THURSDAY, MAY 9, 1895.

THE PYGMIES.

The Pygmies. By A. de Quatrefages. Translated by Frederick Starr. (London and New York: Macmillan and Co., 1895.)

SOME surprise was expressed when Prof. de Quatrefages was appointed, in 1855, to the chair of Anthropology in the Museum of Natural History at Paris. He was then forty-five years of age, and had acquired a considerable reputation as a zoologist, but his published original researches related only to the lower marine forms of animal life. Thenceforward, however, he devoted himself with great energy and success to the cultivation of the subject under his special charge, and the great development of the collections in the Museum and the numerous contributions to the literature of the natural history of man, which he continued to make almost up to the time of his death, three years ago, at the age of eighty-two, abundantly justified his selection for the post. It is true, that during the greater part of this time he had the advantage of the assistance and harmonious co-operation in much of his work of M. E. T. Hamy, who has naturally succeeded to the chair.

The work now under notice, which has just appeared in an English form, was originally published in 1887, as one of the "Bibliothèque scientifique contemporaine," and is essentially popular in its character. It commences by giving an account of the wide-spread belief among the more cultivated nations of antiquity in the existence of a race or races of human beings of exceedingly diminutive stature, who dwelt in some of the more remote and unexplored regions of the earth. The scattered notices of these people, called *Pygmies* by the Greeks, found in the writings of Homer, Aristotle, Herodotus, Ctesias, Pliny, Pomponius Melo, and others, are cited and commented upon. Aristotle places his pygmies in Africa, near the sources of the Nile, and Herodotus gives a circumstantial account of their existence near a river now generally identified with the Niger, while Ctesias describes a race of dwarfs in the interior of India. Whether these legends were merely the offspring of a fertile imagination, or whether they had a solid foundation in fact, may be still an open question. Our author is convinced that the latter view is correct, and devotes the greater part of the work to the task of collecting all the reliable information upon the existing races of people of diminutive stature who inhabit the regions of the earth in which the pygmies of the ancients were supposed to dwell, and to the endeavour to harmonise the scanty notices of those old writers with the facts as now shown by scientific investigation.

A considerable portion of the book is given to an account of the characteristics and culture of that singularly interesting race, the natives of the Andaman Islands, which is naturally taken mainly from the observations of Mr. E. H. Man. These people Quatrefages persists in calling "Mincopies," although it has long been shown that the name is quite unknown in their own language. A chapter is then devoted to showing that people having the general physical characters (small stature, black colour, frizzly hair, and roundish heads) and many of the habits and customs (especially the dexterous use of the bow) of the Andamanese, form a groundwork of the native population of many of the islands of the Malay Archipelago, living mostly in the mountainous regions of the interior. To this race, Quatrefages has given the name of "Negrito." But it is not only in the islands that the Negrito race dwell. Traces of them are found also on the mainland of Asia, but everywhere under the same conditions; in scattered tribes, occupying the more inaccessible mountainous regions of countries otherwise mainly inhabited by other races, and generally in a condition more or less of degradation and barbarism, resulting from the oppressive treatment they have received from their invading conquerors; often, moreover, so much mixed that their original characters are scarcely recognisable. The Semangs of the interior of the Malay Peninsula, the Sakays from Perak, the Moys from Annam—all show traces of Negrito blood. In India proper, especially among the lowest and least civilised tribes, not only of the central and southern districts, but almost to the foot of the Himalayas, in the Punjab, and even to the west side of the Indus, according to Quatrefages, frizzly hair, negro features, and small stature, are so common that a strong argument can be based on them for the belief in a Negrito race forming the foundation of the whole pre-Aryan or Dravidian, as it is generally called, population of the peninsula. The crossing which has taken place with other races has, doubtless, greatly altered the physical characters of this people, and the evidences of this alteration manifest themselves in many ways; sometimes the curliness of the hair is lost by the admixture with straight-haired races, while the black complexion and small stature remain; sometimes the stature is increased, but the colour, which seems to be one of the most persistent of characteristics, remains. The localities in which the Negrito people are found in their greatest purity, either in almost inaccessible islands, as were the Andamans till in comparatively recent times, or elsewhere in the mountainous ranges of the interior only, and their social conditions and traditions wherever they exist—all point to the fact that they were the earliest inhabitants; and that the Mongolian and the Malay races on the east, and the Aryans on the west, which are now so rapidly exterminating and replacing them, are later comers into the land. We now see what constitutes the great interest of the Andamanese natives to the student of the ethnological history of the Eastern world. Their long isolation has made them a remarkably homogeneous race, stamping them all with a common resemblance not seen in the mixed races generally met with in continental areas. They are the least modified representatives of the people who were, so far as we know, the primitive inhabitants of a large portion of the earth's surface, but who are now verging on extinction.

The next portion of the book is devoted to an examination of the so-called "pygmy" races of the African continent. These are the well-known Bushmen or "Sân of South Africa, to whose religious beliefs a whole chapter, derived mainly from the observations of Hahn, is devoted, and another race to which Hamy has given the name of "Negrillos," about which far less is known at present, who seem to hold the same relation to the larger

long-headed African negroes, among whom they dwell, that the small round-headed Negritos of the Indian Ocean do to their larger long-headed Melanesian neighbours. Scattered communities of these small negroes, all much resembling one another in size, appearance and habits, scarcely over four feet in height, and all great hunters, expert with the bow, and living on the produce of the chase, occur at various isolated spots across the great African continent, within a few degrees north and south of the equator, extending from the Atlantic coast almost to the Indian Ocean. In many parts, especially at the west, they are obviously holding their own with difficulty, if not actually disappearing, and there is much about their condition of civilisation and the situations in which they are found, to induce us to look upon them, as in the case of the Bushmen to the south and the Negritos in the east, as the remains of a population which occupied the land before the incoming of the main body of the present natives. If the account of the Nasamonians, related by Herodotus, be accepted as historical, the river they came to, "flowing from west to east," must have been the Niger, and the northward range of the dwarfish people far more extensive twenty-three centuries ago than it is at the present time.

The translator has given, in an appendix, a list of the principal contributions to the literature of the little races of man which have appeared since the publication of the French edition of M. de Quatrefages' book. It would have been still better if he had given some epitome of the considerable advances that have been made in our knowledge of the subject, especially of the recent researches of R. G. Haliburton and Kollmann, which tend to show the former extension of dwarf races over a considerably larger area of the earth's surface than was suspected by our author, such as the whole of North Africa, the Pyrenees, Switzerland, and even Central America.

W. H. FLOWER.

AN ATTEMPT TO POPULARISE EVOLUTION.

A Primer of Evolution. By Edward Clodd. (Longmans, Green, and Co., 1895.)

THE title of this little book is hardly justified by its contents, since it nowhere defines or explains evolution, or deals with it in a systematic manner. As the author tells us in a prefatory note, the book is an abridgment of his former work, "The Story of Creation"; and he does not appear to have made any attempt to rearrange his materials, or to introduce such new matter as was required to constitute it a real introduction to the theory of evolution for those who know little or nothing about it. Such a book should give, at starting, a full statement of what is meant by evolution in modern science and philosophy; should explain how it differs from previous theories of the universe; and should clearly mark out its range of action and its limitations, showing in what way it is supposed to have "evolved" the material universe, and how much must be postulated as the materials and the forces with which it works.

But instead of any explanation of this nature, the first half of the book is devoted to a general descriptive sketch of the universe, inorganic and organic, so brief and elementary as to be quite unnecessary, since any one prepared to enter on the study of evolution would be already acquainted with so much of the facts to be explained. In all this portion, occupying more than half the book, evolution is not once referred to. Then, in the second part, which is headed "Explanatory," all the ground is gone over again, with explanations which assume evolution, but do not often refer to it. Some of this is interesting and well written, the chapter on "Proofs of Derivation of Species" being one of the best; and if this part had been more fully developed, and had been preceded by such an account of the principle of evolution as has been suggested, the work might have been useful to beginners.

But, besides these deficiencies of arrangement and of subject matter, there are more serious defects in numerous obscurities and misstatements, and in the adoption of very doubtful theories as if they were universally accepted. As examples of these faults, the very first sentence states that—"The universe is made up of matter and motion," as if they were things of the same nature. And on turning to the "explanatory" part, we are informed that the "materials which make up the universe" are "matter and motion." On page 3, we are told that "matter is made up of chemical units or elements," about seventy in number, and that—"These elements are named atoms." On page 91, we have force and energy defined as being respectively "motion which draws the atoms together," and "motion which drives the atoms apart." This appears to have been adopted from a well-known popular writer, but as it is quite different from what is to be found in the usual text-books it should not have been adopted in a "primer." At page 95, the friction of the ethereal medium in retarding the orbital motion of the planets, is stated as if it were a demonstrated fact. The abundance of the compounds of carbon are said to be partly due to its having "an affinity for itself" (p. 102); and among the erroneous statements of fact we are told that, among the lower races the great toe survives "as a grasping organ" (p. 127), and that there are in America certain wandering tribes who use gestures as "the sole mode of communication" (p. 157). Again, without a word of doubt or reservation, we have the statements that—"The origin of life is not a more stupendous problem to solve than the origin of water" (p. 103); and that—"mind is the highest product of the action of motion upon matter (p. 174). These few samples are sufficient to show that this little work requires very careful revision to render it a safe guide for the elementary student.

STEEL AND THE NEW IRON-ALLOYS.

Steel Works Analysis. By J. O. Arnold. (London: Whittaker and Co., 1895.)

CHEMISTS engaged in steel works have long been wanting a trustworthy manual adapted to their special requirements, and this work is the latest attempt to meet the want. The work is undoubtedly an advance on its predecessors, for, while it retains the best of the well-known processes, many newer operations are now, for the first time, published in a comparatively handy form. Everything that a steel works analyst may fairly be called upon to examine, finds a place in this volume.

This applies more especially, perhaps, to the sections treating on the examination of chrome-iron, silicon-iron, nickel alloys, &c.

The volume is particularly valuable as embodying the results of an extensive experience in the examination of certain iron alloys which are bound to become of special importance in the near future; most steel works analysts will cordially appreciate this portion.

As the results of my own practice, I can confirm the accuracy and efficiency of most of the selected methods; more especially as applied to the assay of ferro-chrome, ferro-aluminium, silicon, nickel, &c.

In regard to the assay of ferro-chrome or steels, Galbraith's method is to be preferred, if the precautions given are adopted. The original process did not always give concordant results. The gravimetric methods are, however, on the whole most trustworthy. Results are apt to be low unless great care is taken; no doubt for the reasons shown at page 207. The estimation of small quantities of aluminium presents difficulties not easily overcome; indeed, simpler and less complicated methods are required: a remark which applies to most of the methods now practised.

The assay processes for sulphur and phosphorus are clearly set forth, leaving practically nothing to be desired. For the former element, certainly, gravimetric estimations are best; but it is nearly impossible to obtain the necessary acids quite free from sulphur compounds: this constitutes a serious drawback, and entails the necessity of a blank experiment, which should be avoided when possible. The evolution methods give only relative results, agreeing pretty closely amongst themselves, but somewhat under those obtained gravimetrically. The author's colour test is a good one, but somewhat complicated. A more simple modification of the colour test consists in passing the evolved H_2S through 50 c.c. of a very dilute lead acetate solution ($\frac{1}{10}$ grm. in litre H_2O) contained in a long test-tube. This is compared with a standard steel, treated in the same manner, containing a known percentage of sulphur. No precipitate is formed, and a clear brown tint is obtained, which lasts for some time, and is easily compared with the standard.

The processes advocated for phosphorus (pp. 110–115) are complete, but the necessary manipulative skill required to carry them out can only be acquired by constant practice. I find, however, that the addition of a little HCl to the nitric acid solution assists the precipitation of phosphorus when precipitating with ammonium molybdate. Further, I agree with the author that in ordinary steels the presence of silicic acid may be ignored: with regard to time, fifteen or twenty minutes is ample; if longer, molybdic acid is precipitated. In addition, even if this does not occur, the precipitate may redissolve to a notable extent. The dried phospho-molybdate precipitate is distinctly soluble in dilute nitric acid.

The author's method of precipitating arsenic with H_2S is good, but no others are given. The process with modifications gives good results, but the ordinary method is preferable when it is desired to estimate this element. For the mere elimination of arsenic from the phosphoric acid, in order to determine the latter, the boiling or distillation process is useful.

It is to be regretted that no trustworthy process has been given for the determination of oxygen in steel. A thorough examination of the whole work, however, reveals the pains taken by the author, not only as regards the portions mentioned in the foregoing, but also in the somewhat less important sections dealing with fuel and other materials. There can be little question that Prof. Arnold has rendered steel-works analysts a decided service by the publication of his work. JOHN PARRY.

OUR BOOK SHELF.

Wayside and Woodland Blossoms. A Pocket Guide to British Wild Flowers for the Country Rambler. By Edward Step. With coloured figures of 156 species, black and white plates of 22 species, and clear descriptions of 400 species. (London: Frederick Warne and Co., 1895.)

MANY persons who admire the beautiful flowers that adorn our woods and pastures would fain know their names, with a view to further knowledge of them; but for various reasons they are unable to use the ordinary "Flora," however simply compiled. Here is a little book that will meet the wants of such persons, and do more, we believe, to lay the foundation of a sound knowledge of plants than the form in which "life-histories" are taught in ordinary schools and classes for the purpose of passing an examination. In spite of all that is said to the contrary, to know a large number of plants, animals, or minerals by sight, is of more value, to begin with, than a more detailed knowledge of a single, or few, organisms or objects; especially when this detailed knowledge is gained by rote, and not by observation. We therefore commend this little book to the notice of those interested in, and believing in, small beginnings, though the kind of information it contains is not exactly what the examiner demands. The coloured figures are well drawn, and the colouring, although a little crude, is good enough to enable one to recognise the plants the figures are intended to represent. The majority of the common and prominent plants of our native flora are figured. Many of them are drawn of the natural size, whilst others are reduced and a few enlarged, without indications of the reduction or enlargement. These things should be explained for a beginner. The descriptive and explanatory letterpress is instructive, and free from pedantry, by which we mean the display of technical terms only used by "teachers" of botany; not by botanists. There are some inconsistencies in the choice of subjects for illustration. For example, the exceedingly rare *Holosteum umbellatum* is represented, whereas the allied genus *Cerastium*, found in every county, and perhaps in every parish and field in the kingdom, is left out. There is also an unexplainable absence of characteristic sea-side plants. The black and white figures mentioned in the title represent native trees and some of the commonly-planted exotic species. An omission here is the common yew, which might well have taken the place of the very poor figure of *Ailantus*. In spite of the shortcomings indicated, we strongly recommend this little pocket-book to those in search of some practical knowledge of common wild plants. W. B. H.

