Geneva, partly done by Swiss surveyors, is drawn to scale 1/50,000, Lake d'Annecy to scale 1/20,000, and the others 1/10,000. Several results of general interest are obtained—for example, the regular spherical shape of old crater lakes in the Auvergne district, the shallowness and irregularity of lakes at the outflow of a glacier, such as Lake Sylans in the Ain Department; again, the filling-up of lakes at the inflow of the river, typically shown by Lake Brenets, in the course of the River Doubs. The work has been accomplished by M. André Delebecque, Civil Engineer of Bridges and Roads, assisted by his colleagues MM. Garcin and Magnin. The day has yet to come when our Government will authorise a similar special work on British lakes.

So little is known about the origin of many infectious diseases that an article by Dr. Keser, in the *Medical Magazine* for May, will be read with interest. The chief reason why the matter is in obscurity is that the descriptions of diseases found in the works of early writers do not afford the necessary means of identification. A noteworthy exception to this, however, is Thucydides' narrative of the plague of Athens. The author gives a graphic account of an acute well-marked epidemic disease which invaded Athens in the year 430 B.C., appearing unexpectedly amongst healthy people, and destroying the lives of many thousand inhabitants during the three years that it lasted. It has been supposed by some that the disease was small-pox, while others have considered it to have been a malignant form of scarlatina or typhus. A careful review of the facts and evidence, however, leads Dr. Keser to believe that the plague of Athens was probably a variety of the true Oriental plague, characterised chiefly by a varioliform exanthem with redness and lividity of the skin, by ulcers, and by the absence or rarity of buboes. The connecting links between this form of the plague and the typical *Pestis inguinaria* still remains a matter of conjecture.

THE April number of *Das Wetter* contains an article on sun-spots and weather, by P. Polis, based on sixty-four years' observations at Aix-la-Chapelle (1830-93). The author has tabulated Wolf's relative sun-spot numbers, together with the yearly, winter, and summer mean temperature values, the number of thunderstorms and annual rainfall, and has also represented the values graphically. The curves show that down to the year 1878 the summer and annual mean temperatures decrease with greater sun-spot frequency, and that an increase of summer and yearly temperature occurs with a decrease of sun-spots. The winter temperature curve also agrees generally with the other two. From the year 1878 the temperature curves are reversed, a decrease of sun-spots corresponding with a fall of temperature, and *vice versâ*. The rainfall curve is irregular, but it appears, contrary to results obtained elsewhere, to take exactly an opposite course to that of the sun-spots. The number of thunderstorms increases generally with a decrease of sun-spots, and *vice versâ*.

FOR some years past, Prof. Klossovsky, Director of the Meteorological Observatory of Odessa, has been actively engaged in collecting and discussing observations bearing on the climate of south-west Russia, and the observers co-operating with him amounted in 1892 to 1900 in number. A valuable paper on the climate of Odessa has recently been published (in Russian), from which it appears that the mean annual rainfall for 1866-92 was about 17 inches; the wettest month during this period was June 1886, in which the rainfall was 6·6 inches, while in September 1892 no rain fell. The annual mean temperature was 50°·2; the maximum was 95°·4, and the minimum −18°·8, giving an annual range of 114°·2. Several papers have also been published, bearing upon the agriculture of the district, including phenological observations, and also the occurrence of sandstorms, which are frequent in that part of Russia.

A RECENT number of the *Comptes Rendus* contains a paper by M. R. Swyngedauw, on the ratio of the currents produced by the discharge of a condenser in two circuits placed in parallel, one containing a spark-gap and the other self-induction. The apparatus employed by the author consists of a battery of two Leyden jars charged by a Holtz machine. The conductor which joins the coatings of these jars contains (1) a spark gap I_1; (2) a coil T which is traversed by the whole discharge Q_T; (3) two branch circuits, one containing a coil D exactly similar to T, the other containing a spark-gap I_2. The two coils T and D are identical, and can be placed either simultaneously or separately on the cross-bar of a Wiedemann-d'Arsonval galvanometer. Thus, by placing first the coil T and then D on the galvanometer, the total quantity of electricity discharged, or the fraction which passes through the branch circuit containing the coil, can be measured. The author finds that if the sparking distance I is left constant, that the quantity of electricity passing through the branch circuit containing the coil increases continuously as the spark interval I_2 is increased. When the spark interval I_2 passes a certain limiting value, the quantity of electricity passing through the branch coil is greater than that passing through the coil T. This anomalous increase might be considered to be due to a dissymmetry in the spark-gap I_2, so that oscillatory currents set up in the branch circuits would pass one way but not the other. The author finds, however, that if this spark-gap is changed, or the direction of the discharge changed, the increase is still observable.

AN elaboration of the presidential address delivered by Dr. D. Christison in November 1892, before the Botanical Society of Edinburgh, has just been published in the Society's *Proceedings* (vol. xix. part 3). The subject of the address was the actual size of the largest trees of species, native or long-naturalised, in Britain, particularly in Scotland, with a discussion of the question of their probable age. At the end of the paper Dr. Christison dispels a few pleasing illusions with regard to some historic trees. It is chiefly the oak, among trees, that has been associated with historic deeds, and perhaps none has acquired such fame as the Boscobel oak, reputed to have concealed Charles II. after the battle of Worcester in 1651. Dr. Christison says that an inscription which was placed against

the present tree in 1875 certifies:—"This tree, under the blessing of Almighty God, had the honour of sheltering from his foes King Charles II." But, it is pointed out, Mr. R. F. Collins (*Trans. North Staffordshire Field Club*, 1890) has shown that this tree, being only eleven feet ten inches in girth, could not have been the pollard oak of nearly two and a half centuries ago, and that a previous inscription in 1817 testified that "the present tree sprung, it is said, from the above tree" (meaning the Royal tree). Previous inscriptions were also referred to, from which it seems that the original tree disappeared soon after 1787. Indeed, Dr. Stukely recorded that in 1713 "the tree was in the middle almost cut away by people who came to see it." As to historic hawthorns, one is credited with having witnessed the death of Lord Maxwell at the Battle of Dryfe Sands, and several have been associated with Mary Queen of Scots; but Dr. Christison remarks that it is scarcely possible that any hawthorn could exist for three hundred years, as the species rarely exceeds a very moderate size, and his observations show that it grows at a fair average rate.

MR. THOMAS CARROLL'S general report on the Irish Agricultural Department during 1892, published a few weeks ago, contains the results of experiments carried out under his direction, having for their object (1) the determination of the mode by which the disease *Phytophthora infestans* reaches the tubers of the potato plant, and (2) the examination of measures for the prevention of, or for the lessening the effects of, the disease upon the crop. The point upon which information was especially desired was, whether the disease producing Mycelium reached the tubers of the potato plant through the aerial and underground stems, or by means of the disease-producing spores falling upon the ground, and being carried through it to the surface of the tubers. To test this, a portion of ground upon which potatoes were growing was covered beneath the potato stems and leaves with a layer of cotton wool. This cotton wool was carefully placed around the stems, and every means used to have the ground perfectly covered with it, with the view of filtering out the spores that might fall upon the ground. No diseased potatoes were found on plants protected in this manner, whereas many occurred on plants grown in ground not covered with cotton wool. These experiments, which were very carefully carried out, serve to indicate that the disease is carried to the tubers of the potato plant through the spores which cause the disease being taken through the earth to the tuber, and not by means of the Mycelium finding its way to the tubers through the stem of the plant. An experiment, having for its object the testing of the effect of removing the stalks of potatoes upon the appearance of disease, with the view of preventing the tubers from being affected, was carried out at the Ballacutranta School Farm, County Sligo. This system of removing the potato haulm upon the appearance of the disease has frequently been recommended as a preventive. To test it, two plots of ground bearing a crop of potatoes were marked out for experiment. On one the stalks were removed; on the other they were allowed to remain. A comparison of the weights of the crops in each case, and the amounts of diseased tubers, shows, however, that through the removal of the potato haulm, before the crop was matured, the yield of crop was lessened without commensurate benefit in freedom from disease.

MR. GEORGE S. PERRIN has sent us a paper on "Australian Timbers," read before the Royal Victorian Institute of Architects in September 1893, and having special reference to the ornamental and decorative woods of Australia.

Bulletins Nos. 48, 49, and 50 have been sent out from the Purdue University Agricultural Experiment Station. They contain the results of experiments with small fruits; a history of the attempts that have been made to establish the sugar-beet in America, with a statement of the conditions required for its successful cultivation; and the results of some field experiments, by Prof. W. C. Latta, with Indian corn and oats. The *Bulletins* are sent free to all agriculturists in Indiana who desire them, and their contents are found invaluable.

ON April 18 the Geological Survey of Alabama attained its majority—twenty-one years—under the present management. It has been thought desirable to mark this occasion by some sort of permanent memorial, and to this end maps are in course of preparation showing the condition of knowledge of the geology of the State at the beginning and at the end of the period 1873–1894, and columns showing the relative amounts of raw materials and of finished products from Alabama mineral resources at the same times, are also in preparation. In the line of this design a sketch has been prepared by Mr. E. A. Smith, showing the origin and progress of the survey, the difficulties under which it has laboured, what it has accomplished, what it has cost, and what it yet hopes to accomplish.

A LIST of apparatus for the psychological laboratory designed by Prof. J. Jastrow, and made by the Garden City Model Works, Chicago, has been received. It comprises descriptions of æsthesiometers, for determining the distance upon the skin at which two points are just perceived as two; pressure attachments, for testing the pressure sense of the skin; apparatus for the sense of roughness and smoothness; apparatus for all kinds of reaction experiments; an arrangement for testing the appreciativeness of changes of temperature; others for recording involuntary movements; and for testing memory. The character of some of the apparatus shows that experimental psychology and physiology overlap to a large extent. Indeed, it is often difficult to define the limits of psychological and physiological research. Like many other branches of science, these two merge into one another, and their peculiar provinces of investigation are comparatively small.