The Lepidoptera of the British Islands; a Descriptive Account of the Families, Genera, and Species indigenous to Great Britain and Ireland, their Preparatory States Habits, and Localities. By Charles G. Barrett, F.E.S. Vol. ii. Heterocera, Sphinges, Bombyces. (London: L. Reeve and Co., 1895.)

MR. BARRETT'S great work on British *Lepidoptera* is making steady progress, and we are glad to find that the second volume which includes the Sphinges and the first

nine families of Bombyces, ending with the *Psychidæ*, is written in the same careful and painstaking manner as its predecessor. The first volume has been well received abroad, but the foreign critics regret the absence of references, a deficiency more felt by them than by British lepidopterists. The foreign critics speak of the plates as a veritable storehouse of remarkable varieties; but we must again comment very severely on the action of the publishers in issuing two editions of the work, one with, and the other without illustrations, without any reference to the illustrated edition in the letterpress of the other, so far as we have noticed; and in the case of the second volume, without even as much as an advertisement to call attention to its existence.

There are several points of general scientific interest suggested by an examination of Mr. Barrett's book. A great number of species recorded as British by the older entomologists, but rejected by Doubleday and Stainton, have latterly been rediscovered and reinstated. This has happened so often, that it seems likely that when we eliminate accidentally introduced species (chiefly North American), and European species wrongly determined, it will be found that the information given by the older writers was far more accurate than the writers of the middle of the century were at all disposed to admit. Nor did the latter allow for the difficulty of communication with the continent at the beginning of the century, which added much to the improbability of specimens asserted to have been taken in England, having been simply brought over from the continent.

In estimating the probability of a reputed species being truly British, the chief factor to be taken into account is its continental range. It is evident that the British fauna is slowly changing, some specimens becoming rarer or even disappearing, and others becoming commoner, or establishing themselves in England for the first time. There is also some tendency in Mediterranean species to extend their range further north in Western Europe. As the late Mr. Stainton once remarked, the comparison of our present lists with those of the future, will be likely to yield highly unexpected and interesting results.

W. F. K.

Quellenkunde. Lehre von der Bildung und vom Vorkommen der Quellen und des Grundwassers. Von Hyppolyt J. Haas. 8vo. pp. 220. Illustrations in the text. (Leipzig: J. J. Weber, 1895.)

PROF. HAAS, of Kiel, when asked to edit and bring up to date the "Quellenkunde" of Abbé Paramelle, came to the conclusion that in order to state the present position of the science of springs and underground water in a satisfactory form, an entirely new work was necessary. Hence the book under notice. In such small compass, nothing approaching a complete treatise could possibly be attempted. The chief features of springs, their classification and relation to geological conditions, are discussed according to a clearly arranged plan under five principal heads. First comes a discussion of springs in general, including an historical introduction, in illustration of which several of Athanasius Kircher's quaint pictures are reproduced. The following sections deal with thermal and mineral springs, underground water, and the art of finding springs. In the last division we find some remarks on the divining-rod. The book should prove useful to students of physical geography and to those concerned with the practical utilisation of a water-supply derived from wells.

A number of diagrams are reproduced from the works of Daubrée and other authorities. Although several English authors are cited, we fear that Prof. Haas has not made himself familiar at first hand with the literature of the subject in English, which is by no means meagre in records of original observations on the movements of underground water, and deserves more recognition than it receives.

LETTERS TO THE EDITOR.

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Uniformitarianism in Geology.

DR. ALFRED WALLACE, in his letter to NATURE of May 2, calls attention to the significant fact that catastrophes caused by volcanoes "may be of greater magnitude now than in geologic times," owing to the crust of the earth being thicker now than it was then. He, however, is mistaken in supposing that this consideration has been overlooked by geologists. If he will kindly refer to "Geology," vol. i. p. 449, he will find it there stated, speaking of the older fissure and explosive eruptions, that "there is nothing to show that this [the explosive] action was on the same scale of magnitude and permanence as those of late Tertiary and recent date. With the greater thickness of the earth's crust and the greater resistance presented by its rigidity, volcanic eruptions must with time, as suggested long ago by Elie de Beaumont, have altered with the alterations of those conditions, and may now be exhibited under a phase very different from those of the earlier periods."

Or again, he will find in "The Position of Geology" ("Collected Papers," p. i.) it stated that, though one form of volcanic action (the fissure) was more active in the past than at present, that "explosive eruptions are more violent now than in former times." And again, at p. 145 of the same work, I remark that "while with the thinner crust of former times, there would be a more frequent extrusion of the molten rock, there are probably with the thicker crust now formed and consequently its greater resistance, greater forces stored in the explosive eruptions of the present day."

The instance relied upon by Dr. Wallace is, however, another striking example, if others were needed—though in this case it is on the inverse side as against meteorological agencies—of the non-uniformity *in degree* between the action of the forces of past and present times. The increased thickness of the crust is not, however, the sole cause of the violence of recent eruptions, nor are they, I imagine, due to the presence of occluded water in the volcanic foci. The terrific eruptions of Krakatão and other volcanoes are, I conceive, due simply to the access of vast volumes of surface waters and their sudden flashing into steam.

Volcanic action, therefore, does not seem to me to be in any way in contradiction to the conception of uniformity of *kind* or law, and to non-uniformity on the question of *degree*.

Sevenoaks, May 4. JOSEPH PRESTWICH.

Green Oysters.

I HAVE just received a "Note," extracted from the *Monitore Zoologico Italiano*, of Florence, by Dr. Carazzi, in which a number of unsupported statements are made as to "phagocytosis in Mollusca."

Amongst other statements, I find "Non solo sono osservazioni erronee quelle del Lankester, malamente ripetute dello Chatin, ma lo sono egualmente quelle del Pelseneer e del Bruyne." I am surprised that my zoological friends in Florence should publish a bare statement of this nature without a shred of evidence to support it. I desire to draw attention to the simple assertion made by Dr. Carazzi, and to let those who are responsible know that I and others expect him to show in detail what is the error in the observations published by me on the green oysters of Marennes.

It is certainly not a usual thing for a Society to allow an author to print vague accusations of inaccuracy in reference to other writers, without the smallest attempt to justify such accusations.

Dr. Carazzi's assertion is all the more remarkable, since it appears that he has not examined the true *huitres de Marennes* at all, and is singularly ill-informed as to the histology and physiology of Mollusca.

I shall be very much surprised if Dr. Carazzi can show that the observations published by me on green oysters in 1886 (*Quart. Journ. Micr. Sci.* vol. xxvi.) are erroneous, and shall at once re-examine the matter if he succeeds in throwing doubt on the facts as stated by me.

Inferences from observed facts stand in a different position from the observations themselves.

I was the first to describe the cells laden with green granules

which occur in the epithelium of the gills and labial tentacles of the Marennes oyster.

I also showed that such cells are present in the common oysters, but that the granules they contain are not green. I further showed that these cells occur abundantly on the *surface* of the gills, crawling about and exhibiting amœboid movement. I also showed that the Marennes oysters are specially fed upon *Navicula ostrearia* which contains a highly refractory blue pigment "Marennin," and I *inferred* that the granular cells of the gills derive their colour from the blue pigment of the naviculæ—since it was shown long ago by Gaillon (in 1824) that the *huitres de Marennes* are purposely placed by the oyster-culturist into tanks containing the *Navicula ostrearia*; that when placed there they have gills of the usual yellow-brown colour, but rapidly acquire the green colour; that they actually feed on the *Navicula ostrearia*, and that when removed from this article of diet, they lose the green colour of gills.

The inference that the "granular cells" are to be regarded as wandering phagocytes, was not first published by me; and, though I have no doubt of its justification, I may point out that it is an interpretation, and not an observation of fact.

Lastly, let me say that I showed by chemical analysis that the green colour of the oyster's gill is *not* due to any metallic base—either copper, iron, or chromium. The statement made by Carazzi that there is "abbondanza di sesqui-ossido di ferro" in the mud of the tanks where the oysters are fed, is therefore doubly futile. Every one knows that such mud contains abundance of iron; but as there is no iron in the green pigment of the oyster, it is useless to draw attention to the iron in the mud.

E. RAY LANKESTER.

Oxford, May 4.

The Origin of the Cultivated Cineraria.

I MADE two objections to Mr. Dyer's account of the history of the Cineraria; the careful reader will observe that his letter meets neither. Mr. Dyer informed us that the cultivated Cinerarias were produced "*by the gradual accumulation of small variations*," *i.e.* without the selection of definite sports. My object in adducing historical evidence of Cineraria sports was to prevent Mr. Dyer's pronouncement from being repeated without further evidence. That purpose I think has been attained; for I notice that in now restating his account Mr. Dyer does not refer to the point, though it was the object of his original exhibition of the Cineraria to the Royal Society. That the Cineraria was an excellent "illustration of the amount of variation which could be brought about under artificial conditions in a limited time" I should be the last to dispute. As I showed in my first letter, there is evidence that the time was very short indeed.

Compared with this point, the second question—that of the hybrid origin of cultivated Cinerarias—is of subordinate interest. For the view that they were originally hybrids, resulting from crosses between *C. cruenta*, *C. lanata*, and other species, I have given the evidence, quoting the explicit statement of contemporaries and the almost universal opinion of practical gardeners, with references to the sources of information. Mr. Dyer, however (with him Mr. Rolfe) declares that they are descended from *C. cruenta* alone. Is this statement a mere inference from the want of likeness between particular cultivated Cinerarias and the wild species, or have Mr. Dyer and Mr. Rolfe evidence of a more substantial character? Of course these authorities may be right, and the rest who have written on the matter may be wrong; but I ask for proof of this, and the request can hardly be thought unreasonable.

Mr. Dyer has referred to a remark I made at the meeting respecting the Camellia. At the risk of diverting attention from the real issues, I feel bound to speak of this, for I was then in the wrong. In justice the circumstances must be stated. Speaking of the Cineraria, Mr. Dyer declared that though the flowers have changed so much, the foliage, which had not been an object of Selection, still resembled that of his wild plant. I replied that though this might be true of the Cineraria, it led to no universal induction, for it is well known that the foliage of many plants selected solely for their flowers or for their fruits had varied greatly. As an illustration taken on the spur of the moment, I said that though the matter had not come within my own observation, there was, I believed, a passage in one of Darwin's books to the effect that the foliage of the several kinds of Camellia differed so much that they could be recognised by it alone. Upon Mr. Dyer interjecting that this was not true, I immediately gave up the illustration as not coming within my own knowledge, and substituted that of the Apple, of which I myself know several kinds to have distinct and characteristic foliage. Such examples may be multiplied indefinitely. Now the passage in Darwin is as follows:—"Verlot mentions a gardener who could distinguish 150 kinds of Camellia when not in flower" ("Animals and Plants," ed. 1885, II. chap. xxii. p. 238); but Darwin takes the case as an illustration of the fact that structures "though appearing to an unpractised eye absolutely undistinguishable, yet really differ." My use of this case was therefore a wrong one, and as Mr. Dyer has thought fit again to refer to the matter, I take the opportunity of withdrawing it once more.

W. BATESON.

St. John's College, Cambridge, May 5.

The Assumptions in Boltzmann's Minimum Theorem.

MR. CULVERWELL'S letter in your issue of April 18 leaves many important points in connection with the reversibility of Boltzmann's Minimum Theorem untouched. On the question as to what different people mean (or think they mean) when they assert that the theorem is true, enough has already been said. What we want to know is what assumptions are involved in the mathematical proofs of the theorem, why they have to be made, and for what systems they are likely to hold. This question has been ably treated by Mr. Burbury, but in view of Prof. Boltzmann's assertion that the theorem is one of probability, it is desirable to examine more fully where probability considerations enter into proofs such as Dr. Watson's, which contain no explicit reference to them.

Dr. Watson starts by assuming two sets of molecules so distributed that the *numbers* having coordinates and momenta within the limits of the corresponding differentials are

$$F(P_1 \ldots Q_m)dP_1 \ldots dQ_m \text{ and } f(p_1 \ldots q_n)dp_1 \ldots dq_n.$$

If, however, the differential elements are taken very small (as when we consider a volume-element comparable with molecular dimensions), these expressions no longer represent numbers of molecules, and it is *assumed* that in this case they represent the *probabilities* of a molecule having coordinates and momenta within the given limits.

It is then necessary to *assume* that *the probabilities for the two kinds of molecules are independent of each other*. This assumption was pointed out to me by Mr. Burbury, and is what I intended to imply in my previous letter when I said that Dr. Watson's assumption was more *natural* than any other. Under these circumstances alone can we assert that the probability of a given combination of coordinates and momenta of *two* molecules is proportional to

$$F dP_1 \ldots dQ_n \times f dp_1 \ldots dq_n$$

To make the proof independent of the choice of coordinates, let $y_1 \ldots y_{m+n}$ be *any other* system of coordinates specifying the *pair* of molecules, so chosen that $y_1 = 0$ at the beginning of an encounter. Then if $x_1 \ldots x_{m+n}$ denote the corresponding momenta, we may employ the theorem proved in my last British Association Report, § 14, to write the above expression in the form

$$F f |dy_1 dy_2 \ldots dy_n dx_1 \ldots dx_{m+n}.$$

and if we write $(dy_1/dt)dt$ for dy_1, the probability of a configuration in which an encounter will take place in the time-element dt becomes

$$F f |dy_2 \ldots dx_{m+n}(dy_1/dt)dt$$

corresponding to Watson's expression with (dy_1/dt) in place of (dq_n/dt). This step involves the assumption (made above) that dy_1 is small in comparison with the dimensions of a molecule.

From this point on Dr. Watson's proof is easy. But it will be seen that the probabilities for two molecules are not independent of each other *after* a collision between them. The method would fail if the same pair of molecules were likely to collide repeatedly. Thus the Minimum Theorem depends on the free motions of the molecules quite as much as on the collisions themselves, and it only applies to gases whose molecules mix freely among each other between collisions, not to media where they are densely crowded. In such cases, however, we have Mr. Burbury's investigation (*Phil. Mag.* January 1894).

If we were to reverse the motion exactly, we should have one in which the probabilities for two molecules *before* an

encounter were not independent, and our assumptions (*however improbable*) would be therefore entirely based on our previous experience with the direct motion. Without such assumptions we should have inferred, by the ordinary laws of probability, that H would be likely to decrease. This is what I intended to imply in my previous letter; but as I had used accented and unaccented letters in my statement, I failed to make my meaning clear to Mr. Culverwell, who evidently found it difficult to understand a proof involving their use. G. H. BRYAN.

The Unit of Heat.

I WAS glad to read Prof. Joly's communication in your issue of May 2, for I have made many efforts to call attention to the unsatisfactory nature of our present system of calorimetric measurements, and now that a more powerful voice than mine has been raised in favour of a change, I have some hopes of progress.

The indifference with which, as it appears to me, our physicists regard this matter is probably due to several causes. They ignore the fact that the science of calorimetry has recently made great strides, and that an ambiguity as to the unit, which formerly was of little consequence, has now become almost the only bar to further progress; also, as Prof. Joly has pointed out, our system of calorimetric measurements has been so wedded to the method of mixtures, that the union has (wrongly) come to be regarded as essential.

As to Prof. Joly's proposal, there is much to be said in its favour. It is practical and definite. At the same time the change would be so radical, that I should not feel justified in counting myself as his disciple in this matter without serious consideration.

My own inclination is rather in the direction of a C.G.S., or absolute unit, and the course adopted by Prof. Schuster and Mr. Gannon, in entitling their recent important communication to the Royal Society "The Specific Heat of Water," rather than the "Mechanical Equivalent of Heat," shows that a step has already been taken in this direction.

When we reflect on the attention and the labour which have been devoted to the establishment of our present system of electrical units, it is a cause for wonder that so important a unit as that of heat should have been left ill-defined and unregarded.

I would propose that at the forthcoming meeting of the British Association, the attention of Section A should be particularly directed to this matter; and it would prepare the way for such action if those who have definite proposals to make would, in the meantime, communicate them to your columns.

Cambridge. E. H. GRIFFITHS.

REFERRING to Dr. Joly's letter last week, would it not be well definitely to adopt the "Joule" as the only fundamental unit of heat, and to realise distinctly that researches such as those of Mr. Griffiths, Prof. Rowland, and Dr. Joly are determinations of the specific heat of water and of the latent heat of steam in terms of it? OLIVER J. LODGE.

The Examination Curve.

THE extremely interesting article, by Prof. Lloyd Morgan (vol. li. pp. 617–619), on the graphic representation of the marks given in an examination, and of their great use to an examiner, leads me to ask whether even this method may not be developed further with advantage to all concerned, for, as Lloyd Morgan says—"If, after an extensive set of papers has been looked over and carefully marked, an interval of time be allowed to elapse, and then the papers are gone over again, the result of this re-examination is that the head and tail remain practically unchanged, but that there is not a little redistribution among the mediocrities." In other words, the personal equation of the examiner varies, showing itself mostly in the middle of the curve.

The first thing to strike me on looking at Fig 2 (vol. li. p. 618), was the great similarity of the two halves of the curves, and on tracing it, and then turning the tracing half round so that the upper end of the traced curve became superimposed upon the lower end of the original, and *vice versâ*, the similarity was so marked as to make one think, that had a larger number of papers been examined and as carefully marked as the first set, the traced curve would have covered the other.

If such be the case, why should not the examiner, after plotting the marks he thinks best, make a tracing of this curve, then reverse it, superimposing the two ends as before, and sketch it in alongside his first curve (easily done by means of oil-paper), then, if they differed, draw a fresh curve midway between the two; subsequently re-marking his examination papers from this smoothed mean curve? An illustration may be of use; let it be founded on Fig. 1, as it contains the less smooth curve. The dark line is that of the marks first adjudged; the light line, the same curve reversed; and the dotted line, the smoothed mean curve of the two from which his papers are finally marked.

Granting that the plus variations and the minus variations on the two sides of the mean nearly balance, the question would appear to be—Would one be justified in smoothing them in accordance with the generalised results of many such series? It involves some forcing of the examiner's marking into the general mould, but would this be more than sufficient to correct

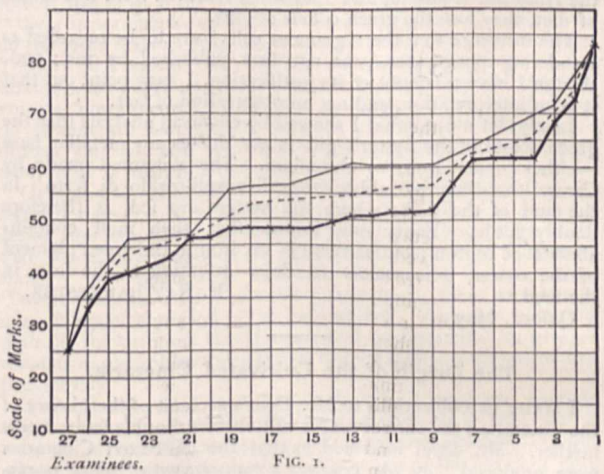

FIG. 1.

his personal equation? On the other hand, the two halves—say from paucity of examiners—might be so dissimilar, that the mean curve would differ very much from the original form. In this case, would it be possible to give any general rule whereby one could be guided whether to adopt the mean curve, or to remain satisfied with the original marks given?

In Herbert Spencer's "Principles of Sociology," (vol. i. p. 88) are many references to the fact that "the children of Australians, of Negroes in the United States, of Negroes on the Nile, of Andamanese, of New Zealanders, of Sandwich Islanders [and others], are quicker than European children in acquiring simple ideas, but presently stop short from inability to grasp the complex ideas readily grasped by European children, when they arrive at them." F. HOWARD COLLINS.

April 29.

Teaching Young Pheasants to Peck.

IT may interest Prof. Lloyd Morgan and others to know that when Asamese find newly hatched chicks in the jungles, they have a system of teaching the little ones to peck and pick up food, without which, I am told, many of them would die.

Walking down a road one morning with a neighbour, we suddenly noticed a little ball of fluff between my feet, and I could hardly avoid stepping on it, as it stuck close to me; almost immediately another appeared at my friend's feet, and we saw they were newly-hatched pheasants, the mother probably carried off by some wild cat.

As it was difficult to walk with these little things running so close and in the way, we lifted them into the short grass alongside, and hurried on some fifty yards.

On returning we had forgotten them, but one ran out, and so pertinaciously stuck to my boots, that to save it I put it into my pocket, and on our arrival at the bungalow tried to feed it with small fragments of hard-boiled egg, rice, and white ants. Of all these it took no notice.

Next morning the other chick was found at the foot of the bungalow steps, having probably followed us unnoticed the day before. I then called my "Babu," as I could not get them to eat, and he said "they must be *taught*."

He put the gauze wire cover they were under, and the crushed

rice, egg, &c., on a hard wood table, and taking a pencil from his pocket and collecting the eatables together, close to the edge of the gauze cover, he lifted its edge, and with the pencil point inserted, began sharply tapping among the rice débris. The two chicks at once ran over to that place and bent over, watching the tapping, and to our astonishment they began tapping with their little beaks the same way, and before long had begun to feed on their own account, just as the "Babu" had predicted; and after that lesson we had no trouble.

As I happen to be writing, I may mention that our land lizard (3 feet 6 inches to 4 feet 6 inches total length, name unknown to me) has begun calling in the early dawn and dusk at evening. It is silent during the day and night.

From the bearings taken, it can be heard plainly at a mile in forest, and often five or six calling at once in different directions. The native Asamese name is "Gui," which is precisely the sound it makes; by the old spelling it is "Gooee." S. E. PEAL.

Sibsagar, Asam, April 4.

The Bagdad Date-mark.

THERE will be found in Grattan Geary's "Through Asiatic Turkey" all about the date-mark—a mysterious and troublesome excoriation, coming only once, but which lasts a year, leaving an ugly scar the size and outline of the fruit—visitors for any length of time at Bagdad seldom, and residents never, escape. It is also known at Aleppo and other places, but is worst in Bagdad, almost every native being marked. Even nitric acid has been found to have little effect upon it. I lately spent forty-four days, off and on, at Bagdad, and imagined I had escaped; not so, however, as it proved six weeks after my return to India. But the mark yielded forthwith, and before any damage was done, to hyposulphite of soda, which does so much "fixing" for every amateur photographer, and seemed worth trying. The fact may be usefully mentioned in the interest of Mesopotamian explorers who do not want to be date-marked as a memento; but it is to physiologists they must look for an explanation.

Bombay, April 12. A. T. FRASER.

THE ROYAL SOCIETY SELECTED CANDIDATES.

THE following are the names and qualifications of the fifteen candidates recommended by the Council of the Royal Society, on Thursday last, for election into the Society.

J. WOLFE BARRY,

C.B., Civil Engineer. Vice-President of the Institution of Civil Engineers. Is eminently distinguished in his profession, and has designed and executed many works of national importance, which include the Tower Bridge, opened by H.R.H. the Prince of Wales, 1894; the City Terminus extension of the Charing Cross Railway, the Inner Circle Railway, and the Barry Dock. Has served as a member of the following Royal and Departmental Commissions:—Royal Commission on Irish Public Works, 1887; Highlands and Islands of Scotland Commission, 1890; Commission on the River Ribble, 1891; Thames Navigation Commission, 1894. Member de la Commission Consultative des Travaux de la Campagnie Universelle du Canal Maritime de Suez. Is the author of many papers, mainly in reference to engineering works, which have been published in the *Transactions of the Institution of Civil Engineers* and elsewhere. Is the author of several professional treatises, among which the following are the more important: "The Barry Dock" (British Association Report, 1888): "Railway Appliances," "Railways and Locomotives," published in conjunction with Sir F. Bramwell, Bart.

ALFRED GIBBS BOURNE,

D.Sc. (Lond.), Professor of Biology in the Presidency College, Madras. Fellow of University College, London. For many years engaged in teaching and in researches upon Comparative Anatomy and Embryology, especially of Invertebrata. Especially known to comparative anatomists for his discoveries in the structure of leeches, and as discoverer of the hydroid phase of Limnocodium, also of two remarkable new genera of Chætopod worms, described by him as Haplobranchus and Chætobranchus. Author of the following, as well as several other memoirs:—"On the Structure of the Nephridia of the Medicinal Leech" (*Quart. Journ. Micros. Sci.*, 1880); "Contributions to the Anatomy of the Hirudinea" (*ibid.*, 1884); "On the Hydroid Form of Limnocodium" (*Proc. Roy. Soc.*, 1884); "On the Supposed Communication of the Vascular System with the Exterior in Pleurobranchus" (*Quart. Journ. Micros. Sci.*, 1885). Since he has been in India, Prof. Bourne has sent home important researches on Indian Earthworms, on Chœtobranchus (a new naidiform worm), on a new Protozoon of the genus Pelomyxa, with observations on the structure of protoplasm, and some valuable experimental researches on the suicide of Scorpions (*Proc. Roy. Soc.*, 1889).

GEORGE HARTLEY BRYAN,

M.A., Fellow of Peterhouse, Cambridge. Lecturer (on Thermodynamics, &c.) on the University list. Fifth Wrangler, 1886; Class I, Division 1, 1887; bracketed with Senior Wrangler, Smith's Prize, 1888, for the Essay "On the Curves on a Rotating Spheroid of Finite Ellipticity" (*Phil. Trans.*, 1889 A). Author of the following papers:—"On the Stability of a Rotating Spheroid of Perfect Fluid" (*Proc. Roy. Soc.*, vol. xlvii.); "On the Stability of Elastic Systems"; "Waves on a Viscous Rotating Cylinder" (*Proc. Camb. Phil. Soc.*, vol. vi.); and several others in *Phil. Mag.*, *Proc. Lond. Math. Soc.*, and *Proc. Camb. Phil. Soc.*, &c. Also joint author, with Mr. Larmor, of the Report on Thermodynamics, published in the British Association Reports, 1891.

JOHN ELIOT,

M.A. (Cantab.), Meteorological Reporter to the Government of India. Late Meteorological Reporter to the Government of Bengal. Was Second Wrangler and Smith's Prizeman, 1869. Mr. Eliot, as Meteorological Reporter to the Government of Bengal, and subsequently as Head of the Meteorological Department of India, has made many important additions to the physical data of Indian meteorology, and has done much in their utilisation, and in the improvement of the administration of the department of which he is now the head. Under him have been carried out the publication of Daily Weather Charts for the Bay of Bengal and Calcutta, for Bombay and the Western Coasts of India, and general charts for the whole peninsula. He has also organised the systematic collection of marine observations from ships arriving at the chief Indian ports. His special work, contained in a long series of memoirs, published either in separate form by the Meteorological Department, or in the *Journal of the Asiatic Society of Bengal*, chiefly relates to storms in India and Indian seas, and comprises complete histories and discussions of fifteen cyclones and upwards of one hundred storms that have occurred between 1877 and 1886. The Annual Reports of the Meteorological Department, prepared by him, also contain many valuable and original discussions. He has contributed very largely to establish the Indian Meteorological Department on a thoroughly scientific basis, and to maintaining its high character and recognised practical importance to our great Indian dependency.