The fourth volume of the *Proceedings* of the Chester Society of Natural Science and Literature, which has just been published, contains a number of very interesting articles by several well-known men of science. It is a matter for regret that the publication of some of the papers has been so long delayed. For instance, we note that a paper by Prof. T. McKenny Hughes, F.R.S., on the Silurian Rocks of North Wales, was read before the Society in January 1886, and another, on caves and cave deposits, in October of the same year. Mr. A. O. Walker contributes to the volume some notes on the natural history of the Chester district, from 1879 to 1893, a paper on the climate of Chester, and one on that of the North Coast of Wales. The Heron, and Heronries of Cheshire and North Wales, forms the subject of a contribution by Mr. R. Newstead, who also gives a preliminary list of the mammals of the same district. Another important list gives the results of observations on the occurrence and distribution of birds in different parts of West Cheshire, Denbighshire, and Flintshire. This list was drawn up by Mr. W. H. Dobie, and is accompanied by a map. From this brief description it will be seen that the Chester Society of Natural Science is doing something to promote the study of natural knowledge. We are glad to learn that the Society is in a very flourishing condition, the number of members being at present over six hundred.

THE Society for the Protection of Birds have added to their list of publications a pamphlet by Mr. W. H. Hudson, entitled "Lost British Birds." The species described as lost by Mr. Hudson are those of which the British race is extinct, or very nearly so. The list includes the Crane, White Spoonbill, Capercailzie, Avocet, Great Bustard, Blacktailed Godwit, Great Auk, Red Night-reeler, Bittern, Marsh Harrier, Ruff and

Reeve, and Hen Harrier. Though it may be thought a little "previous" to refer to some of these species as lost, there are others, such as the Goshawk, Night Heron, Little Bittern, and Baillon's Crake, not included in the list, but which there is reason to believe were once summer residents and breeders in Great Britain. It is often remarked that the total disappearance of some species of birds, and the extreme rarity of others once common in this country, is due to the draining of marshes and similar changes on the face of the land. But the facts brought together by Mr. Hudson show that the disappearances have been mostly brought about by the direct action of those inveterate bird-destroyers, described as "The Cockney sportsman, who kills for killing's sake; the gamekeeper who has set down the five-and-twenty most interesting indigenous species as 'vermin' to be extirpated; or, third and last, the greedy collector, whose methods are as discreditable as his action is injurious." If these and others who have helped to degrade the character of our bird-population will read Mr. Hudson's little pamphlet, they will see the greatness of the change that has taken place.

FURTHER interesting properties of sodium peroxide are described in the current *Berichte* by Prof. Poleck, of Breslau. It is shown that sodium peroxide rapidly reduces salts of gold, silver and mercury with separation of the metal and evolution of oxygen gas. Platinum, however, is not precipitated from chloroplatinic acid or chloroplatinates until they are decomposed with a silver salt, when reduction both of the resulting platinum chloride and of the silver chloride occurs, both metals being precipitated. Ferric hydroxide is precipitated, as might be expected, from both ferrous and ferric salts; from manganous salts manganese dioxide is precipitated, presumably hydrated, and from salts of cobalt the higher cobaltic oxide. Permanganates are reduced to manganese dioxide, but chromic oxide is oxidised to chromic acid. The separation and quantitative estimation of iron and chromium or manganese and chromium are easily achieved by utilising these reactions, for iron is precipitated as ferric hydroxide and manganese as peroxide, while chromium remains in solution as chromate of sodium. Sodium peroxide also produces the highly oxidised sodium peruranate, $Na_4U_2O_8+8H_2O$, directly from salts of uranium, and it may readily be isolated by addition of alcohol which precipitates it. It is also interesting that iodine is oxidised on warming directly to the difficultly soluble acid sodium periodate, and upon decomposition of this salt with silver nitrate the normal silver periodate is at once produced, and free periodic acid HIO_4+2H_2O may be readily obtained from it in large crystals by decomposition with bromine and subsequent evaporation *in vacuo*. Potassium ferricyanide behaves towards sodium peroxide in a similar manner to its action with hydrogen peroxide, reducing it energetically to ferrocyanide, and the volumetric process of Kassner can be readily carried out by use of it. Sodium peroxide reacts with lead oxide in presence of water to produce a plumbate of sodium of the composition $Na_2PbO_3+4H_2O$. Organic compounds dissolved in alcohol are usually very rapidly oxidised by sodium peroxide, while the alcohol itself is not attacked. Ether, on the contrary, at once ignites when brought in contact with the peroxide. Prof. Poleck recommends its use likewise in the separation of arsenic, antimony and tin, for the sulphosalts of these elements are at once oxidised by sodium peroxide in presence of water to oxygen compounds, the whole of the sulphur being simultaneously converted into sulphuric acid. Hence in toxicological investigations it is only necessary to oxidise the sulphosalts with sodium peroxide before proceeding immediately to employ Marsh's test. The practical uses of sodium peroxide appear indeed to be very numerous, and the information now rapidly accumulating concerning it will doubtless prove of value both from the theoretical and the technical point of view.

IN our note concerning the atomic weight of barium (vol. xlix. p. 562), the statement that "the highest and lowest individual values obtained among the whole fifty separate estimations were 137·42 and 137·45" should have read "the highest and lowest of the mean values obtained from the different series of estimations were 137·42 and 137·45."

THE additions to the Zoological Society's Gardens during the past week include a Mozambique Monkey (*Cercopithecus pygerythrus*, ♀) from South-east Africa, presented by Mr. H. Tattenhall; two Laughing Kingfishers (*Dacelo giganteus*), two Berigora Hawks (*Hieracidea berigora*) from Australia, presented by Mr. A. E. Henniker; seven Spanish Blue Magpies (*Cyanopolius cooki*) from Spain, presented by H.R.H. the Comte de Paris; a Tuatera Lizard (*Sphenodon punctatus*) from New Zealand, presented by Dr. W. J. Mackie; an Egyptian Terrapin (*Trionyx ægypticus*) from West Africa, presented by Mr. F. W. Marshall; a Green Lizard (*Lacerta viridis*) European, presented by Miss S. Borgaes, a Yellow-billed Sheathbill (*Chionis alba*) from Antarctic America, a Red and Blue Macaw (*Ara macao*) from South America, a Black Iguana (*Metopoceros cornutus*) from San Domingo, a Geoffroy's Terrapin (*Hydraspis geoffroyana*) from Trinidad, seven Say's Snakes (*Coronella sayi*) from North America, deposited; a Derbian Wallaby (*Halmaturus derbianus*, ♂) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

FINDER-CIRCLES FOR EQUATORIALS.—A very ingenious and what may prove a most useful addition to an equatorial are the so-called star-dials or finding-circles, a brief account of which is contributed to the current number of the *Zeitschrift für Instrumentenkunde* (4 Heft, April 1894). Every worker with the equatorial will no doubt at some time have found out that the present mode of setting the instrument on some object, as, for instance, a star, is not always very convenient, and in addition employs comparatively far too much time. The object of these finding-circles is to reduce this time very considerably, and a use of three years has shown that its aim has been successfully attained. The instrument to which it has been applied is the 12-inch of Georgetown College Observatory, Washington. On the pillar of this instrument are the two hand-wheels, by means of which the telescope is moved in right ascension and declination, and also two microscopes for reading the R.A. circle. Both axes of the telescope carry the usual circles for orientation, each being graduated in fine divisions on silver and large white divisions on a dark background. The finding-circles are situated just above the hand-wheels mentioned above, and fixed to the pillar, looking like a pair of aneroid barometers or steam gauges; they are arranged as follows:—The circular divided disc, with the declination divisions arranged round its circumference, is fixed firm in its case, and the index is so geared to the telescope that any movement of the latter is recorded on the dial; this gives one directly the declination. In the case of the other dial, that for right ascension, the disc is divided into two circles of twelve hours each, and instead of being fixed is moved by clockwork, sidereal time being shown on its face by means of another index; this latter index responds also to the movement of the telescope, but is quite independent of the first one. It will at once be seen that with these two dials so conveniently placed the telescope can be at once oriented, while the question of hour-angle is entirely eliminated.

THE HARVARD OBSERVATORY IN PERU.—An historical sketch of the establishment of the Peru branch of the Harvard College Observatory, and the investigations carried on there, is contributed to the *Harvard Graduates' Magazine* for March by Prof. W. H. Pickering. The Observatory is situated about two miles from Arequipa, and four hundred feet above it, on the slopes of Mount Chachani. It is furnished with a very complete instrumental outfit, the most important instrument being a 13-inch equatorial, capable of being used for either visual or photographic purposes, and an 8-inch photographic telescope. Five meteorological stations have been established by the Observatory. One is at Mollends, on the sea-coast, 100

feet above sea-level. The second is at La Joya, in the desert, altitude 4140 feet. The third is at the Observatory itself, altitude 8060 feet. The fourth is upon the side of the Misti, at an altitude of about 16,000 feet, and the fifth is upon the summit of the Misti, altitude 19,200 feet. The discoveries made at the Observatory are enumerated by Prof. Pickering. They include double stars, the "lakes" on Mars and the rapid changes in some of the canals and dark markings on the planet at the time of the melting of the southern snow-cap, the observations of changes of shape of Jupiter's satellites, which led to the conclusion that the outer satellites are not solid bodies, but dense swarms of meteorites, and pointed to a modification of Laplace's nebular hypothesis, to explain some of the diffitulties inherent in it. Peculiar lunar formations have also been observed, and an explanation has been given of the bright streaks seen at the time of full moon. A new class of lunar rills has been found, winding and tapering like a terrestrial river-bed, and various facts have been determined with regard to what are called "variable spots" on the moon, which darken as the sun rises upon them, and fade out as it sets. Finally, the remarkable photograph of the spectrum of Nova Normæ, showing the star's constitution to be the same as that of Nova Aurigæ, was obtained at Arequipa. But only a small portion of the work of the Observatory is devoted to original research, the greater part of the time being taken up by routine work. Few observatories, however, can show a better record than that made at Arequipa during the three years of the Observatory's existence.

THE DIAMETERS OF SOME MINOR PLANETS.—Various attempts have been made to measure micrometrically the diameters of some of the larger asteroids, and also to determine them by photometric means, but the values obtained have never been very trustworthy. Prof. E. E. Barnard has now taken up the work, using the 36-inch of the Lick Observatory, and has already obtained some new results (*Astronomy and Astro-Physics*, May). So far, he has succeeded in directly measuring Ceres, Pallas, and Vesta, to which he assigns the following diameters :—

Ceres	...	599 ± 29 miles.
Pallas	...	273 ± 12 ,,
Vesta	...	237 ± 15 ,,

It will be seen from this that, contrary to the general belief, Ceres is the largest of the minor planets, and not Vesta. The values obtained by Argelander from a consideration of the relative light of the three foregoing asteroids and Juno, and those determined by Mr. E. J. Stone in 1867 from measures made by Herschel and Lamont, are as follows:—

	Argelander.	Stone.
Ceres ...	230 miles ...	196 miles.
Pallas ...	162 ,, ..	171 ,,
Juno ...	108 ,, ...	124 ,,
Vesta ...	275 ,, ...	214 ,,

Juno will soon be in a favourable position for observation, and Prof. Barnard will then apply the filar micrometer to its disc.

RETURN OF TEMPEL'S COMET.—A telegram from the Cape Town Observatory to Prof. Krueger (*Astr. Nach.* 3228) announces that Tempel's periodical comet (1873 II), the return of which was expected this year, was observed by Mr. Finlay on May 8. Its position was then R.A. = 356° 20′ 16″·5. P.D. = 94° 51′ 11″. The object was circular, with a diameter of about one minute of arc and some central condensation, but no tail. Its brightness was about the eleventh magnitude, or fainter.

THE NEW ENGINEERING LABORATORY AT CAMBRIDGE.

THE new Engineering Laboratory was opened on Tuesday by Lord Kelvin, in the presence of a brilliant assemblage of University dignitaries. The building occupies the site of the old Perse Grammar School, and has been erected from the designs of Messrs. Marshall, Vicars, and Co. The exterior is of plain but not unattractive red brick, in the French *château* style. The main building is of three stories. The three chief rooms, one above the other, are on the left of the handsome entrance doorway, and overlook the grounds of Corpus Christi College. To the right of the doorway are offices, small class-rooms, and rooms for special researches. The electrical laboratory is on the ground-floor; above it is the drawing school, excellently lighted by large western windows; and at the top is the mechanical museum, lighted by dormer windows and a cupola. Behind, the fine old schoolroom has been altered by raising its floor, but the beautiful oaken-roof of sixteenth-century work has been preserved, and the room gains rather than loses by the slight change in its proportions. Here is the chief mechanical laboratory, and it is furnished with all needful apparatus for work on the strength of materials, mechanism, and applied mechanics. Beyond, in the old schoolyard an admirable steam and dynamo laboratory has been erected from Prof. Ewing's designs. Here are several types of experimental steam-engines, dynamos, and motors, and in another compartment the boilers and other heavy appliances. The laboratories are on one side contiguous to the Chemical Laboratory, and when some day the necessary extension of the Cavendish Laboratory takes place, they will also abut on the Physical department. The cost of the whole has been some £6000, of which about £5000 was contributed by friends of the University who desired to see engineering science properly established and equipped in Cambridge.

The Vice-Chancellor presided at the ceremony, and in a happy speech alluded to the doubts at first entertained by many worthy Cambridge men as to the wisdom of admitting purely professional studies among those fostered by the University. In medicine, however, in law, and lately in agriculture, the claims of applied and practical knowledge had been recognised, and the recognition had been amply vindicated. It was due to the enterprise and ability of Prof. Ewing that engineering had now overcome all opposition to its admission to rank as a scientific profession, the preliminary training for which might fitly be carried on within the academic precincts. Lord Kelvin, in declaring the Laboratory open, spoke of the direct evolutional connection between the theoretical mechanics and pure mathematics of his day at Cambridge, and the establishment of a department in which their principles found application and verification. The Laboratory was excellently furnished so far as it went, but £20,000 might well be spent, in the interest of the University as well as of engineering science, in extending and completing it. Prof. Kennedy spoke of the place of such laboratories in the training of the engineer. Engineering was taking its due rank as a liberal profession, and from Cambridge, the centre of mathematical and physical inquiry, future engineers would go out fitted for acquiring with sureness and rapidity the practical details of their work. Sir Frederick Bramwell told stories of his early experiences. Prof. Jebb, M.P., and Prof. Ewing, who was very warmly received, gave thanks to all who had wrought with the Engineering Laboratory Syndicate to bring about the result they were celebrating. The donors, past and future, the architect, builders, demonstrators and workmen received their meed of acknowledgment. After the ceremony a reception was held by Prof. and Mrs. Ewing, and nearly 800 of the members of the University and ladies inspected the rooms. The students acted as guides and demonstrators, and at the close it was on all hands acknowledged that the occasion had been one of the most successful of University functions in recent years.

SCIENCE IN THE MAGAZINES.

THOUGH articles on scientific subjects are sprinkled through this month's magazines, they contain little that is new or suggestive. In the *Quarterly Review* (No. 356) two interesting articles appear, one on "Shakespeare's Birds and Insects," and another on "Ocean Meadows." Much has been written concerning Shakespeare's natural history, but the conclusion to which an examination of the poet's writings inevitably leads is that he was not an observant student of animal and plant life. The *Quarterly* reviewer criticises Shakespeare's knowledge of these matters, pointing out that Chaucer wrote of what he saw and heard in the animal life about him with a sense of personal delight that convinces the reader of his familiarity with animate nature. So too with Spenser, and with Ben Jonson. But, says the reviewer, Shakespeare resembles neither of these. "He borrows from Gower and Chaucer and Spenser; from Drayton and Du Bartas and Lyle and William Browne; from Pliny, Ovid, Virgil, and the Bible; borrows, in fact, everywhere he can, but with a symmetry that makes his natural history harmonious as a whole, and a judgment that keeps it always moderate and passable." This indictment is supported by

uncontrovertible evidence, and concludes with the remark that Shakespeare's natural history "is commonplace when it is correct, and 'Elizabethan' when it is wrong." His method of handling animated nature has had a momentous effect on all succeeding poetry, so that poetry has sung of nature on Shakespeare's lines with an extraordinary fidelity. Groups of creatures which he misrepresented have been held up to reproach by poets since his time, and many others deserving of notice have been neglected. It is remarked, however, that "there is no necessity for a poet to be a naturalist in order to be true to nature; but there is the most urgent necessity that he should be in sympathy with nature and ready to acknowledge the good and beautiful, even if it should reach him in such questionable shapes as 'the deadly owle' or 'a full-blown toad that venom spits.'" In fact, owing to the great influence of Shakespeare's writings, the peculiarities of his sympathies and antipathies have been followed by almost all succeeding poets. His natural history was largely at fault; indeed, the reviewer asserts that he was sadly unsympathetic and unobservant. We conclude with a quotation which will come as a revelation to many people: "But taking men all round, ordinarily intelligent men of a country life (a town life was in Shakespeare's day what we should now call country life), was Shakespeare, as compared with these average individuals, 'an observer of nature?' The question is one liable to shock whose who have followed blind guides so long. The answer to it is liable to shock them more severely. No. Shakespeare was curiously unobservant of animated nature. He seems to have seen very little. Our authority for this is his own works, which, while they abound with beauties of fancy and imagination, are most disappointing to lovers of nature by (their errors apart) their extraordinary omissions."

Four important works on marine fauna and flora form the basis of an article in the *Quarterly Review* on "Ocean Meadows." In the course of the article, the reviewer refers to the necessity for making scientific investigations in the sea round our coasts, and shows the improbability of such work being furthered when those who hold high offices cannot appreciate its importance. In his words:—

"The minute animal life in turn furnishes food for shoals of fishes, and the importance of an inquiry into the whole life-history and seasonal occurrences of such organisms—the basis of the nutrition of marine life, as green plants are of terrestrial life—can scarcely be overrated. No such inquiry has ever been conducted in a serious scientific spirit in our seas by other than private investigators, unequipped with adequate resources for the proper study of the subject in its economic aspect. Our Fishery Boards concern themselves as little with this vital matter as they possibly can, Nor is this apathy surprising, when it is remembered that the present Government have appointed to the chairmanship of the Scottish Fishery Board an estimable gentleman, who possibly understands the 'branding' of herrings, but whose chief qualification for the post was a safe constituency. Yet, at the moment when this appointment was made, they had the opportunity, pressed upon them by a large body of scientific men, of choosing an eminent naturalist, whose claims as a student of the ocean are admitted by men of all nations to be unrivalled."

Almost every great advance in the study of the ocean has been made by this country, and though other countries are now competing with us, an opportunity will soon arise for us again to forge ahead.