JOSEPH REYNOLDS GREEN,

D.Sc. (Cantab.), M.A., B.Sc. (Lond.), F.L.S. Professor of Botany, Pharmaceutical Society of Great Britain. Distinguished for his acquaintance with botany. Attached to science, and has contributed to its progress by discoveries in the region of physiological chemistry, with reference chiefly to plants. His more important contributions are contained in the following papers:—"On the Organs of Secretion in the Hypericaceæ" (*Journ. Linn. Soc.* (*Bot.*), vol. xx., 1883); (with Dr. Sheridan Lea) "Some Notes on the Fibrin-ferment" (*Journ. of Physiol.*, vol. iv., 1883); "On the Edible Bird's Nest of the Java Swift" (*ibid.*, vol. vi., 1885); "On Proteids occurring in Latex" (*Proc. Roy. Soc.*, 1886); "On the Action of Sodium Chloride in dissolving Fibrin" (*Journ. of Physiol.*, vol. viii., 1887); On Certain Points connected with the Coagulation of the Blood" (*ibid.*); "On the Changes in the Proteids of the Seed which accompany Germination" (*Phil. Trans.*, 1887); "On the Germination of the Tuber of the Jerusalem Antichoke" (*Annals of Botany*, vol. i., 1888); "On the Germination of the Seed of the Castor-oil Plant" (*Proc. Roy. Soc.*, 1888); "On the Occurrence of Diastase in Pollen," (Brit. Assoc. Report, 1891); "On the Occurrence of Vegetable Trypsin in the Fruit of *Cucumis utilissimus*" (*Annals of Botany*, vol. vi., 1892); (with Prof. Vines) "On the Reserve Proteid of the Asparagus Root" (*Proc. Roy. Soc.*, 1892); "On the Ger-

mination of the Pollen-grain and the Nutrition of the Pollen-tube" (*Phil. Trans.*, 1894); "On Vegetable Ferments" (*Annals of Botany*, vol. vii., 1893); "On the Influence of Light on Diastase" (*ibid.*, vol. viii., 1894).

ERNEST HOWARD GRIFFITHS,

M.A. Private Tutor. Author of the following papers:—"On the Comparison of Platinum Temperatures with the Kew Standard" (Rept. of Committee on Electrical Measurements, Brit. Assoc., 1890); "On the Determination of certain Boiling and Freezing Points" (*Phil. Trans.*, 1891 A); "The Electrical Resistance of Platinum Wire at Absolute Zero" (*Phil. Mag.*, Dec., 1892); "On the Determination of Low Temperatures by Platinum Thermometers" (*Proc. Camb. Phil. Soc.*, vol. viii., Part I.); "On the Increase in Resistance of a Conductor when Transmitting a Current" (*ibid.*, vol. viii., Part I.); "The Mechanical Equivalent of Heat, together with an Investigation into the Changes in the Capacity for Heat of Water" (*Phil. Trans.*, 1893 A); "The Boiling Point of Sulphur, together with a Method of Standardising Platinum Thermometers," jointly with Mr. Callendar (*Phil. Trans.*, 1891 A).

Supplementary Certificate.—Appendix to the communication entitled "The Mechanical Equivalent of Heat" (*Proc. Roy. Soc.*, vol. lv., 1893); "A Method of Joining Glass and Metal Tubes" (*Proc. Phil. Soc. Camb.*, 1893); "The Measurement of Temperature" (*Science Progress*, 1894); "The Influence of Temperature on the Specific Heat of Aniline" (*Phil. Mag.*, 1895); "The Latent Heat of Evaporation of Water" (read Royal Society, January 1895).

CHARLES THOMAS HEYCOCK,

M.A., Lecturer on Natural Science, King's College, Cambridge. Author of "Revision of the Atomic Weight of Rubidium" (Brit. Assoc. Rept., 1882); joint author of:—"Spectrum of Indium" (*Phil. Mag.* [5] I., 1876); "On a Simplified Form of Apparatus for Determining the Density of Ozone" (*Proc. Camb. Phil. Soc.*, v.); "Lowering of the Freezing Point of Tin by the Addition of other Metals" (*Proc. Chem. Soc.*, No. 65, 1889); "Lowering of the Freezing Point of Sodium by the Addition of other Metals" (*Trans. Chem. Soc.*, lv., 1889); "Molecular Weights of Metals when in Solution" *ibid.* (lvii.); "Freezing Point of Triple Alloys of Gold, Cadmium, and Tin" (*ibid.*, lix.); "Lowering of the Freezing Points of Cadmium, Bismuth, and Lead, when alloyed with other Metals" (*ibid.*, lxi.); "Isolation of a Compound of Gold and Cadmium" (*ibid.*); "Freezing Point of Alloys in which Thallium is the Solvent" (*ibid.*, 1894); "Freezing Point of Triple Alloys" (*ibid.*); "Change in the Zero of Mercury Thermometers" (*Proc. Camb. Phil. Soc.*, vii.).

SYDNEY JOHN HICKSON,

D.Sc. (Lond.), M.A. (Cantab.), Hon. M.A. (Oxon.), F.Z.S. Fellow of Downing College, Cambridge. Author of papers published in the *Philosophical Transactions*, "On the Ciliated Groove (Siphonoglyphe) in the Stomodæum of the Alcyonarians" (1883); "On the Sexual Cells and Early Stages in the Development of *Millepora plicata*" (1888). In the *Quart. Journ. Micros. Sci.*, "The Eye of Pecten" (1880); "The Eye of Spondylus" (1882); "The Structure and Relations of Tubipora" (1883); "The Eye and Optic Tract of Insects" (1895). In the *Tijdschr. van het Nederl. Aardrijkskund. Genootsch.*, "Omzwervingen in Noord-Celebes" (1887). In the *Journ. Anthrop. Inst.*, "Notes on the Sengirese" (1886). Author of the work, "A Naturalist in North Celebes."

HENRY CAPEL LOFFT HOLDEN,

Major, Royal Artillery. In India from 1877–84, he carried out a number of experiments in telephony and telegraphy for the Indian Government. Since 1885 he has been in charge of the Department for the proofs of Naval and Land Service Ordnance, and Gunpowders, and for experiment work connected therewith, and has invented and constructed many pieces of apparatus connected with the science of artillery, as well as with electrical and scientific research. Amongst those which have been publicly exhibited are his devices in connection with the chronograph, for measuring the velocity of projectiles; an extremely accurate and sensitive hydrometer for measuring the variations of the density of the acids in the electrolyte accumulator cells (exhibited Royal Society, 1887; see also paper before Iron and Steel Inst., 1891); a high-speed chronographic pen for recording minute intervals of time by electromagnetic means; various instruments for making accurate and rapid tests of the pressure and current in direct current circuits, and in alternating current circuits of both high and low frequency (some exhibited Royal Society, 1892); an instrument for rapidly ascertaining the E.M.F. and resistance of a galvanic cell (exhibited Royal Society, 1893); a compact moving coil galvanometer adapted to universal purposes, which was employed by Profs. Dewar and Fleming in their researches on the resistance of metals, and is used in the recording pyrometer of Prof. Roberts-Austen. He was deputed by the Commander-in-Chief to write the electrical sections of the Paris Exhibition of 1889, the Frankfort Exhibition of 1891, and the Chicago Exhibition of 1893, and furnished the Government with most valuable reports.

FRANK MCCLEAN,

M.A., LL.D. (Glasg.), F.R.A.S., M.I.C.E. Author of "Photographs of the Red End of the Solar Spectrum from D to A" (*Monthly Notices*, vol. xlix.); "Parallel Photographs of the Sun, Iron, and Iridium, from H to near D" (*ibid.*); "Comparative Photographs of High and Low Sun H to A, with Notes on the Method of Photographing the Red End of the Spectrum" (*ibid.*, vol. li.); "Comparative Photographs of Sun and Metal Spectra" (Series 1 and 2, *ibid.*, vol. lii.). Inventor of McClean's Star Spectroscope, an invaluable aid in the study of stellar spectra. Attached to science, and anxious to promote its progress. Founder of the Isaac Newton Scholarship at Cambridge. Donor of a large telescope to the nation, to be used in physical inquiries at the Royal Observatory, Cape of Good Hope.

WILLIAM MACEWEN,

M.D. (Glasg.), Hon. LL.D. (Glasgow). Professor of Surgery, University of Glasgow. A distinguished Surgeon. Author of:—"Observations concerning Transplantations of Bone, &c." (*Proc. Roy. Soc.*, May 1881, and *Comptes rendus* Acad. Sci., Paris, June 1881); "Treatise on Osteotomy" (London, 1880; translated into French, German, Italian, Roumanian, Swedish and Russian); "Osteogenic Factors in the Development and Repair of Bone" (*Annals of Surgery*, 1887); Address on the Surgery of the Brain and Spinal Cord (*Lancet*, and *Brit. Med. Journ.*, 1888); "The Pupil in its Semiological Aspects" (*Internat. Journ. of Med. Sciences*, 1887); "Radical Cure of Hernia" (*Annals of Surgery*, 1886); also numerous articles on special points in Surgery.

Supplementary Certificate.—Author of a treatise on Pyogenic Infective Diseases of the Brain and Spinal Cord (1893); an Atlas of Head Sections, with fifty-three copper plates, fifty-three key plates and descriptive text (1893). Especially distinguished for his work on the Surgery of the Bones and in the Development and Practice of the Surgery of the Brain and Spinal Cord.

SIDNEY MARTIN,

M.D., B.S., B.Sc., F.R.C.P. Assistant Physician, University College Hospital, and Hospital for Consumption, Brompton. Distinguished for researches in chemical physiology and pathology; has carried out researches on chemical bacteriology for the Local Government Board, and for the Royal Commission on Tuberculosis. The following are his principal published papers:—"Papain Digestion" (*Journ. of Physiol.*, v.); "Nature of Papain and its action on Vegetable Proteids" (*ibid.*, vi.); "The Proteids of the Seeds of *Abrus precatorius*" (*Proc. Roy. Soc.*, xlii.); "Physiological Action of the Active Principle of *Abrus precatorius*" (*ibid.*, xlvi.); "The Toxic Action of the Albumose from the Seeds of *Abrus precatorius*" (*ibid.*); "Gluten and the Proteids of Flour" (*Brit. Med. Journ.*, 1886); "The Influence of Bile on Digestion" (with Dr. D. Williams—*Proc. Roy. Soc.*, xlv. and xlviii.); "The Chemical Products of the Growth of *Bacillus anthracis* and their Physiological Action" (*ibid.*, xlviii.); "Preliminary Report on the Chemical Products of the Life of *Bacillus anthracis*" (Rept. of the Med. Officer, Local Govt. Board, 1889-90); "Chemical Pathology of Anthrax" (*ibid.*, 1891); "Diphtheritic Paralysis" (*Proc. Roy. Soc.*, 1892); "Gulstonian Lectures on the Chemical Pathology of Diphtheria compared with that of Anthrax, Infective Endocarditis and Tetanus," 1892; "Two Classes of Vegetable Globulins" (*Proc. Physiol. Soc.*); "Pathology of the Proteids of the Body" (*Brit. Med. Journ.*, 1890).

GEORGE M. MINCHIN,

M.A. (Dubl.), Professor of Mathematics in the Royal Indian Engineering College, Cooper's Hill. Author of the following treatises:—"Statics," "Uniplanar Kinematics," and "Hydro-

statics." Also of the following papers :—"Astatic Equilibrium of any System of Forces, treated by Quaternions" (*Proc. Lond. Math. Soc.*) ; "The Absolute Sine Electrometer" (*Nature, Electrical Review*, &c.) ; "Researches in Photo-electricity" (*Proc. Phys. Soc.* and *Phil. Mag.*) ; "Impulsion Cells" (*Electrician, Proc. Phys. Soc.*) ; "Seleno-Aluminium Cells and the Electromotive Forces of Starlight" (*Astronomy and Astro-Physics*) ; "The Magnetic Field of a Circular Current" ; "The Magnetic Field close to the Surface of a Wire carrying a Current" (*Phil. Mag., Proc. Phys. Soc.*).

WILLIAM HENRY POWER,

Assistant Medical Officer, H.M. Local Government Board. Author of Reports to the Local Government Board relating to the natural history of epidemic diseases and materially extending the knowledge thereof, more especially (*a*) Demonstration in 1882 of the existence of Scarlatinal Disease in Cows, explaining the previously obscure spread of Scarlatina in human communities by means of Cow's Milk ; (*b*) Record of Cases (afterwards followed by Dr. Klein) where Diphtheria had been spread by the consumption of Cow's Milk ; (*c*) Discovery, in 1881, of the ability of Smallpox to extend atmospherically (without other personal relation) from a hospital to houses in its neighbourhood. The subject was investigated by a Royal Commission which recognised the facts ; they have been subjected to further demonstration by Mr. Power during subsequent years.

THOMAS PURDIE,

B.Sc., Ph.D., A.R.S.M., Professor of Chemistry in the University of St. Andrews. Author of the following :—"On the Synthesis of α Isoheptane" ; and "On the Action of Sodium Alcoholates on Fumaric Ethers" (*Trans. Chem. Soc.*, 1881) ; "Action of Sodium Alkyl Oxides on Ethereal Fumarates" (*ibid.*, 1885) ; "The Action of Metallic Alkylates on Mixtures of Ethereal Salts with Alcohols" (*ibid.*, 1887). Joint author with W. Marshall, B.Sc., of :—"Action of Alcohols on Ethereal Salts in presence of Small Quantities of Sodic Alkylates" (*Trans. Chem. Soc.*, 1888) ; "The Addition of the Elements of Alcohol to the Ethereal Salts of Unsaturated Acids" (*ibid.*, 1891). Joint author with J. Wallace Walker, M.A., of :—"Resolution of Lactic Acid into its Optically Active Components" (*ibid.*, 1892) ; "Optically Active Ethoxysuccinic Acid" (*ibid.*, 1893).

APRIL METEORS.

COMPARATIVELY few meteors of the April shower appear to have been seen this year in consequence of the cloudy weather which prevailed. But if the results are scanty they are interesting, for three fine meteors were observed at more than one station, and their real paths in the atmosphere have been computed.