"The proposed Antarctic expedition, for which a convincing case has been made out, can add to its usefulness by taking such an investigation in hand, not only in the Southern Seas but on its way to them. There is probably no region so fertile in the forms of pelagic life as the Southern Ocean, and an expedition which should not make the study of its vegetation one of its main objects had better stay at home. There is little fear of the subject being neglected in its widest aspects, since it is one of the professed 'aims which the promoters have in view,' to use the language of a prospectus. Botanists will have themselves to blame, and the public will have them to blame, if through their supine indifference this great and rich harvest of the ocean be not gathered in. In another respect the times are favourable. For many years this country lost its once eminent position in the study of the coast vegetation of the sea; but during the last six or seven years so much good and honest work has been done by a young and energetic band of observers that this position has been in a great measure retrieved. There are not lacking among our younger botanists men of skill in the use of the most recent methods of research, capable of meeting the Germans on their own field. It will be their fault if the naturalists of another nation forestall them in taking possession of not the least honourable part of our empire over the sea."

In the *Fortnightly*, Mr. Grant Allen, in an article entitled "The Origin of Cultivation," attempts to answer the question as to how early savages found out that plants would grow from seeds. His views are as follows:—"Cultivation began with the accidental sowing of grains upon the tumuli of the dead. Gradually it was found that by extending the dug or tilled area and sowing it all over, a crop would grow upon it all, provided always a corpse was buried in the centre. In process of time corpses were annually provided for the purpose, and buried with great ceremony in each field. By-and-by it was found sufficient to offer up a single victim for a whole tribe or village, and to divide his body piecemeal among the fields of the community. But the crops that grew in such fields were still regarded as the direct gifts of the dead and deified victims, whose soul was supposed to animate and fertilise them. As cultivation spread, men became familiarised at last with the conception of the seed and the ploughing as the really essential elements in the process; but they still continued to attach to the victim a religious importance, and to believe in the necessity of his presence for good luck in the harvest. With the gradual mitigation of savagery an animal sacrifice was often substituted for a human one; but the fragments of the animal were still distributed through the fields with a mimic or symbolical burial, just as the fragments of the man-god had formerly been distributed. Finally, under the influence of Christianity and other civilised religions, an effigy was substituted for a human victim, though an animal sacrifice was often retained side by side with it, and a real human being was playfully killed in pantomime."

Another origin about which Mr. Grant Allen makes suggestions is that of language. His remarks on this subject appear in *Longman's Magazine*, under the title "The Beginnings of Speech." The *Sunday Magazine* contains an article on "The Stuff we are Made of," by Dr. J. M. Hobson, in which some facts concerning amœbæ are stated, and also a sketch of the life and environment of Richard Jefferies, by the Rev. B. G. Johns. "Moon-Man or Moon-Maid" is the title of a short article by Mr. William Canton in *Good Words*. One of Cassini's drawings of the Gulf of Rainbows on the moon shows the form of a girl's head emerging from the rocks of the promontory of Heraclides on one side of the Gulf. M. Flammarion reproduced this drawing in *L'Astronomie* some time ago, and lamented that he had been unable to find the figure in any other drawing, or observe it himself. A few months later, however, M. Quénesset made out the form of a man's face at the spot to which attention had been drawn, and two hours later on the same evening M. Mabire, observing at the Juvisy Observatory, depicted "without a single stroke of imagination" the head of a woman in the same place. Mr. Canton's remarks refer to these two drawings, reproductions of which are given. The illustrations are curious, but not very instructive; they appeal more to the poetical than the scientific mind.

Mr. Henniker Heaton writes on "Telephones: Past, Present, and Future," in the *New Review*, his point of view being chiefly commercial. Sir Herbert Maxwell espouses the cause of tree-planting in London, and enumerates some of the trees suitable for town adornment. "The Imitative Functions, and their Place in Human Nature," is the theme of Mr. J. Royce in the *Century*. *Chambers's Journal* has several quasi-scientific contributions, among them being articles on amber, breath-figures and dust-photographs, and trees of the genus *Adamsonia*—Cream-of-Tartar trees. In addition to the magazines named in the foregoing, we have received *Scribner's*, the *Contemporary*, and the *Humanitarian*; but none of these contain articles calling for comment here.

THE SCIENCE OF VULCANOLOGY.[1]

VULCANOLOGY, or the science which deals with volcanoes and related phenomena, is a very important branch of geology—the science which treats of the earth's crust in general. Geology is yet hardly a century old; for before that time it consisted of little else than a collection of romantic hypotheses

[1] Introductory Address to a Course of Lectures on Vulcanology, delivered in the R. Univ. of Naples, by Dr. H. J. Johnston-Lavis.

and incredible superstitions. This remark applies with still greater force to vulcanology, for the study of which it is necessary to possess an extensive knowledge of physics, chemistry, and a well-developed faculty of observation. For a century or two previous to the nineteenth, however, there were acute observers, and we in Naples well know such names as those of Sorrentino, Duca e Padre della Torre.

Towards the end of the last century the active and extinct volcanic regions of Italy attracted the attention of four great men of science, each of a different nationality. I allude to Spallanzani, Sir William Hamilton, Dolomieu, and Breislak. Although their nationality was different, they had two merits in common—that of scientific truth and that of Baconian methods of reasoning. In other words, they were pure men of science, since by that term we understand one who observes carefully, records neither more nor less than he observes, and draws from these facts, and those collected by others, his conclusions, without disregard to a clear knowledge of the principles involved, and without flights of imagination. It is, therefore, more to these four men that we owe the advance of human knowledge concerning volcanoes than to all the writers who preceded them.

In the first years of the nineteenth century, vulcanological literature was enriched by many workers, because, as the allied sciences were then making great strides, they were able to offer to vulcanologists much more powerful and accurate means of investigation. Thus we had Humboldt, Scrope, Daubeny, Pilla, and Gemmellaro.

Following these came a phalanx of illustrious students of geology, some of whom are still among us, while others, though dead in person, are living and immortal in the memory of man as heroes of science and of human knowledge. Amongst these we may enumerate Lyell, Dana, Scacchi, Palmieri, Silvestri, and Phillips, whilst at present many younger and gifted investigators are not wanting.

No other branch of science has been so heavily burdened by extravagant hypotheses, which have so much retarded its progress, as that of vulcanology. It is not only in the first half of the present century but even still that we find an extensive literature produced by men who advertised themselves as scientific investigators, when in truth they did little else but write memoirs and books to promulgate and sustain fantastic, extravagant, imaginary, and impossible hypotheses. Nevertheless, amongst this chaff we not only meet with grain, but very good grain.

As a subject of study, Vesuvius holds the first place in all vulcanological investigations of this and the last century. A few figures will make this fact more evident. Some four years since, my wife and myself collected the titles of books, memoirs, and other writings referring to the South Italian volcanoes, for the purpose of publishing a bibliographical list. We found the following numbers :—

Graham's Island, or Isola Ferdinandea ...	28
Roccamonfina	33
Lipari Islands	119
Alban Hills	210
Campi Phlegræi	539
Etna	880
Vesuvius	1552

From this table it will be seen how much has been written concerning Vesuvius; in fact, its literature constitutes nearly half of what has been written about all the volcanic regions south of Rome. If we add to these the titles referring to the Campi Phlegræi, we then find that in a total of 3361 not less than 2091 concerns the volcanic district around Naples. Let me, however, give you a still more striking fact. The Naples branch of the Italian Alpine Club possesses the richest vulcanological library in existence. The catalogue contains more than 7000 entries of papers, books, and manuscripts. In this number, however, are included books that not only treat of vulcanology, but in large part refer to seismology and, to a smaller extent, to geology. It will be seen, therefore, that the Neapolitan volcanic district represents more than a quarter of all vulcanological literature.

It is true that the history of Etna and the Æolian Islands reach farther back than that of Vesuvius, but on the other hand the history of this latter is by far the most complete. From a chronological point of view, Vesuvius and also the Campi Phlegræi hold a more important place in history than any of their rivals. Even if the Pompeians, the Herculaneans and the Stabians did lose all their property eighteen centuries since, the modern world has recovered it as archæological treasures, whose value represents, from the point of view of culture, many times the original and the compound interest on the same for the whole interval; and this we owe to our Vesuvius. The Phlegræn region around Naples is so enchained with the poetry of the heroic and classic periods, that without it the legends of Cuma, of Pithecusa, of Sparctacus, of Partenope, of Baja, and so many others, which fill pages and pages of ancient history, would not exist.

Sometimes poetic ecstacy attacks the mind of the scientist; for, contrary to what the general public believe, science rather than abolish poetic sentiment further develops it, but in a more serious and refined form.

When, as we wander around Naples, we reach the hill of Cuma, and we encounter a few ruined walls and a few potsherds that peep out through the rich vegetation of that spot, where now the only inhabitants are the goats and the lizards, our imaginations speed back for nearly three millenniums, when this same rock, almost as in its present state, was chosen by the daring Greek navigators as the site of their new colonial town. All of us know the history of Cuma, all of us know that this little bit of Italy for one half of historic time held a very important place. We are deeply impressed when we make an effort to conceive clearly what 3000 years really is, how many generations lived and died during that time and in that place; but far greater are we impressed when we think that 3000 years is but a fraction in the *geological* history of that hill, and finally our mind fails to grasp the value of time when we consider that the physical record of this hill is not more than a minute fraction of the geological chronology of our globe.

Without going very far back in the geological history of our region, I will ask you to follow me to the first part of the Pliocene epoch, an epoch, as all know, to be considered quite near our own time. All of us now admire the beauty of the Gulf of Naples, which has few rivals in the entire world, but at that time its conformation was very different to what it is now. It then formed a very much larger gulf, represented to-day by the plain we call the Campania Felice, with a large part of the Terra di Lavoro. We must figure to ourselves a broad gulf limited on the north by the promontory of Gaeta, where its confines were limited by high limestone cliffs. Its coast had roughly the following trend. From Gaeta it corresponded with the present provincial road to close under Castelforte, and from there was almost represented by the valley of the Garigliano as far as the gorge between Monte Faito and Monte Cammino, by which narrow strait it was in communication with the sea covering the plain of Cassino. Winding round the south of Monte Cammino it again extended northwards to Mignano. The eastern coast of this strait corresponded with the present line of railway from Mignano to Taverna St. Felice, which coast, turning eastwards, passed under Presenzano to extend into the mountains by the valley of the Volturno. From this point the coast, winding round several islands, represented to-day by hills and mountains separated from the main mass of the Appennines, it extended into these latter, forming so many fiords. The sea then covered all the plain, and its waves beat the foot of the mountains behind Pietramelara, Pignataro Maggiore, Capua, Caserta, Nola, Palma, Sarno, Angri, and Castellamare, and then corresponded roughly with the present coast of the peninsula of Sorrento. In the middle of this great gulf rose two important isles—Capri and Monte Massico, besides a quantity of small ones. Numerous fiords penetrated the Appennines, where to-day we have the Garigliano, the Volturno, Valle di Maddaloni, Valle Caudina, and the Valle di Avella. In fact, this part of the coast of Italy in those pliocene times was very similar in configuration to that of the Istrian coast of to-day.

The rivers bringing down to the sea sand and mud, which, settling at the bottom of the gulf, prepared an almost flat marine floor, which later was to form the foundation of the Campanian Plain. At that period the Campania Felice was only sea, and where to-day flourishes vines, oranges, lemons, and gardens of flowers, then only grew marine algæ.

The great fissure in the earth's crust which corresponds with the western coast of Italy, and along which were formed the Italian volcanoes, opened a way for the igneous magma to the bottom of this gulf. Numerous eruptive centres were formed, giving rise to the volcanoes of Ischia, Roccamonfina, Campi Phlegræi, and Vesuvius. The order in which these different

groups were formed is still an unsolved enigma. Ischia, as has been long known, shows by the fossiliferous deposits clothing its flanks, to have undergone great elevation since its original formation, and as we have no such evidence in the other volcanoes, we must conclude for the greater antiquity of Ischia. I also believe that the volcanic group of Roccamonfina is very much older than that of the Phlegræan Fields and Vesuvius, because we find the *piperno* and the *pipernoid tuff*, very old volcanic deposits in these regions, forming a mantle over Roccamonfina when it was almost a complete mountain. It must not be forgotten, however, that in the "Museum Breccia," first described by me, we have evidence of the effusion in these regions of many varieties of rocks long anterior to the *piperno*.

Gradually the large quantity of lava and fragmentary materials that were ejected at the bottom of the gulf, greatly diminished its depth, and this, combined with general elevation, resulted in the emergence of a number of volcanic islands at Roccamonfina, Ischia, Naples; and probably Vesuvius was, at first, like the others an island. Constant general elevation soon drove back the sea, leaving high and dry all that region we so well know. This plain, with its volcanic hills and mountains, constitutes one of the most beautiful, the most fertile, and the healthiest regions of our earth, if man were more capable of appreciating, enjoying, and developing this *pezzo di cielo caduto in terra*.

So many are the advantages that Vesuvius offers to the student of vulcanology, that I think it advisable to pass them in review. This renowned volcano occupies a very central position in the civilised part of the globe, only a few kilometres from Naples with all the resources of a great city, and in communication by numerous lines of passenger vessels and railways with all parts of Europe and America. Means of visiting Vesuvius are numerous, whilst the volcano is now entirely surrounded by a network of railways, besides good roads. By road and railway the top of the mountain can be reached, and upon its flanks can be found hotels and accommodation of all kinds, besides a meteorological observatory, intended to be used for the daily study and record of its varying phases. The simple but interesting form of the mountain, the extraordinary and unrivalled variety of its productions, which surpass in number, beauty, and interest those of any other volcano yet studied, are also a matter of maximum importance to the student. Besides this, of equal importance we must reckon that continuous activity with variation within such limits as to permit detailed study on the spot, and still more fully in the University laboratories or elsewhere.

Scattered over Italy, and within a few hours' reach, are several other active volcanoes, each having its own special interest, besides a large number of extinct ones and subsidiary volcanic phenomena, all of which, beyond their scientific interest, have a very great importance to the inhabitants from an agricultural, industrial, and hygienic point of view. This is especially the case in the immediate vicinity of the active ones, so that it becomes the duty of the Government to maintain a system of observation and record, and to develop a school in which students may acquire a scientific knowledge of vulcanology.

At Naples we have a chair of terrestrial physics, but as under this name is included a vast amount of different groups of phenomena, it is impossible for its holder to give a fair share of vulcanology alone. So far, the only chair of vulcanology was that of Catania, which was so well occupied by the late Prof. O. Silvestri, and which, after his premature death, was abolished.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The following have been appointed Public Examiners in the Honour School of Natural Science:—Mr. James Walker, of Christ Church, in Physics, Dr. Henry F. Morley, in Chemistry, and Dr. George A. Buckmaster, of Magdalen College, in Physiology.

The list of the newly elected Fellows of the Royal Society includes three Oxford men—the Rev. F. J. Smith, Mr. V. H. Veley, and Prof. Viriamu Jones.

A conversazione will be given in the University Museum on Tuesday next, by the members of the Junior Scientific Club.

CAMBRIDGE.—The Board of Managers of the Arnold Gerstenberg Studentship give notice that a Studentship on this Foundation will be offered for competition in the Easter Term of 1895. Candidates will have the option of being examined either in Logic and Methodology, or in Psychology. The Examination will be held at the time of the Moral Sciences Tripos: that is, not earlier than the last Monday but one in May 1895. The exact date of the examination will be announced later. The schedule of the subjects of examination will be the same as the schedules in Psychology and in Logic and Methodology for Part I. of the Moral Sciences Tripos. The competition will be open to men and women who have obtained honours in Part I. or Part II. of the *Natural Sciences Tripos*, and whose first term of residence was not earlier than the Easter Term of 1889. Candidates must send in their names not later than April 19, 1895, to Dr. Sidgwick, Newnham College, Cambridge, and must declare their intention, if successful, of pursuing a course of philosophical study. The studentship, which will be of the annual value of nearly £90, will be tenable for two years, upon the condition that at the end of the first year the student's progress in philosophical study is deemed satisfactory by the Board of Managers.

Dr. W. S. Melsome, Fellow of Queen's College, and Mr. Hubert Higgins, of King's College, have been appointed Senior and Second Junior Demonstrators of Anatomy respectively.

There are vacancies at the University's tables in the Naples Zoological Station, and at the Plymouth Marine Biological Laboratory. Applications to occupy these are to be sent to Prof. Newton, Magdalene College, by May 24th.

Prof. Macalister announces a short course of lectures in Physical Anthropology for May 16th, 19th, and 21st. The subjects are "Methods of Anthropometry," "The Races of Ancient Egypt" (at this lecture a mummy will be unwrapped and examined), and "The Races of Western Europe."

The Council of the Senate have published a Report recommending that in future all appointments of Demonstrators, and of Assistants to Professors, shall be made for a specific period not exceeding five years. At the end of this period the Demonstrator or Assistant is to be eligible for reappointment. It is also proposed that in the case of the vacancy of a Professorship, the Demonstrators and Assistant are to cease to hold office within three months of the appointment of a new Professor.

THE Master, Wardens, and Commonalty of the Society of Merchant Venturers of the City of Bristol have decided that their Technical School shall henceforth be known as the Merchant Venturers' Technical College. In this connection the following nominations have been made:—Principal and Professor of Chemistry, Mr. J. Wentheimer; Professor of Mechanical Engineering, Mr. J. Munro; Professor of Electrical Engineering and Applied Physics, Mr. W. Wilson.

SCIENTIFIC SERIALS.

The Mathematical Gazette, No. 1, April 1893, 8 pp. (London: Macmillan.)—It is now matter of ancient history that a correspondence in the columns of NATURE resulted in the formation, in January 1871, of the Association for the Improvement of Geometrical Teaching. The original objects of the association were threefold: to collect and distribute information as to the prevailing methods of instruction in geometry practised in this and other countries, to use its influence to induce examining bodies to frame their questions in geometry without reference to any particular text-book, and to stamp with its approval some text-book already submitted, or to bring out a new one under its own auspices. Ten years later, viz. in January 1881, the association widened its basis, though after some discussion it retained its name. The objects it had in view were now sought to be carried out by the reading of papers and raising discussions, and by the appointment of committees to report on existing defects in the usual methods, order, range, &c., in teaching special subjects—all branches of elementary mathematics and mathematical physics being included in the widened basis. Now that the association has passed its majority, it is thought that it owes its continued existence to a "widespread desire on the part of teachers of mathematics to become acquainted with the methods of other teachers." The editor of the *Gazette*, Mr. E. M. Langley, to whose long-continued and enthusiastic

advocacy of its aims the Association for the Improvement of Geometrical Teaching owes so much as late secretary, hopes, through the agency of its columns, to extract from experienced teachers MSS. which have long been lurking in desk or pigeon-hole for want of a suitable organ for making them known. This new venture, which has been started in consequence of a resolution passed at the association's annual meeting in January last, is proposed to be "a terminal journal for students and teachers." The editor has to feel his way: words of encouragement have come from the far East and West, as well as from many teachers in this country. The number before us opens with a short paper, by the editor, on the eccentric circle of Boscovich. We borrow from Dr. C. Taylor's classical book on Conics the following verdict on Boscovich's work :—It is "a clear and compact treatise, which for simplicity, depth, and suggestiveness will not readily be surpassed." Dr. J. S. Mackay abstracts the first book of Gino Loria's treatise on "the exact sciences in ancient Greece," viz. that on the Greek geometers before Euclid. In addition to the works cited by Dr. Mackay, we may call attention to three notes on the history of mathematics by the Danish mathematician, H. G. Zeuthen (which have recently been published in the *Bulletin de l'Académie Royale des Sciences de Danemark* (1893). Prof. A. Lodge gives some useful approximations and reductions. Then follow some elegant solutions of examination questions, and a select number of questions for solution. A commendation of the new French journal, *l'Intermédiare des Mathematiciens* closes this No. 1. The size of the page, the clear type, and the excellent paper, should secure for the *Gazette* far more than a mere *succès d'estime*. The figures are lithographed on a separate sheet. We note one little slip—*Adam's* property for *Adams'* (p. 8.)