On April 14, 11h. 44m., a bright first mag. meteor was seen by Prof. A. S. Herschel at Slough, and by the writer at Bristol. It moved rapidly in a rather long path, and left a bright streak. The radiant point is indicated at 316° + 31° near ζ Cygni, and the meteor fell from 87 to 71 miles over the English Channel. During its visible career it traversed a course of 107 miles with a velocity of about 49 miles per second. The radiant of this meteor near ζ Cygni is almost identical with that (314° + 27°) found for a 1–2 mag. meteor observed on April 20, 1893, also by Prof. Herschel and the writer.

On April 19, 10h. 59m., a fine meteor, variously estimated as = 1st mag., 2 × ♃, = ♀, = 1st mag., was observed by Mr. Corder at Bridgwater, Mr. Blakeley, Dewsbury, Mr. Packer, Birmingham, and the writer at Bristol, respectively. Its motion was moderately slow, and it left a streak. The direction of its flight shows it to have been a Lyrid with a radiant at 269° + 30°. The meteor descended from 91 to 43 miles over the North Sea and Lincolnshire, and traversed a path of 97 miles with a velocity of 33 miles per second. This object appeared much brighter to the observers at Birmingham and Dewsbury than to those at Bridgwater and Bristol, for the meteor was far more distant from the latter places, and its light much veiled in the mist lying over the stars of Cygnus near the north-east horizon.

On April 19, 11h. 46m., another conspicuous meteor, moving very swiftly, and leaving a bright streak, was seen in Hercules and Boötes by Mr. Corder at Bridgwater, and the writer at Bristol. Its radiant was in Sagitta at 300° + 20°. The meteor fell from 77 to 71 miles over Wiltshire and Somerset, and travelled along a path of 40 miles in less than one second of time. The radiant in Sagitta furnishes a well-defined meteor shower at the April epoch, and I first detected it in 1877. My positions for the radiant are as follow :

D, 92 ...	1877, April 16–19 ...	298 + 25	6 meteors
D, 110 ...	1885, April 18–20 ...	299 + 24	5 ,,
D, 121 ...	1887, April 19-25 ...	302 + 23	4 ,,

The mean position is at 300° + 24°. Mr. Corder saw a shower in April–May 1876–9 from 300° + 20° (7 meteors), which presents an excellent accordance. The meteors of this stream are very swift, and commonly germinate streaks; but the shower is not well displayed until the morning hours, the radiant being very low before midnight. W. F. DENNING.

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. J. Wolfe Barry, Prof. A. G. Bourne, Mr. G. H. Bryan, Mr. J. Eliot, Prof. J. R. Green, Mr. E. H. Griffiths, Mr. C. T. Heycock, Prof. S. J. Hickson, Major H. C. L. Holden, Mr. F. McClean, Prof. W. MacEwen, Dr. S. Martin, Prof. G. M. Minchin, Mr. W. H. Power, Prof. T. Purdie. We give the qualifications of the candidates in another part of this number.

THE memorial of the late Prof. J. C. Adams, at Westminster Abbey, will be unveiled this afternoon by the Duke of Devonshire.

WE are glad to be able to report that Prof. Huxley has been steadily improving in health during the past few days.

DR. P. DANGEARD has been appointed Professor of Botany to the Faculty of Sciences at Poitiers.

AT a meeting of the Court of the Spectacle Makers' Company, on Thursday last, Mr. W. H. M. Christie, the Astronomer Royal, was presented with the honorary freedom of the Company, in recognition of his services to astronomical science.

THE De Candolle prizes have been awarded by the Physical and Natural History Society of Geneva to Dr. O. Warburg for his monograph of the *Myristicaceæ*, and to Dr. R. von Wettstein for his monograph of the genus *Euphrasia*.

DURING the past week, the deaths of several eminent men of science have occurred. Surgeon-Major Carter, who was elected a Fellow of the Royal Society in 1859, and obtained the Royal Medal in 1872, died on Saturday last, the 4th inst., at his residence in Budleigh Salterton. We notice also the death of Mr. A. E. Durham, late Vice-President of the Royal College of Surgeons of England, and the author of numerous works on subjects connected with medicine and surgery. Among the announcements of deaths abroad, we regret to see the name of Prof. K. Ludwig, Professor of Physiology in the University of Leipzig, and Director of the Physiological Institute there. He was seventy-eight years of age. The death is also announced of Prof. Manuel Pinheiro Chagas, General Secretary of the Royal Academy of Sciences at Lisbon. Prof. Chagas was born November 13, 1842.

DR. KARL VOGT, the eminent biologist, died at Geneva on Monday, at seventy-eight years of age. He was born at Giessen, and studied under Liebig and Agassiz. After residing for a time in Paris, he returned to Germany, in 1847, as Professor of Zoology in the University of his native town, but soon lost his chair for political reasons. In 1852 he became Professor of Geology at Geneva, and from that time identified himself with the civic life of the country of his adoption.

WE regret to notice that Sir George Buchanan, formerly medical officer to the Local Government Board, died on Sunday last, at the age of sixty-four. As mentioned in these columns last week, he was chairman of the Royal Commission on Tuberculosis, the report of which has just been published. His contributions to the literature of preventive medicine, hygiene, and sanitation are numerous and of prime importance. He was elected a Fellow of the Royal Society in 1882.

ON Monday, May 20, a meeting will be held at the Royal Geographical Society to commemorate the fiftieth anniversary of the sailing of the Arctic Expedition, under Sir John Franklin. The Society's anniversary meeting and the annual conversazione will be held on the following Monday, May 27.

THE Earl of Selborne, whose death occurred on Saturday last, was elected a Fellow of the Royal Society in 1860. He was raised to the peerage as Baron Selborne in 1872. The little Hampshire village, from which the title was derived, is that which is immortalised by Gilbert White's "Natural History."

THE Department of Science and Art has received, through the Foreign Office, a programme of an Exhibition of Medicinal and Useful Plants, which is to be held at the Hague in July next. Intending exhibitors may obtain further information from Dr. M. J. Greshoff, 97 Laan van Meerdervoort, at the Hague.

SIXTY-SIX natives, and as many as 252 animals, have been brought over from Somaliland by Herr Menges, for the East African Village at Sydenham. Among the animals was a "Waller" antelope, and numerous lions, cheetahs, hyenas, jackals, baboons, and ostriches. A further instalment of twenty lions, eleven elephants, four zebras, nineteen ostriches, six leopards, four pythons, and other animals will shortly arrive.

AN International Health Exhibition is to be opened in Paris in a few days, and is to remain open until September 15 next. The exhibits are divided into ten groups, as follow:—(1) Hygiene of the house; (2) the health of towns; (3) treatment of infectious diseases; (4) demography and sanitary statistics; (5) sanitary science; (6) hygiene of infancy; (7) industrial and professional hygiene; (8) food products; (9) the hygiene of clothing—laundry work, sanitary clothing, &c.; (10) physical exercise.

A COURSE of lectures on "Our Edible Sea Fish and the Sea Fisheries," to be delivered by Prof. W. A. Herdman, F.R.S., at University College, Liverpool, has been arranged by the Lancashire Sea Fisheries Joint Committee. The object of the lectures is to interest and inform the general public in a matter of national importance, viz. the present position and future prospects of our fisheries, the need of protection and regulation, and the benefits which may be expected to result from such operations, and from fish-hatching and shell-fish culture.

THE library of the Marine Biological Association's laboratory at Plymouth is in want of a number of volumes to complete sets of those books which form an essential part of the equipment of an institution where scientific investigation is carried on. Among the volumes badly needed are: *Philosophical Transactions* previous to 1878, and the *Proceedings* of the Royal Society previous to 1888. Fellows of the Royal Society, who do not wish to keep their old *Transactions* and *Proceedings*, or the families of Fellows who are dead, could not bestow those volumes more worthily than by giving them to the Plymouth Laboratory. Other volumes which would be welcomed are: *Proceedings* of the Zoological Society previous to 1891, and the *Zeitschrift für Wissensch Zoologie* previous to 1875. Any special monographs on biological subjects, or separate copies of papers, would also be gladly received. Every man of science knows that the literature of a subject should be easy accessible to an investigator, and will therefore recognise the necessity of making the library at Plymouth less deficient in works of reference than it is at present.

WE gave last week a list of the new officers of the U.S. National Academy of Sciences, elected at the recent annual meeting. The new members elected at the same meeting were—Dr. William H. Welch of Johns Hopkins University, Dr. William L. Elkin of Yale University, Prof. Charles S. Sargent of Harvard University, and Prof. Charles Whitman of Chicago University. Three foreign associates were chosen—Prof. Rudolph Leuckart of the University of Leipzig, Prof. Julius von Sachs of Wurzburg, and Prof. Sophus Lie, of Leipzig. The Barnard gold medal was voted to Lord Rayleigh for the discovery of argon. The Watson medal and a purse of 100 dollars was presented to Prof. L. C. Chandler for his researches on the variation of latitude and on the variable stars. An account of this award was given in NATURE a year ago (vol. 50, p. 157). A list of the papers read at the meeting will be found among our Reports of Societies. The Academy selected Philadelphia as the place for the autumn meeting, and fixed the date at October 29. At that meeting the new president, Prof. Wolcott Gibbs, will be inducted into office, and Prof. O. C. Marsh's term of office will terminate.

A NEW era of cheap telephoning seems to have followed the expiration of certain patents and the judicial annulment of others in the United States a few months ago. Simultaneous announcements of reduced rates in Connecticut and Illinois coincide with the formation of a new company—the Standard Telephone Company—with ramifications or sub-companies extending all over the United States, and an aggregate capital of 160,000,000 dollars. Preliminary arrangements were very quietly made, but this company now comes forward with rates of 3 dollars a month, instead of many times that amount now charged, in some cases running as high as 240 dollars a year. Efforts have been made, to induce the legislature of the State of New York, to secure a compulsory reduction of rates; but the old companies have opposed such legislation strenuously, on the ground that no cheaper service could be given. The Standard Company, however, claim to have discovered a new principle or method of operating in electricity, which will enable them to converse over unprecedented distances—say from New York to Denver, or even San Francisco—at very moderate cost. The reticence maintained, however, makes it impossible to decide whether or not these extravagant claims are well-grounded.

AT the second International Zoological Congress held in Moscow in 1892, a resolution was passed to the effect that the third meeting should take place in Leyden, the oldest University of the Netherlands, and that Dr. F. A. Jentink, Director of the Leyden Natural History Museum, should be its President. A circular informs us that the Netherlands' Zoological Society is making the necessary arrangements for this meeting, which is to be held on September 16-21, under the patronage of the Queen-Regent of the Netherlands. The Ministers of the Interior, of the Public Works, and of Commerce and Industry, will be Honorary Presidents of the Congress. A number of well-known

zoologists have promised to attend the meeting, and to deliver addresses or read papers. The following scheme for the sectional meetings has been arranged :—(1) General zoology ; geographical distribution, including the fossil faunas ; the theory of evolution. (2) Classification of living and extinct vertebrates ; bionomy ; geographical distribution, including fossil vertebrates. (3) Comparative anatomy of living and extinct vertebrates ; embryology. (4) Classification of living and extinct invertebrate animals ; bionomy. (5) Entomology. (6) Comparative anatomy and embryology of invertebrate animals. Intending members may send the subscription (£1) to Dr. P. P. C. Hoek (Helder), the General Secretary, or to Dr. R. Horst (Leyden), Treasurer.

THE summer meetings of the Institution of Naval Architects will be held in Paris on Tuesday, June 11, and during the remainder of the week. The Right Hon. Lord Brassey, K.C.B., President of the Institution, will occupy the chair. We are informed that the French Government is taking a warm interest in these meetings, and that, under the honorary presidency of the Minister of Marine, Vice-Admiral Besnard, and under the acting presidency of Vice-Admiral Charles Duperré, a strong and influential Reception Committee has been formed, representing the Ministry of Marine, the French Navy, the Municipality of Paris, the Chamber of Commerce of Paris, the Great French Industries and Steamship Owners, the Railroad Companies, the University of Paris, the Conservatoire des Arts et des Métiers, the French Institution of Civil Engineers, the Society for the Encouragement of National Industry, the French Institution of Naval Architects, and the Union of Yachts. This Committee has already taken active steps to draw up a programme of exceptional interest for the instruction and entertainment of the Institution. Papers have already been promised by M. Émil Bertin, Director of the French Government School of Naval Architecture, and M. V. Daymard. There will also be papers by Sir William White, Mr. B. Martell, Dr. Francis Elgar, Mr. Archibald Denny, and Mr. Mark Robinson.

DURING the Easter vacation the following naturalists have been at work in the Liverpool Marine Biological Station at Port Erin :—Dr. H. O. Forbes, Mr. F. G. Baily, Mr. P. M. C. Kermode, Dr. J. D. Gilchrist (Edinburgh University), Mr. A. O. Walker, Prof. Herdman, and Mr. J. C. Sumner (curator). Two steamer dredging expeditions have been carried out to the west and south of the Isle of Man. On these a small shank trawl was worked, in addition to the dredge, with considerable advantage—on one occasion, in fact, coming up so full that the net burst with the weight on leaving the water, and the contents were lost. A number of fine Echinoderms were obtained with the trawl, including *Luidea*, *Palmipes*, *Porania*, *Stichaster*, *Synapta*, and other Holothurians. Amongst the Crustacea were *Scalpellum*, *Munida bamffica*, *Xantho tuberculata*, *Ebalia tuberosa* and *E. tumefacta*, *Anapagurus hyndmanni*, *Galathea dispersa* with *Pleurocrypta dispersæ*, *Melphidipella macera*, and a number of the rare shrimp *Pontophilus spinosus*, Leach. Floating fish eggs (plaice and another species) were caught in the tow-nets in Port Erin Bay, both in March and April ; and *Aplysia*, *Doris*, *Sepiola*, and other Invertebrates have spawned in the tanks at the Biological Station. The Liverpool Committee is at present considering the possibility of a further extension of the Station in the form of a hatchery and a large tidal pond, such as was contemplated in Prof. Herdman's original scheme of the institution.