American Journal of Mathematics, vol. xvi. 2. (Johns Hopkins University, April, 1894.)—W. H. Metzler in compound determinants (pp. 131–150) shows how to express certain minors of a compound determinant $\Delta_{(m)}$ in terms of the minors of various orders of Δ. The paper is divided into two parts, one relating to determinants, the other to matrices. A short note follows on the order of terms in a semi-convergent series, by H. P. Manning (pp. 151–155). Writing on the addition theorems of Jacobi and Weierstrass (pp. 156–163), E. Study gives a new presentation of results connected with an investigation of the addition theorems given in Hirzel's paper, "Sphärische Trigonometrie, orthogonale Substitutionen und Elliptische Functionen" (1893). Two articles follow by A. Chessin. The first is summation of logarithmic and exponential series (pp. 164–185), the second a note on the general solution of Bessel's equation (pp. 186–7). In an article on adjustable cycloidal and trochoidal curves (pp. 188–204) Prof. F. Morley gives many interesting results in connection with these curves. The text is illustrated with several carefully drawn figures. A two-page note on induced linear substitutions, by Prof. F. Franklin, closes the number.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, April 19.—"Electrical Interference Phenomena somewhat analogous to Newton's Rings, but exhibited by Waves along Wires." By Edwin H. Barton, B.Sc., late "1851 Exhibition" Science Scholar.

(1) The preliminary paper (Roy. Soc. Proc., vol. liv. pp. 85–96, 1893) on this subject gave the results of a single experiment, and approximately accounted for them by a mathematical theory of the phenomena involved.

(2) The present paper discusses the question of disturbances, and gives nine experiments. Two of these are similar to the first experiment, but were made under better conditions; the others were made either to lead to these improved conditions or in confirmation of the original fundamental conclusions.

(3) The disturbances alluded to arise from the fact that the electrical waves are not suddenly lost after their first incidence upon the abnormal part of the secondary, but course to and fro until they die out. A method of avoiding the greatest disturbance due to this cause is pointed out and adopted. A correction is also calculated and applied for another disturbance which still remains.

(4) The chief experiment (Expt. v. arts. 42–48) is on interference phenomena, somewhat analogous to Newton's rings, by transmission.

(5) The experiments conclude with two examples (Expts. viii. and ix. arts. 51–62) of modifications of the secondary which produce *no* reflexion. These consisted respectively of thinner wires near together, and of thicker wires further apart, than the normal spacing. In each case the capacity was practically unaltered by the change in the wires; hence, as anticipated from the theory, no reflexion occurred.

(6) The systematic comparison of theory and experiment, made (Arts. 63–77) near the end of the paper, does not exhibit an absolute quantitative agreement. Nevertheless, the two are so far concordant in all their general features as to be mutually confirmatory, and were approved by Prof. Hertz (under whose able guidance the work was carried out in Bonn, 1892–93) as close approximations.

"On Rocks and Minerals collected by Mr. W. M. Conway in the Karakoram-Himalayas." By Prof. T. G. Bonney, F.R.S., and Miss C. A. Raisin.

Physical Society, April 27.—Prof. A. W. Rücker, F.R.S., President, in the chair.—A paper on the mechanism of electrical conduction (Part I. Conduction in Metals) was read by C. V. Burton. Considering a body not at absolute zero of temperature, the author shows that electromagnetic radiation would result in heat being degraded into a lower form of energy, if any parts of finite electric conductivity were present, and from the fact that our planet is not devoid of heat, deduces the following Theorem I. :—"In a region containing matter there may be (and probably always are) some parts which are perfect insulators, and some parts which are perfect conductors, but there can be no parts whose conductivity is finite, unless every finitely conductive portion is enclosed by a perfectly conductive envelope." This conclusion is in accordance with Poisson's theory of dielectrics, and with Ampère's and Weber's theories of magnetism and diamagnetism respectively. Theorem II. is enunciated as follows :—"In metals, and in other non-electrolytes whose conductivity is finite, the transmission of currents must be affected by the intermittent contact of perfectly conductive particles"; and as a corollary, Theorem III. is given :—"If we suppose that in a substance at the absolute zero of temperature there is no relative motion amongst the molecules or amongst their appreciable parts, it follows that every substance at this temperature must have either infinite specific resistance (which does not imply infinite dielectric strength) or infinite conductivity." Fleming and Dewar's experiments on pure metals tend to confirm this. The author then shows why, on the intermittent contact hypothesis, a conductor is heated when a current flows through it. On the assumption that in ordinary conductors the relation between the electromotive intensity in the intermolecular spaces and electric displacement is a linear one, and that the electric forces are small in comparison with the ordinary intermolecular forces, Ohm's Law is deduced. A model is next described by means of which contact E.M.F. and the Peltier effect can be represented and explained, and in considering Volta E.M.F.'s, the author points out that it is doubtful whether experiments in a perfect vacuum could decide the questions at issue in the contact-force controversy. The fact that the transparency of metals is much greater than Maxwell's theory indicates might be explained without attributing any new properties to the electromagnetic field by supposing the dimensions of molecules not quite negligible in comparison with the wave-length of light. Prof. S. P. Thompson thought the paper had an important bearing on the kinetic theory of solids. He saw no reason why Ohm's Law should be proved, for he regarded it as a definition. The President said the author represented all actions as being due to collisions, thereby introducing the same difficulties as were felt in the kinetic theory of gases, viz. that collisions would give rise to mechanical oscillations in the molecules of shriller and shriller pitch. Prof. J. J. Thomson had recently given an explanation of electrical phenomena by vortex filaments. After some remarks on the visibility of molecules by Mr. Hovenden, Dr. Burton, in reply to Prof. Thompson, said Ohm's Law, when expressed as $\frac{E}{C} = a$ *constant*, was really a law, and not a mere definition.—A communication on the design and winding alternate-current electromagnets, by Silvanus P. Thompson, F.R.S., and Miles Walker, was read by the former. The paper describes experiments showing that when the magnetic induction does not exceed 4000 (C.G.S.), the pull exerted by a laminated electro-

magnet on its armature is the same, whether it be excited by a continuous or by an alternating current of equal strength. For higher inductions the continuous current gives slightly greater force. Another experiment made with solenoids and the U-shaped plunger of a Brush alternate current arc lamp, gave similar results. In considering the question of winding alternate current electromagnets so as to obtain a given excitation when the current is supplied at constant voltage, it is shown that the ampere-turns are inversely proportional to the number of turns, for the impedance varies nearly as the square of the number of turns. One important property of such electromagnets when supplied at constant voltage is that they give a fairly constant pull over a long range, for as the armature moves away from the magnet the current increases, thus counteracting to some extent the effect of distance. On the other hand, the alternating voltage required to obtain a given force is much greater than that needed with continuous currents. With the armature in contact with the core the ratio of the two voltages was found to be 170, whilst separating them by 9·2 mm. reduced the ratio to 21·5. Prof. Perry pointed out that the constant pull of the alternate current magnet followed immediately from the fundamental equation $e = rc + n\dot{\mathrm{I}}$ when rc is small, for if e be constant then $\dot{\mathrm{I}}$ and therefore I and I^2 are constant. He was interested to see that the pulls for equal ampere-turns were the same, and indicated how the problem could be worked out mathematically when hysteresis was taken into account. Mr. Blakesley thought it better to fill the space on a magnet full of copper, rather than use wire only just large enough to carry the current, for the loss of energy would be reduced. Some of the formulæ given might be put in simpler form. Mr. Swinburne said an alternate current magnet would only give constant pull in special cases. As another rule for winding alternate current magnets, he said, wind the magnets as for continuous currents, and put a condenser in to take the same current, thereby reducing the voltage required. Mr. Blakesley said it would require a capacity of 600 microfarads to suit the magnet mentioned in the paper. Dr. Thompson, in reply, agreed with Mr. Blakesley that the condenser was impracticable in many cases.—Major R. L. Hippisley, R.E., read a paper on a graphical method of constructing the curves of current in electromagnets and transformers, and exhibited a machine for drawing these curves. Taking the ordinary equation for a simple alternate current circuit $\mathrm{E}\sin pt - \frac{dB}{dt} = \mathrm{R}i$, where B is the total magnetic flux, and i the current; the author writes it in the form

$$\mathrm{E}\sin pt - m_k \mathrm{L}\frac{di}{dt} = \mathrm{R}i,$$

where L is the coefficient of self-induction of the circuit with the iron withdrawn and m_k the tangent of the inclination of the BH curve at the point corresponding to the instant considered. This equation is integrated for a short part of the cycle during which m may be considered constant giving

$$i = \frac{\mathrm{E}}{\mathrm{R}}\cos\theta_k \sin(pt - \theta_k) + \mathrm{A}_{k^t} e^{-\frac{\mathrm{R}t}{m_k \mathrm{L}}}.$$

Methods of finding the constants in the last equation are then described, and the method of drawing the current curves step by step explained. The machine for performing the process is illustrated in the paper, and the curve for an electromagnet fed with alternating current shown. The case of a transformer without magnetic leakage is worked out at some length, and the curves of primary and secondary current determined. Dr. Sumpner said the author had used great care in working out a difficult problem more completely than usual. In cases such as arise in practice the Ri term is small, and for this case Evershed showed how to determine the current curves of a transformer when the periodic state had been reached, some five or six years ago. He (Dr. Sumpner) had also shown how to graphically determine the current curves for circuits containing iron in 1888. The author's method was, however, of more general application. Mr. Trotter inquired if whether the machine could be used in practical alternate current problems, say, for example, to predetermine the E.M.F. curve of an alternator. Major Hippisley replied to the points raised.