AN Italian Seismological Society has recently been founded by Prof. Tacchini, the well-known Director of the Central Meteorological and Geodynamic Office at Rome. Its objects are to make known as soon as possible all the seismic and volcanic phenomena occurring either in Italy or in other countries, to publish short notes about them, descriptions of seismic apparatus, &c., and generally to promote the study of geodynamics. The subscription being moderate, and national and foreign members being admitted on nearly the same terms, the new society, it is to be hoped, may become practically a European one.

A USEFUL innovation, that we hope is to be continued, has been started by the Geological Society of London, in the publication of a catalogue of geological literature added to the Society's library during the half-year ended December 1894. This is equivalent to a list of all important books and papers on geology published in that period. Every paper is catalogued separately, under the author's name, and there is a subject-index. The whole is a distinct improvement on the list hitherto published annually in the November *Quarterly Journal ;* and in spite of the improvements, this list for the half-year is less than half the bulk of the last annual one. The only important omission is that of maps. The work will be most useful to all geologists who wish to keep abreast of recently published works.

THE science of oscillations has been enriched by some simple and instructive elementary experiments, due to Dr. H. J. Oosting, which are described in the *Zeitschrift für den Physikalischen Unterricht*. That the velocity of a pendulum is greatest when the bob reaches its mean position is shown by means of a pendulum with a mirror attached to it at its axis of suspension, the upper end of the pendulum-rod being attached to a stout wire bridge, the feet of which take the place of the knife edge. When a beam of light is reflected from this mirror, a line of light is formed upon the screen if the pendulum vibrates rapidly enough. The light from the lamp is made intermittent by a uniformly revolving disc provided with holes bored at equal intervals near the edge. A series of points are then produced on the screen, which are crowded together towards the ends, and further apart towards the middle of the line of light, the distance being proportioned to the velocity of the bob.

ANOTHER neat contrivance designed by the Dutch physicist is one for producing Lissajous' curves resulting from the combination of two vibrations at right angles to each other. The simplest form of vibrating mirrors consists of two small mirrors attached to wires stretched in a vertical and horizontal position respectively. The periods of vibration are adjusted by screws carrying nuts mounted behind the mirror at right angles to the wire. The vibration is made slower by screwing the nuts outwards ; or, if a pendulum is to be used, it is attached to the bottom of a U-shaped wire bent out and down at the upper ends, so as to oscillate about the ends of the wire. A horizontal circle is attached to the U at the centre of suspension, carrying a precisely similar suspension for a second and smaller pendulum, except that a horizontal mirror takes the place of the horizontal circle. The periods are adjusted by weights movable along the rods, and the resulting curves may be thrown upon the ceiling, or back upon a screen just in front of the lantern with a hole for letting the light through. In this case the beam must be twice reflected from a mirror at 45° to the horizon.

WITHIN the last year or two, the number of methods for observing the characteristics of an alternating current which have been described is considerable. The latest step in this direction is due to M. J. Pionchon (*Comptes rendus*, April 22, 1895), who uses an optical method. The alternating current is passed through a coil, surrounding a tube filled with carbon bisulphide or a saturated solution of mercuric and potassium iodides. This tube is placed between the polariser and analyser of a half-shadow polarimeter. Under these circumstances the plane of polarisation of the light, after its passage through the tube, passes in succession through all the positions between two limits, one of which corresponds to the maximum current in one direction, and the other to the maximum current in the opposite direction.

If, as is the case in practice, the alternations are fairly rapid, the appearance presented is that during the passage of the current the two halves of the field appear equally bright when the analyser is adjusted in the zero position for no current passing. By adopting the stroboscopic method of observation, the author has, however, succeeded in making clear the different phases of illumination through which the field of view passes. By suitably adjusting the difference (ϵ) between the period (T′) of the stroboscope and the period (T) of the current, it is possible to see the various phases of the phenomenon pass as slowly as is desirable, the period of the apparent change being to the period of the current in the ratio of T′ to ϵ. Hence, by determining the time taken to go through a whole cycle of the apparent changes, the period of the current can be deduced. The maximum value of the current can also be determined. If we denote by μ the rotation of the plane of polarisation of the light corresponding to the maximum current, then, when the principal plane of the analyser is rotated through a less angle than μ, the two halves of the field will appear equally bright twice during each cycle of the apparent changes. If the angle of rotation of the analyser is μ, this equality will only occur once in a cycle, while if the rotation is greater than μ, at no time will the two halves of the field of view appear equally bright. Thus it is quite easy to determine the position of the analyser corresponding to the maximum current. The method also admits of obtaining the current curve, by noting the times at which, when the angle of rotation of the analyser (α) is less than μ, the two halves of the field are equally bright. The current corresponding to the two times observed can be calculated from the value if α, the known dimensions of the coil, and Verdet's constant for the liquid employed.

PROF. FRANK CLOWES' "Treatise on Practical Chemistry and Qualitative Analysis," adapted for use in the laboratories of colleges and schools, has reached a sixth edition. Messrs. J. and A. Churchill are the publishers of the book.

THE *Quarterly Journal* of the Geological Society, just issued (No. 202), contains, in addition to papers read at the meetings, the report of the proceedings of the annual meeting and the anniversary address of the president, Dr. Henry Woodward, on "Some Points in the Life-history of the Crustacea in Early Palæozoic Times."

THE very useful pamphlet entitled "Notes on Polarised Light," by Mr. A. E. Munby, which we favourably noticed when it appeared about a year ago, has been translated into Russian by Prof. Glinka, of St. Petersburg University. Students of mineralogy beginning work with the polariscope, will find the contents of the pamphlet of great assistance.

WE have received a report of the proceedings of the conference on inland navigation, held in Birmingham in February, by the Federated Institution of Mining Engineers. The report contains some useful information on the important subject of the inland navigation of Great Britain, and a number of valuable suggestions for improving the present inefficient state of our inland waterways.

MESSRS. DULAU AND CO. have prepared and published a useful catalogue of separate papers from the *Philosophical Transactions* of the Royal Society offered for sale by them. The papers are indexed according to the authors' names. Two other new catalogues which scientific bibliographers will find valuable are R. Friedländer and Son's "Bücher-verzeichniss" (No. 417), containing titles of entomological works, and a list of books issued by Mr. Bernard Quaritch, Piccadilly, S.W.

Science Gossip for May contains several articles of scientific interest. Dr. Dallinger has a note on *Melicerta ringens*, illustrated by drawings of this small though interesting denizen of our ponds. Messrs. Wanklyn and Cooper write on Argon. Mr. Thomas Leighton has an article on "Geology of the Isle of Wight"; and Dr. Guppy writes on "Stations of Plants and Buoyancy of Seeds." Mr. Rudolph Beer has an interesting illustrated article on "Leguminous Plants."

THE West Australian Year-Book for 1893–94, issued by the Registrar-General, contains tables showing the results of meteorological observations at the chief observing stations, together with some general remarks on the climate of the colony. The climate varies a good deal in the different parts; in the south and south-west it is excellent, being temperate and cool, with regular and sufficient rainfall. To the eastward the climate is dryer, but little accurate information is available in that direction.

THE Report of the Royal Zoological Society of Ireland for the year 1894, shows that the Society is in an exceedingly prosperous condition. Nine lion cubs were born during the year, four of which died, but the five others (all males) were disposed of as exchanges. There are still two lions and five lionesses in the gardens of the Society. The Council has decided to make a donation to the funds of the *Irish Naturalist*, a monthly journal which frequently contains valuable information on the natural history of Ireland.

WE have received No. 2 of the Official Guide to the Museums of Economic Botany at the Royal Gardens, Kew, comprising Monocotyledons and Cryptogams. Among the specimens and products belonging to Monocotyledons, by far the larger number are naturally derived from the great order of palms; though the origin is also illustrated of other very important products, such as vanilla, ginger, grains of paradise, arrowroot, the pine-apple, aloes, bananas, the yam, New Zealand hemp, dragon's-blood, and many others. The palms include nearly 100 distinct exhibits, and the grasses upwards of 60. Among Cryptogams, several officinal and other useful articles are obtained from the fibres; while the Algæ and Fungi also yield their quota. A very copious index adds greatly to the value of this publication.

A REPORT, lately issued, on the progress and development of the Manchester Museum, Owens College, during the past four years, shows that the museum is a great power for good. By means of short courses of popular lectures, and informal demonstrations and addresses, the collections have been rendered more interesting and intelligible to the public. Clubs, societies, and classes have paid frequent visits of inspection, and have had the contents of various sections of the museum explained to them by Prof. Boyd Dawkins, or by members of the museum staff. A number of additions have been made in the geological department, one of the most interesting accessions being a model of a glacier, made to scale by Prof. Heim. The zoological and botanical collections have also been benefited by additions, and the specimens in most of the sections have been reduced to law and order.

A RECENT redetermination of the atomic weight of strontium, by T. W. Richards, confirms the value 87·70 found by Pelouze in 1845. Pelouze employed the method founded on a comparison of anhydrous strontium chloride and silver. The present author finds (1) the ratio between very carefully purified anhydrous strontium bromide and silver in three sets of analyses carried out by different methods, and (2) the ratio $2AgBr : SrBr_2$ in two other series of experiments. Taking oxygen = 16·000, the values obtained for the atomic weight of strontium are respectively (1) 87·644; 87·663; 87·668, and (2) 87·660; 87·659. The mean value from these results may be taken as 87·66.

THE additions to the Zoological Society's Gardens during the past week include a Common Squirrel (*Sciurus vulgaris*),

British, presented by Mrs. Herbert Morris; four Yellow-bellied Liothrix (*Liothrix lutens*) from China, presented by Mr. Albert Kettich; a Black-billed Sheathbill (*Chionis minor*), captured at sea, a Water Rail (*Rallus aquaticus*), British, presented by Mr. John Gunn; a Lineolated Parrakeet (*Bolborhynchus lineolatus*) from Mexico, presented by Mr. Edward Hawkins; a Puff Adder (*Vipera arietans*) from South Africa, presented by Mr. J. E. Matcham; a Lear's Macaw (*Ara learî*) from South America, four White-backed Pigeons (*Columba leuconota*) from the Himalayas, a Rock-hopper Penguin (*Eudyptes chrysocome*) from New Zealand, deposited; two Alpine Choughs (*Pyrrhocorax alpinus*), European, purchased; an English Wild Cow (*Bos taurus*, var.), born in the Gardens.

OUR ASTRONOMICAL COLUMN.

RELATIVE DENSITIES OF TERRESTRIAL PLANETS.—Attention is drawn to an interesting relation between the diameters and densities of the terrestrial planets, by E. S. Wheeler (*Science*, April 19). The planets are plotted with their diameters in miles as abscissæ, and their densities (the earth being taken as unity) as ordinates, and it is then seen that the points located in this way lie approximately in a straight line. Such a line passes within the limits of the probable errors of all except Venus. If this relation should prove to represent a natural law, the mass of a planet or satellite could be determined from its diameter. Venus is the only one of the five planets (the moon being included) that is any more discrepant than might be expected from its probable error; to make it accordant, either its mass must be increased by one-tenth, or its diameter decreased by one-thirtieth. A sufficient increase in the mass of Venus is stated to be all that is necessary to explain the movement of the perihelion point of the orbit of Mercury; but some of the irregularities of Mercury may be accounted for by the small mass which it is now supposed to have, namely, one-thirtieth that of the earth. In plotting the planetary curve, the density of Mercury adopted, is that derived by Backlund from a discussion of the movements of Encke's comet.

THE ORBIT OF COMET 1893 IV (BROOKS).—An investigation of the path of this comet, by Signor Peyra, seems to suggest that it is one of a series travelling in the same elliptic orbit (*Ast. Nach.* No. 3281). This conclusion is based on the similarity of the orbit with those of comets 1864 I and 1822 I, the periods of the comets rendering actual identity impossible. The elements of the orbit are as follows:

T = 1893 Sept. 19·25954 Berlin M.T.

Longitude of perihelion	162	22	19	1893
,, ,, node ...	174	55	12	
Inclination	129	50	14	
Eccentricity	0·9964886			
Log q	9·909551			
Period	3516 years.			

THE SPECTRUM OF MARS.—A very practical contribution to the recent discussion as to the spectroscopic indications of aqueous vapour in the atmosphere of Mars is afforded by the investigations of Mr. Jewell as to the amount of vapour necessary to produce effects which can be observed with instruments of specified power. (*Astrophysical Journal*, April.) Expressing the amount of vapour present in the air of Baltimore by the depth in inches of a layer of water, the observed monthly mean for January is 0·73, June 3·25, October 1·56, the maximum occurring in June. He concludes that "unless the amount of water in the atmosphere of Mars is greater than that in the earth's atmosphere in October at Baltimore, it is useless to look for the presence of water vapour in the spectrum of Mars, unless our instrumental means are much superior to any hitherto used for that purpose." Since instruments of greater dispersion are unsuitable, because of the lack of sufficient light, there seems but little chance of obtaining any very decisive direct evidence of the presence of water vapour in Mars. It will be remembered that Dr. Janssen and others satisfied themselves as to the indications of water vapour bands in the spectrum of Mars, whilst Prof. Campbell has more recently failed to detect them.

The chances of detecting the presence of oxygen, however, if present, do not seem so hopeless, as the B group is readily seen with small dispersion.

It is also suggested by Mr. Jewell that attempts should be made to observe the chlorophyll bands in the spectrum of the green areas of the planets, since one of the bands is quite strong in the vegetation spectrum.

THE ASTRONOMICAL SOCIETY OF FRANCE.—During the eight years of its existence, this Society has attained a membership of nearly 1000. At the annual meeting held recently, Dr. Janssen was elected president, and M. Camille Flammarion general secretary for the current session. The progress of astronomy in 1894 formed the subject of an address by M. Tisserand, the Director of the Paris Observatory. Among other matters he referred to the reappearance of De Vicò's comet (NATURE, vol. li. p. 542), which he regarded as further evidence of the fact that, at certain epochs, comets are subject to increases of brightness which they are incapable of maintaining, the increased activity being probably due to internal disturbances, the nature of which are not yet understood. It will be remembered, however, that Mr. Lockyer explains these fluctuations in brilliancy by collisions with meteor-swarms lying in the track of the comet. Referring to minor planets, M. Tisserand believed it not improbable that those appearing as bright as 12th magnitude stars have an average diameter of about 130 kilometres; that is, about one-hundredth of the earth's diameter; at that rate, even a thousand of them would not have a total mass equal to a thousandth part that of the earth, assuming that their mean density is not greater than that of the earth. (*Bull. Mens. Soc. Ast. de France*, May.)