Geological Society, April 25.—Dr. Henry Woodward, F.R.S., President, in the chair.—Mr. A. R. Sawyer, referring to specimens exhibited by him from the Transvaal, Orange Free State, Cape Colony, Mashonaland, and Matabeleland (the last mentioned collected during the recent war), remarked that gneisses and gneissose granites cover a large portion of Mashonaland, together with patches of schistose rocks and a few stratified rocks. He drew attention to the fantastic shapes assumed on weathering by the granitic gneiss, which he considered solely due to atmospheric agencies, and not to ice-action or to the effects of submersion. The schistose rocks are, for the most part, sheared and altered igneous masses. There are numerous examples of dolerites and epidiorites passing into hornblende-schists, and of more acid igneous rocks. Masses of magnetite occur in various parts of Mashonaland, and serpentinous rocks (which probably owe their origin to the alteration of peridotites) in the north-west corner of the Victoria gold-field. Extremely auriferous veins occur amongst the sheared acid igneous rocks of the Umhungwe Valley in the Manica district, and gold occurs in the kaolin produced by the disintegration of these rocks.—The following communications were read:—Further notes on some sections on the new railway from Romford to Upminster, and on the relations of the Thames Valley beds to the boulder clay, by T. V. Holmes. The author alluded to his discovery of boulder clay on this new railway at Hornchurch (*Quart. Journ. Geol. Soc.* August 1892), and described the finding of more boulder clay close to Romford during the deepening and widening of a cutting there. The boulder clay was on precisely the same level as that at Hornchurch, a mile and a half to the south-east, and, like it, was covered by gravel belonging to the highest, and presumably oldest, terrace of the Thames Valley system. A portion of the silted-up channel of an ancient stream-course was also found in this Romford cutting. Its relations to the boulder clay could not be seen, as they were not in contact, but they were alike covered by the oldest gravel belonging to the Thames Valley system. The author discussed the probable direction of the flow of this stream-course, and the way in which it was superseded by the ancient Thames. After noticing certain points brought forward during the discussion on his former paper, he concluded with a criticism on the views to which Dr. Hicks inclines in his paper on the sections in and near Endsleigh Street (*Quart. Journ. Geol. Soc.* vol. xlviii. 1892) as regards the age of those beds, asserting that they are, in all probability, simply river drift of the Thames Valley system, and consequently post-glacial, in the sense of being later in date than the boulder clay of Essex and Middlesex.—On the geology of the Pleistocene deposits in the valley of the Thames at Twickenham, with contributions to the flora and fauna of the period, by Dr. J. R. Leeson and G. B. Laffan. The section described in this paper was exposed during the construction of an effluent from the Twickenham sewage-works to the Thames. Its length was about one mile. The beds exposed were (1) coarse reddish-yellow gravels, coloured blue below, lying on an eroded surface of (2) dark blue loam, varying in thickness, the greatest thickness seen being three feet, at a place where the bottom was not reached; (3) dark sand; (4) coarse ballast gravel; (5) London clay. The loam (which is quite a local deposit) yielded eight species of mollusca and fourteen species of plants, all still living in the neighbourhood. A number of mammalian bones, referable to seven species, were lying just on the surface of the loam. Amongst the forms were bison and reindeer. The authors consider that the loam was deposited in a small lake, and they alluded to similarities between it and a deposit described by Dr. Hicks as occurring in the Endsleigh Street excavations. In the remarks on these two papers, the President congratulated the authors of the second paper on having succeeded in rescuing so interesting a collection of remains of Thames Valley mammalia. Sir John Evans expressed his pleasure at Mr. Holmes's further discovery of evidence as to the superposition of the old Thames Valley gravels upon the boulder clay, as these discoveries supported the view he had always held that these gravels, whether at a high or at a low level, were "post-glacial" in the sense indicated by the author. He also remarked that the finding of the mammalian remains by Dr. Leeson in the low-level gravels at Twickenham was of interest, as proving the existence of the reindeer and bison in the Thames at the time of the deposition of these beds. As to some of the remains of other animals, however, he entertained doubts whether, though found in the course of the excavation, they really belonged to the gravels. Mr. E. T. Newton, Mr. Lewis Abbott, Mr. G. B. Laffan, Prof. Hull, and Dr. Leeson also spoke, and Mr. T. V. Holmes briefly replied to the remarks made on his paper.—On a new goniatite from the lower coal

measures, by Herbert Bolton. Sowerby in his "Mineral Conchology" figures two fossils under the name of *Goniatites Listeri*, of which the left-hand figure is clearly *G. Listeri*, whilst the right-hand one differs considerably from it. The author gave diagnoses of *Goniatites Listeri* and of a new species, which agrees with the form represented in Sowerby's right-hand figure. This species is limited to the shales forming the roof of the "Bullion" or upper foot seam of the lower coal measures, whilst *G. Listeri* ranges from the lower limestone shales to the "Bullion" seam.

Chemical Society, April 19.—Dr. Armstrong, President, in the chair.—The following papers were read:—The magnetic rotations of fatty acids containing halogens; of acetic and propionic acids, phosgene and ethylic carbonate, by W. H. Perkin. The molecular association investigated by Ramsay and Shields is apparently without influence on the magnetic rotations of acetic and propionic acids. In a number of cases where two similar atoms or groups of atoms enter a compound by substitution, the change in magnetic rotation caused by the entrance of the first group is different to that caused by the second; as the President pointed out, Thomsen has observed an analogous phenomenon in his thermochemical investigations.—The action of concentrated acids on certain metals when in contact with each other, by G. J. Burch and J. W. Dodgson. The authors are investigating the chemical and electrical behaviour of different pairs of metals in contact when placed in the strong mineral acids. Very slow action occurs when a piece of sodium impaled on a strip of platinum, iron, or carbon, is placed in concentrated sulphuric acid; the sodium of a sodium-carbon couple requires more than eight hours for its solution in sulphuric acid.—The action of light on oxalic acid, by A. Richardson. Oxalic acid, exposed to light, is slowly decomposed with formation of hydrogen peroxide and carbonic anhydride.—English jute fibre, by A. Pears, jun.—Natural oxycelluloses. I. Celluloses of the *Gramineæ*, by C. Smith.—Preliminary note on the volatilisation of salts during evaporation, by G. H. Bailey. During the evaporation of salt solutions a considerable amount of the salt is volatilised, although every precaution be taken to guard against mechanical loss. Cæsium chloride solution containing 286 grams to the litre lost 18·86 milligrams of salt per litre during evaporation.—Constitution of glycocine and its derivatives, by Joji Sakurai. The author considers that glycocine must be regarded as an internal ammonium salt of the constitution

$$\begin{array}{l} CH_2—NH_3 \\ | \quad | \\ CO—O \end{array} .$$

Similar views of the constitutions of hippuric acid, aspartic acid, and asparagine are also expressed.—Note on the constitution of glycocine, by J. Walker. Reasoning by analogy, the evidence afforded by the electrical conductivity goes to show that glycocine has the ordinarily accepted constitution

$$NH_2 . CH_2 . COOH.$$

—On the oxidation of the alkali metals, by W. Holt and W. E. Sims. Potassium, sodium, and probably lithium may be distilled in perfectly dry oxygen without undergoing oxidation; potassium monoxide, K_2O, is not formed by the oxidation of the metal in any of the oxides of nitrogen, as is generally supposed, and there is no evidence of its existence in the pure state.—The action of iodine and of methyl iodide on aconitine, by W. R. Dunstan and H. A. D. Jowett.

Zoological Society, May 1.—Dr. A. Günther, F.R.S., Vice-President, in the chair.—The Secretary read a report on the additions that had been made to the Society's menagerie during the month of April 1894, and called special attention to a valuable collection of mammals presented to the Society by Dr. J. Anderson, F.R.S., being part of the proceeds of his recent expedition to Egypt.—Dr. Günther, F.R.S., exhibited and made remarks on specimens of a South African Hornbill (*Buceros melanoleucus*) and of a portion of the tree in which the nest was placed, and spoke of its mode of nesting and of its extraordinary habits during that season. The specimens had been transmitted to the British Museum by Dr. Schönland of Grahamstown.—Dr. H. E. Sauvage exhibited a vertebra of the earliest known Snake from the gault of Portugal.—Mr. W. Bateson exhibited a large number of specimens of *Gonioctena variabilis*, a Phytophagous Beetle from Spain, in illustration of discontinuous variation in colour.—Prof. F. Jeffrey Bell gave an account of the Echinoderms collected during the voyage of H.M.S. *Penguin* and by H.M.S. *Egeria*, when surveying Macclesfield Bank. The collection, which had been made by Mr. P. W. Bassett Smith, with the co-operation of Mr. J. J. Walker, was very extensive, and contained examples of many new species, some of which were of a very remarkable character.—Mr. Ernest W. Holt gave an account of some of the results of his recent studies in teleostean morphology made at the Marine Laboratory at Cleethorpe. Mr. Holt spoke first of some specimens of the Birkeläuge (*Molva abyssorum*, Nilsson). The regular occurrence of this fish off the Faroë Islands and its occasional capture on the coast of Iceland were now recorded for the first time, the species having been previously observed only on the Scandinavian coasts. The specimens, six in number, all of considerable size, were described in detail, and the species was carefully compared with the allied form *M. vulgaris* (the Common Ling). Mr. Holt next proceeded to describe the "*recessus orbitalis*," an accessory visual organ of the Pleuronectid Fishes. The organ in question was stated to be a highly elastic saccular process of the membranous wall of the orbital cavity. It had been found to occur in all the flat-fishes examined, viz., the Halibut, Long Rough Dab, Brill, Plaice, Flounder, Lemon-Sole, Dab, and Common Sole, and was believed to occur in all flat-fishes with well-developed eyes. Finally, Mr. Holt spoke of an adult specimen of the Common Sole with symmetrical eyes, and discussed the bearing of this specimen on ambicoloration. The specimen in question, about fifteen inches long, was perfectly normal in external configuration, except that the left eye had retained its position on the left side of the head, and was nearly opposite to the right eye. Antero-ventrally it had been somewhat overgrown by the skin. The coloration was normal, the right side being brown and the left side white.—A communication was read from Mr. St. George Littledale, containing field-notes on the Wild Camel of Lob Nor, as observed during his recent journey across Central Asia.—Mr. Oldfield Thomas gave an account of a collection of mammals from Oman, S.E. Arabia, which had been transmitted to the British Museum by Dr. A. S. G. Jayakar, among which were examples of a new Hare (*Lepus omanensis*) and of a new Goat of the genus *Hemitragus*, proposed to be called *jayakari*, after its discoverer. Altogether seventeen species were represented in this collection, from a locality of which very little was previously known.

Linnean Society, May 3.—Prof. Stewart, President, in the chair.—Dr. Johann Mueller, of Aargan, and Prof. K. Mitsikuri, of the University of Tokio, were elected foreign members of the Society.—Prof. Poulton exhibited the larvæ of certain Lepidoptera to illustrate the results of experiments which he had made in regard to the influence of environment upon their colours. Variously coloured twigs and shoots, such as occur in nature, were shown to influence the appearance of many twig-like larvæ in such a manner as to aid their concealment.—Prof. G. B. Howes exhibited and made remarks upon the eggs and young of *Ceratodus Fosteri*, received from Prof. Semon, of Jena, who is engaged in working out the development of this fish.—Mr. James Saunders, of Luton, with the aid of the oxyhydrogen lantern, exhibited plasmodium in the act of forming sporangia; the species, which had been found on birch, was *Didymium squamulosum*.—On behalf of Dr. H. B. Guppy, the Secretary read a paper on the habits of three species of *Lemna*. In this paper, the author detailed the results of experiments made by him during a period of twenty months, and showed that *Lemna gibba* can pass the winter either in the gibbous form or with fronds which in appearance resemble those of *Lemna minor*. The flowering of *Lemna gibba* was observed in July, when it was found that the gibbous plants were producing their flat fronds, which were also in flower, and floating detached. In both cases the flowers were hermaphrodite, but they had the appearance of being unisexual, on account of the flowers of the gibbous plants protruding only the pistil, while those of the flat fronds only evolved the stamens. After describing the habits of the winter fronds of *Lemna polyrhiza*, and alluding to *Lemna minor*, the paper concluded with a table of temperatures relating to the germinating, budding, and flowering of these plants.—A paper was then read on the fertilisation of certain Malayan orchids, by Mr. H. N. Ridley.

Entomological Society, May 2.—Captain Henry J. Elwes, President, in the chair.—Mr. S. Stevens exhibited a specimen of *Argynnis aglaia* var. *charlotta*, taken by the late Rev. James Watson in the New Forest in 1870.—Mr. J. A. Clark exhibited a curious variety of *Chelonia caja*, having an extraordinary wedge-shaped marking extending from the outer margin to the base of the left hind wing, and also, on the same wing, a small spot, which was brown and white in colour, and had the appearance of having been taken from the fore wing and inserted in the hind wing. The specimen was taken at Abbotts Wood, Sussex, in July 1892.—Prof. E. B. Poulton, F.R.S., exhibited living specimens of the larvæ of *Gastropacha quercifolia*, surrounded respectively during the early stages of growth by black twigs and lichen-coloured twigs, the food being the same in both cases. All the larvæ were shown upon a white paper background, but examples of the surrounding twigs which produced the change of colour were shown beside each batch. Mr. Merrifield made some remarks on the subject.—Mr. E. Meyrick communicated a paper entitled "On *Pyralidina* from the Malay Archipelago."—Mr. C. J. Gahan read a paper entitled "A Supplemental List of the Longicorn Coleoptera obtained by Mr. J. J. Walker, R.N., during the voyage of H.M.S. *Penguin*."

PARIS.

Academy of Sciences, May 7.—On the spectra of oxygen at high temperatures, by M. J. Janssen.—Researches on the isomeric propylenes and their compounds with sulphuric acid, by M. Berthelot. Trimethylene is rapidly absorbed by pure sulphuric acid forming the normal ethereal salt $(C_3H_7)_2\,SO_4$. On addition of water it separates as a heavy oil which is only very slowly acted on by water and is decomposed by potash slowly in sealed tubes at 100°. Ordinary propylene combines with sulphuric acid in the same way to yield a much less stable derivative.—On *Flabellum anthophyllum* from the Gulf of Lyons, by M. de Lacaze-Duthiers.—Articular movements studied by means of photography, by M. Marey. Photographs are taken in successive positions of a bright wire attached to the moving part. The results of a study of human jaw movements are given.—Report of M. Darboux on a memoir on the triangle of sequences (presented by M. Désiré André).—Azimuth, latitude, and longitude, by equal heights without the aid of the chronometer, by M. E. Caspari. The method described is held to have many good characteristics, among which the fact of the same precision being obtained for all latitudes and all zenithal distances is noted.—Experiments on the contraction of liquid jets and on the distribution of velocities internally: abstract of a memoir by M. Bazin.—Mathematical theory of the Watt indicator: abstract of a memoir by M. L. Lecornu.—Observations of the comet Gale, made at Algiers Observatory, by MM. Rambaud and Sy. M. Tisserand gave details concerning a photograph of this comet obtained on May 5, at Paris. The photograph shows the comet with a tail 4° in length.—Emission of sounds, by M. Henri Gilbault.—Equality of the speeds of propagation of very short electric waves in free space and in long wire conductors, by M. M. Dufour. The author experimentally demonstrates the extension of MM. Sarasin and de la Rive's conclusions on the subject to the case of a wave-length of 8·5 cm.—Absorption spectra of cupric bromide, by M. Paul Sabatier. The spectral absorption of aqueous solutions varies with the concentration; alcoholic solutions give the same absorption spectrum as concentrated aqueous solutions, probably the salt here exists in the anhydrous condition.—On the variations of viscosity shown by melted sulphur, by MM. J. Brunhes and J. Dussy.—On the blue lakes obtained from dibromogallanilide and on some reactions yielding blue products of polyphenols, by M. P. Cazeneuve.—On a new carbon chloride, the dichloride of hexachlorobenzene, by M. Et. Barral. The properties are described of the substance C_6Cl_8 obtained from hexachlorophenol by action of PCl_5.—On the aldehyde from essence of lemon grass, by MM. Ph. Barbier and L. Bouveault.—On the industrial manufacture of products rich in nicotine, by M. Th. Schlœsing.—On the oxidation of beer worts, by M. P. Petit.—Researches on the chemical transformations of the fundamental substance of cartilage during normal ossification, by M. C. Chabrié.—On some points in the anatomy of Cryptoproctus from Madagascar, by M. H. Filhol.—The perfume glands of Viverridæ, by M. H. Beauregard.—The sexual reproduction of Ascomycetes, by M. P. A. Dangeard.—The lacustrine basin of Constantine and oligocene formations in Algeria, by M. E. Ficheur.—Examination of milks by pressure, by MM. R. Lezé and E. Hilsont.—On the *réclamation*, by M. Calmette, concerning the antitoxic blood of animals protected against the poison of serpents, by MM. C. Phisalix and G. Bertrand.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Notes on the Ventilation and Warming of Houses, &c.: Prof. E. H. Jacob (S.P.C.K.).—Simple Experiments for Science Teaching: J. A. Bower (S.P.C.K.).—Practical Botany for Beginners: Prof. F. O. Bower (Macmillan).—Alternating Generations; a Biological Study of Oak Galls and Gall Flies: Dr. H. Adler, translated and edited by C. R. Straton (Oxford, Clarendon Press).—Lux Naturæ: D. Sinclair (E. Stock).—Monograph of the Stalactites and Stalagmites of the Cleaves Cove, near Dalry, Ayrshire: J. Smith (E. Stock).—Fallen Angels: One of them (Gay and Bird).—The Steam-Engine and other Heat-Engines: Prof. J. A. Ewing (Cambridge, University Press).—Creatures of other Days: Rev. H. N. Hutchinson (Chapman and Hall).—Theorie des Fernrohrs auf Grund der Beugung des Lichts: K. Strehl; 1 Theil (Leipzig, Barth).

PAMPHLETS.—Tertiary Tipulidæ: S. H. Scudder.—Zweiter Jahres-Bericht des Sonnblick-Vereines für das Jahr 1893 (Wien).—Lost British Birds: W. H. Hudson (Society for the Protection of Birds).—Tracks for the Times (London).

SERIALS.—American Journal of Science, May (New Haven).—Bulletins de la Société d'Anthropologie, January (Paris).—Mémoires de la Société d'Anthropologie de Paris, tome 1 (3e series), 3e fasc. (Paris).—American Meteorological Journal, May (Ginn).—Engineering Magazine, May (New York).—Proceedings of the Chester Society of Natural Science and Literature, No. 4 (Chester).—Memoirs and Proceedings of the Manchester Literary and Philosophical Society, Vol. 8, No. 2 (Manchester).—Psychological Review, Vol. 1, No. 3 (Macmillan).—Astronomy and Astro-Physics, May (Wesley).—Actes de la Société Scientifique du Chili, tome 3, 3e Livn (Santiago).

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