THE ROYAL SOCIETY CONVERSAZIONE.

THE annual Royal Society conversazione, to which gentlemen only are invited, was held in the Society's rooms on Wednesday of last week.

Many branches of science were represented in the exhibits, either by apparatus or by results of research. An exhibit that attracted much attention was the electrical furnace as used for the melting of chromium, titanium, platinum, and other metals, with high melting-points, shown by Prof. Roberts-Austen, C.B. The furnace consisted of a fire-clay case lined with magnesia, and contained a magnesia crucible. The carbon poles were horizontal, the arc being deflected by means of a magnet on to the material to be heated. For purposes of exhibition, an image of the molten contents of the furnace was projected, by means of a lens and mirror, on to a screen; the current employed is usually about 60 or 70 amperes at 100 volts.

Some very valuable metals of the platinum group were exhibited by Messrs. Johnson, Matthey, and Co., among them being a platinum nugget, weighing 158 ozs.; palladium ingot, of 1000 ozs.; rhodium ingot, 72 ozs.; osmium, melted and sponge; ruthenium melted by the electric arc; and pure iridium rolled sheet.

A magnet, showing the effects of currents in iron on its magnetisation, was exhibited by Dr. Hopkinson. A large electromagnet had buried in its substance two coils of comparatively small dimensions, one around the centre of the magnet, the other half-way between the centre and the surface. These coils were connected to two galvanometers. On reversing the current round the magnet it was seen that a considerable time elapsed before either galvanometer showed any substantial current, and that the current in the central coil occurred much later than in that at a less depth in the mass of iron.

Prof. J. A. Fleming showed a synchronising alternating current motor and contact maker, for the delineation of the form of alternating current and electromotive force curves, and a form of resistance of small inductance for use with the apparatus.

An instrument for analysing primary and secondary volts and amperes simultaneously was exhibited by Prof. W. M. Hicks.

Mr. R. E. Crompton had on view electrically heated apparatus, showing the method of applying electricity for heating tools and appliances used in trade; also for domestic purposes. Wires of high resistance composed of nickel, steel, or other suitable alloys, were embedded in an insulating enamel, and by it attached to the various articles to be heated. By this means loss of heat was obviated. Connection was made with the circuit by means of safety connectors, in which the contacts were automatically protected. The perfect flexibility of the system was exemplified in the electric oven, which was heated on all sides top, and bottom, and the temperature of which could be regulated

by turning on or off any part, or the whole of the current. Electrically heated hot-plates, flat-irons, and radiators were shown constructed on the same principle. Mr. Crompton also exhibited the latest form of Crompton potentiometer, for ratio measurements (accuracy 1 in 1,000,000), and simple forms of platinum thermometers for use with potentiometer.

A new instrument for testing the quality of iron in regard to magnetic hysteresis was exhibited by Prof. Ewing (Fig. 1). Its special use is to test sheet-iron for transformers and dynamo armatures. A few strips of the iron to be tested are cut to the length of three inches. These are clamped in a carrier, which is then caused to revolve between the poles of a magnet. The magnet is suspended on a knife-edge, and becomes deflected in consequence of the work expended in overcoming the magnetic hysteresis of the sample. The deflection is observed by means of a pointer, and serves as a measure of the hysteresis. The apparatus is so designed as to make the induction nearly the same in all specimens, notwithstanding differences of permeability. This makes its indications strictly a test of hysteresis.

Mr. L. Pyke showed an arrangement by means of which it is possible to obtain a greater efficiency in the reduction of the highly electro-positive metals from aqueous solutions, into and forming an amalgam with a mercury cathode.

A system of electric meters, viz., voltmeters, ammeters, and wattmeters, suitable for either direct or alternating currents, formed Major Holden's exhibit.

Prof. George Forbes exhibited a torsion model of submarine cable. A thread vertically suspended in oil represented the cable; the torsion (E.M.F.) being applied at the top by vanes and a positive or negative air blast (battery). The whole was suspended at the top by a spring (sending condenser); at the bottom was a mirror to reflect spot of light. This was controlled by a magnet (receiving condenser). Fluid friction represented resistance. Twist represented charge. The model gave signals compared with those of a cable 2000 miles long.

Specimens of the deposit or incrustation on the insulators of the electric light mains at St. Pancras, in which metallic sodium

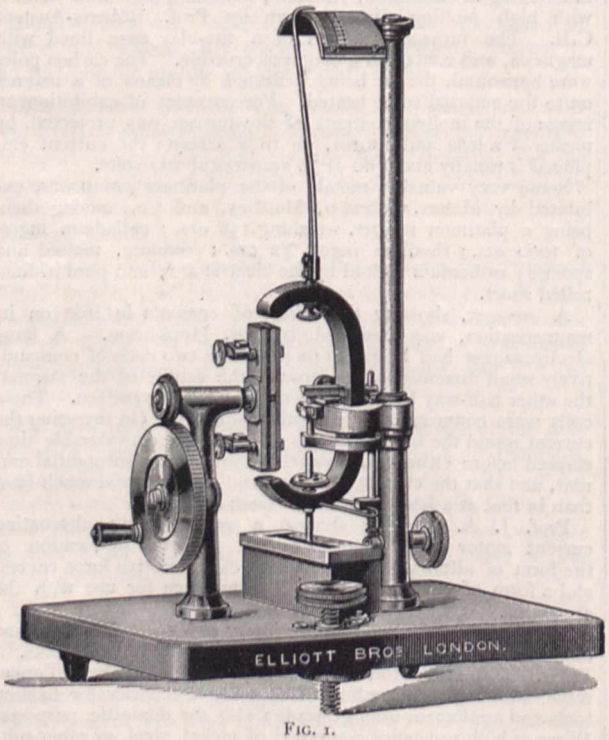

FIG. 1.

and potassium have been found, and of the insulators and wood bearers, which were in use on these mains, were exhibited by Major Cardew, R.E. The deposit was found to have been caused by the passage of alkaline salts in solution to the negative main, the salts being chiefly derived from the neighbouring soil, with which the end fibres of the wood bearers were in contact. Electrolysis of these salts took place with liberation of the metals at the negative main, the metals being oxidised and slowly carbonated in air. During this process nodules of the metal seem to have become embedded in the oxides, and preserved from oxidation.

Mr. Francis Galton showed enlarged finger prints, with descriptive notation, and a print of the hand of a child eighty-six days old.

Prof. J. B. Farmer had on view examples of heterotypical nuclear division in reproductive tissues of plants.

Microscopic specimens illustrating some appearances of nerve-cells were exhibited by Dr. Gustav Mann; and wandering cells of the intestine were shown by Dr. Wesbrook and Mr. W. B. Hardy.

Mr. W. T. Burgess showed the results of experiments in connection with the transmission of infection by flies. Flies having been placed in momentary contact with a cultivation of *Bacillus prodigiosus* (or other suitable chromogenic organism) were allowed to escape into a large room. After some time they were recaptured and caused to walk, for a few seconds, over slices of sterile potatoes, which were then incubated for a few days. The experiments showed that the flies' tracks on the potatoes were marked by vigorous growths of the chromogenic organism, even when the flies spent several hours in constant activity before they were recaptured. The use of pathogenic organisms in these experiments would be attended with obvious dangers, but the results obtained with harmless microbes indicated the constant risks to which flies expose us.

Prof. Gotch and Dr. H. O. Forbes showed a living specimen of the *Malapterurus electricus* from the River Senegal; Mr. Stanley Kent, a new bacterial species; and Mr. D. Sharp, F.R.S., examples of variation in the size of beetles. In some beetles there is great difference in the size of adult individuals of the same species and sex. In one of the cases exhibited—*Brenthus anchorago*—this difference was, in length alone, nearly as five and one. It is believed that these extreme cases occur chiefly in forms in which the males are ornamented with "useless" appendages, *e.g.* the families Scarabæidæ, Lucanidæ, Brenthidæ.

The exhibit of the Marine Biological Association consisted of (1) marine organisms preserved in formic aldehyde, which, in dilute solutions, is specially useful for the preservation of transparent organisms as museum specimens; (2) a new method of fixing methylen-blue preparations. The methylen-blue preparations are fixed with ammonium molybdate. This method, due to Dr. Berthe, of Berlin, has the advantage of retaining the original blue colour of the preparations, and also of allowing the object to be mounted in balsam, or imbedded in paraffin in the usual way; (3) the action of light on the under sides of flat fishes. The flat fishes exhibited were reared in a tank with a flat slate bottom and glass front. Those portions of the under side of a fish which were not in contact with the slate, and to which light was accessible—this point being demonstrated by the exposure of a photographic plate upon which the fish lay—have become pigmented, whilst the remaining portions are without pigment; (4) living representatives of the Plymouth fauna.

A gradient indicator was exhibited by Mr. J. Wimshurst; and Sir Benjamin W. Richardson showed an electrical cabinet, for use in the wards of a hospital.

There were only two astronomical exhibits. Mr. J. Norman Lockyer, C.B., showed an enlargement of a photograph of the spectrum of α Orionis, taken with a 6-inch telescope and an objective prism of 45°.

Mr. Sidney Waters exhibited charts showing the distribution of the nebulæ and star-clusters, and their relation to the Milky Way. These charts, upon which are recorded the position of the 7840 objects of the New General Catalogue of 1888, were designed to show the distribution of the nebulæ and star-clusters, more especially in relation to the Milky Way. The resoluble and irresoluble nebulæ are shown to be most densely scattered in the poles of the galactic circle, and avoid the track of the Milky Way, while the star-clusters follow its course with great fidelity. The evidence derived from this distribution seems to point to some general connection between the nebular system and the system of the stars.

Prof. Ramsay had a spectroscope and Plücker tubes arranged to give ocular demonstration of the spectra of argon extracted from air, and of a mixture of argon and helium extracted from cleveite. It is hardly necessary to say that the spectroscope was in great demand all the evening.

Students' simple apparatus for determining the mechanical equivalent of heat was exhibited by Prof. Ayrton. The apparatus enables the heat equivalent of a watt-second to be experimentally ascertained with an error of less than 1 per cent., without any allowance having to be made for heat lost by conduction, convection, or radiation. It will give the result when 2000 c.c. of water are warmed for two minutes with a current of about 30 amperes, at a pressure of about 10 volts. The conductor consisted of 10 feet of manganin rolled into a thin strip to give off heat rapidly, and formed into a double grid so as to be used as an efficient water stirrer. The cross section of the flexible leads was such that practically no flow of heat occurred between them and the grid when a current of about 30 amperes is used.

Photographs of sections of gold nuggets etched to show crystalline structure, were exhibited by Prof. A. Liversidge. Gold nuggets, on being cut through or sliced and polished, and etched by chlorine water, were found to exhibit well-marked crystalline structure, closely resembling the Widmanstatt figures shown by most metallic meteorites, except that, in the nuggets, the crystals are more or less square in section, and show faces which evidently belong to the octahedron and cube.

Phenomena associated with the formation of cloud were experimentally illustrated by Mr. W. N. Shaw. Clouds formed by mixture of two currents of air of different temperatures were shown in a large glass globe. The currents were due to convection. The motion of the clouds gave an indication of the motion of the air. Under suitable conditions the motion assumed a gyratory or "cyclonic" character. A second globe was arranged to show the formation of a cloud by the dynamical cooling of air, consequent upon a sudden expansion equivalent to an elevation of about 10,000 feet. The water globules could be seen to fall slowly. A light was arranged at the back of the globe to show (under favourable circumstances) coloured coronæ surrounding a central bright spot. Two other globes were used in conjunction to demonstrate the modification which cloud formation introduces into the dynamical cooling of air. In one of the pair condensation diminished the fall of temperature incidental to sudden expansion, and the difference was indicated by the final pressure-difference between the globes.

There were two barometric exhibits, one a mechanical device for performing temperature corrections in barometers, by Dr. John Shields, and a new form of barometer, exhibited by Dr. J. Norman Collie.

The preparation of acetylene from calcic carbide was shown by Prof. V. B. Lewes. The combustion of acetylene for illuminating purposes attracted great attention. Calcic carbide, formed by the action of carbon on lime at the temperature of the electric furnace, was decomposed by water with evolution of acetylene. The remarkable brilliancy of the flame produced may be judged by the fact that the acetylene when consumed in suitable burners develops an illuminating value of 240 candles per 5 cubic feet of gas.

Generalised frequency curves were exhibited by the Applied Mathematics Department of University College, London, and also compound frequency curves, a harmonic analyser, and a bi-projector.

Mr. T. Clarkson showed his circlographs for drawing and measuring circular curves of any large radius without requiring the centre, with examples of curves. The construction of these instruments is based upon a recent discovery that it is possible to cut a flat plate of steel (of uniform thickness and temper) into a certain form, which imparts to it the property of bending always into circular curves.

Mr. R. Inwards had on view examples of curious mortise joints in carpentry, all made without compression or veneering, and Mr. Hermann Kühne exhibited Junkers' patent calorimeter.

The radial cursor, a new addition to the slide rule, was shown by Mr. F. W. Lanchester. This cursor added to the slide rule makes the rule applicable at once to the calculation of whole or fractional powers, and renders it specially useful for the solution of problems in thermodynamics.

The Cambridge Scientific Instrument Company showed a new form of rocking microtome and a new form of spectrometer, and an improved form of Donkin's harmonograph. This was a modification of Donkin's harmonograph, and draws, on a moving strip of paper, a curve compounded of two simple harmonic motions.

During the evening demonstrations by means of the electric lantern took place in the meeting room.

Prof. A. C. Haddon showed lantern slides illustrating the ethnography of British New Guinea. The slides illustrated the physical characters of different tribes inhabiting British New Guinea, some of the occupations of the people, several kinds of dances, and the distribution of dance-masks. Evidence was given in support of the view that British New Guinea is inhabited by true dark Papuans, and by two distinct lighter Melanesian peoples, one of whom may have come from the New Hebrides, and the other from the Solomon Islands.

Lord Armstrong showed some of the results of his recent experiments on the electric discharge in air. The figures exhibited by means of the lantern, showed various phases, hitherto unobserved, of the brush discharge accompanying the electric spark. They showed also the remarkable modifying effect of induction on the results obtained. The luminous effects were delineated by instantaneous photography, and the mechanical effects by the electric action on dust plates. The spark itself had to be taken in a dark box on a shunt line, as its strong light and violent action would otherwise have been incompatible with the photographic and mechanical methods used in the experiments; but nearly the same tensions were obtained outside the box as within.

THE RARER METALS AND THEIR ALLOYS.[1]

II.

NOW turn to more complex curves taken on one plate by making the sensitised photographic plate seize the critical part of the curve, the range of the swing of the mirror from hot to cold being some sixty feet. The upper curve (Fig. 4) gives the freezing point of bismuth, and you see that surfusion, *a*, is clearly marked, the temperature at which bismuth freezes being 268°. The lower point represents the freezing point of tin, which we know is 231° C., and in it surfusion, *b*, is also clearly marked. The lowest curve of all contains a subordinate point in the cooling curve of standard gold, and this subordinate point, *c*, which you will observe is lower than the freezing point of tin, is caused by the falling out of solution of a small portion of bismuth, which

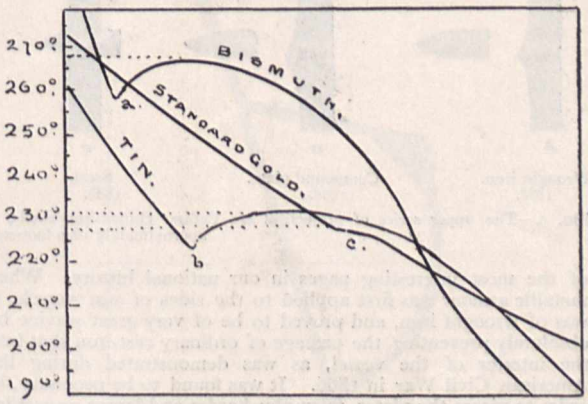

FIG. 4.

alloyed itself with some gold atoms, and "fell out" below the freezing point not only of bismuth itself but of tin. Now gold with a low freezing point in it like this is found to be very brittle, and we are in a fair way to answer the question why $\frac{2}{10}$ per cent of zirconium doubles the strength of gold, while $\frac{2}{10}$ per cent of thallium, another rare metal, halves the strength. In the case of the zirconium the subordinate point is very high up, while in the case of the thallium it is very low down. So far as my experiments have as yet been carried, this seems to be a fact which underlies the whole question of the strength of metals and alloys. If the subordinate point is low, the metal will be weak; if it is high in relation to the main setting point, then the metal will be strong, and the conclusion of the whole matter is this.—The rarer metals which demand for their isolation from their oxides either the use of aluminium or the electric arc, never, so far as I can ascertain, produce low freezing points when they are added in small quantities to those metals which are used for constructive purposes. The difficultly fusible rarer metals are never the cause

[1] A Friday evening discourse, delivered at the Royal Institution on March 15, by Prof. Roberts-Austen, C.B., F.R.S. (Continued from p. 18.)

of weakness, but always confer some property which is precious in industrial use. How these rarer metals act, why the small quantities of the added rare metals permeate the molecules, or, it may be the atoms, and strengthen the metallic mass, we do not know; we are only gradually accumulating evidence which is afforded by this very delicate physiological method of investigation.

As regards the actual temperatures represented by points on such curves, it will be remembered that the indications afforded by the recording pyrometer are only relative, and that gold is one of the most suitable metals for enabling a high, fixed point to be determined. There is much trustworthy evidence in favour of the adoption of 1045° as the melting point hitherto accepted for gold. The results of recent work indicate, however, that this is too low, and it may prove to be as high as 1061·7, which is the melting point given by Heycock and Neville[1] in the latest of their admirable series of investigations to which reference was made in my Friday evening lecture of 1891.

It may be well to point to a few instances in which the industrial use of such of the rarer metals, as have been available in sufficient quantity, is made evident. Modern developments in armour-plate and projectiles will occur to many of us at once. This diagram (Fig 5) affords a rapid view of the progress which has been made, and in collecting the materials for it from various sources, I have been aided by Mr. Jenkins. The effect of projectiles of approximately the same weight, when fired with the same velocity against six-inch plates, enables comparative results to be studied, and illustrates the fact that the rivalry between artillerists who design guns, and metallurgists who attempt to produce both impenetrable armour-plates and irresistible projectiles, forms one

ATTACK OF 6-INCH ARMOUR-PLATES BY 4.72-INCH SHELLS, WEIGHING 57.2 LBS.

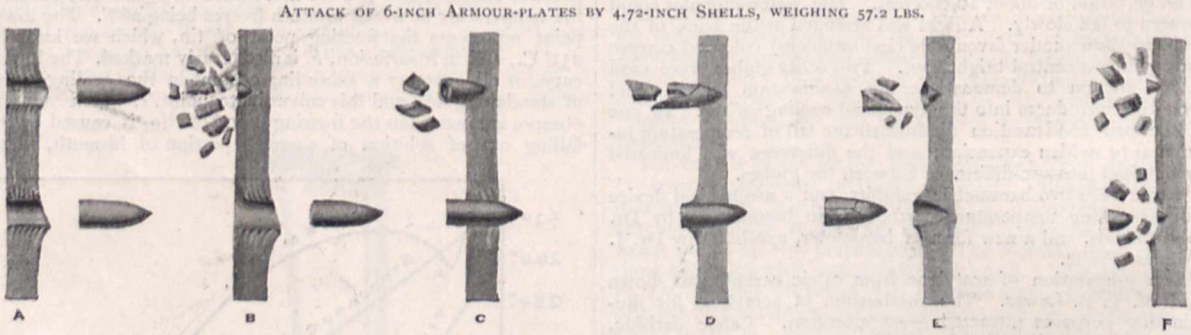

FIG. 5.—The upper series of projectiles are Palliser chilled-iron shells, and the lower are chrome-steel. In each case the velocity of the projectile is approximately 1640 foot-seconds, and the energy 1070 foot-tons.

of the most interesting pages in our national history. When metallic armour was first applied to the sides of war vessels, it was of wrought iron, and proved to be of very great service by absolutely preventing the passage of ordinary cast-iron shot into the interior of the vessel, as was demonstrated during the American Civil War in 1866. It was found to be necessary, in order to pierce the plates, to employ harder and larger projectiles than those then in use, and the chilled cast iron shot with which Colonel Palliser's name is identified proved to be formidable and effective. The point of such a projectile was sufficiently hard to retain its form under impact with the plate, and it was only necessary to impart a moderate velocity to a shot to enable it to pass through the wrought-iron armour (A, Fig. 5).

It soon became evident that in order to resist the attack of such projectiles with a plate of any reasonable thickness, it would be necessary to make the plate harder, so that the point of the projectile should be damaged at the moment of first contact, and the reaction to the blow distributed over a considerable area of the plate. This object could be attained by either using a steel plate in a more or less hardened condition, or by employing a plate with a very hard face of steel, and a less hard but tougher back. The authorities in this country during the decade, 1880-90, had a very high opinion of plates that resisted attack without the development of through-cracks, and this led to the production of the compound plate. The backs of these plates (B, Fig. 5) are of wrought iron, the fronts are of a more or less hard variety of steel, either cast on, or welded on by a layer of steel of an intermediate quality cast between the two plates. Armour-plates of this kind differ in detail, but the principle of their construction is now generally accepted as correct.

Such plates shown by plate B, resisted the attack of large Palliser shells admirably, as when such shells struck the plate they were damaged at their points, and the remainder of the shell was unable to perforate the armour against which it was directed. An increase in the size of the projectiles led, however, to a decrease in the resisting power of the plates, portions of the hard face of which would at times be detached in flakes from the junction of the steel and the iron. An increase in the toughness of the projectiles by a substitution of forged chrome-steel for chilled iron (see lower part of plate B), secured a victory for the shot, which was then enabled to impart its energy to the plate faster than the surface of the plate itself could transmit the energy to the back. The result was that the plate was overcome, as it were, piecemeal; the steel surface was not sufficient to resist the blow itself, and was shattered, leaving the projectile an easy victory over the soft back. The lower part of plate, B (in Fig. 5), represents a similar plate to that used in the *Nettle* trials of 1888.[1] It must not be forgotten in this connection, that the armour of a ship is but little likely to be struck twice by heavy projectiles in the same place, although it might be by smaller ones.

Plates made entirely of steel, on the other hand, were found, prior to 1888, to have a considerable tendency to break up completely when struck by the shot. It was not possible, on that account, to make their faces as hard as those of compound plates; but while they did not resist the Palliser shot nearly so well as the rival compound plate, they offered more effective resistance to steel shot (see lower part of plate C, Fig. 5).

It appears that Berthier recognised, in 1820, the great value of chromium when alloyed with iron; but its use for projectiles, although now general, is of comparatively recent date, and these projectiles now commonly contain from 1·2 to 1·5 per cent. of chromium, and will hold together even when they strike steel plates at a velocity of 2000 feet per second,[2] (see lower part of plate D); and unless the armour-plate is of considerable thickness, such projectiles will even carry bursting charges of explosives through it. [The behaviour of a chromium-steel shell, made by Mr. Hadfield, was dwelt upon, and the shell was exhibited.]

It now remained to be seen what could be done in the way of toughening and hardening the plates so as to resist the chrome steel shot. About the year 1888, very great improvements were made in the production of steel plates. Devices for hardening and tempering plates were ultimately obtained, so that the latter were hard enough throughout their substance to give them the necessary resisting power without such serious cracking as had occurred in previous ones. But in 1889, Mr. Riley exhibited, at the meeting of the Iron and Steel Institute, a thin plate that owed its remarkable toughness to the presence of nickel in the steel. The immediate result of this was that plates could be made to contain more carbon, and hence be harder, without at the same time having increased brittleness; such plates, indeed, could be water hardened and yet not crack.

[1] "Trans. Chem. Soc.," vol. lxvii., 1895, p. 160.

[1] *Proceedings*. Institution of Civil Engineers, 1889, vol. xcviii. p. 1, *et seq.*

[2] *Journal* U.S. Artillery, 1893. Vol. . p. 497

The plate E (Fig. 5) represents the behaviour of nickel-steel armour. It will be seen that it is penetrated to a much less extent than in the former case; at the same time there is entire absence of cracking.

Now as to the hardening processes. Evrard had developed the use of the lead bath in France, while Captain Tressider[1] had perfected the use of the water-jet in England for the purpose of rapidly cooling the heated plates. The principle adopted in the design of the compound plates has been again utilised by Harvey, who places the soft steel or nickel-steel plate in a furnace of suitable construction, and covers it with carbonaceous material such as charcoal, and strongly heats it for a period, which may be as long as 120 hours. This is the old Sheffield process of cementation, and the result is to increase the carbon from 0·35 per cent. in the body of the plate to 0·6 per cent., or even more at the front surface, the increase in the amount of carbon only extending to a depth of two or three inches in the thickest armour.

The carburised face is then "chill-hardened," the result being that the best chrome-steel shot are shattered at the moment of impact, unless they are of very large size as compared with the thickness of the plate. The interesting result was observed lately[2] of shot doing less harm to the plate, and penetrating less, when its velocity was increased beyond a certain value, a result due to a superiority in the power of the face of the plate to transmit energy over that possessed by the projectile, which was itself damaged, when a certain rate was exceeded. At a comparatively low velocity the point of the shot would resist fracture, but the energy of the projectile is not then sufficient to perforate the plate, which would need the attack of a much larger gun firing a projectile at a lower velocity.

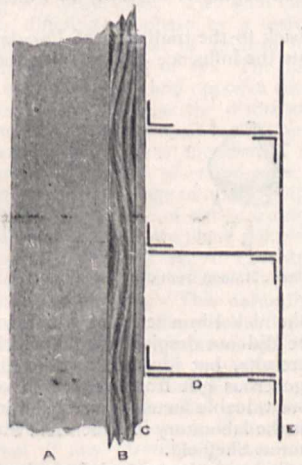

FIG. 6.—Section of Barbette of the *Majestic*.

The tendency to-day is to dispense with nickel, and to use ordinary steel, "Harveyed;"[3] this gives excellent six-inch plates, but there is some difference of opinion as to whether it is advantageous to omit nickel in the case of very thick plates, and the problem is now being worked out by the method of trial. Probably, too, the Harveyed plates will be much improved by judicious forging after the process, as is indicated by some recent work done in America. The use of chromium in the plates may lead to interesting results.

Turn for a moment to the "*Majestic*" class of ships, the construction of which we owe to the genius of Sir William White, to whom I am indebted for a section representing the exact size of the protection afforded to the barbette of the *Majestic*. [This section was exhibited and is shown as reduced to the diagram Fig. 6.] Her armour is of the Harveyed steel, which has hitherto proved singularly resisting to chromium projectiles.

In this section, A represents a 14-inch Harveyed steel armour-plate; B, a 4-inch teak backing; C, a 1¼-inch steel plate; D, ½-inch steel frames; and E, ½-inch steel linings.

It will, I trust, have been evident that two of the rarer metals, chromium and nickel, are playing a very important part in our national defences; and if I ever lecture to you again, it may be possible for me to record similar triumphs for molybdenum, titanium, vanadium, and others of these still rarer metals.

Here is another alloy, for which I am indebted to Mr. Hadfield. It is iron alloyed with 25 per cent. of nickel, and Hopkinson has shown that its density is permanently reduced by two per cent. by an exposure to a temperature of −30°, that is the metal expands at this temperature.

Supposing, therefore, that a ship-of-war was built in our climate of ordinary steel, and clad with some three thousand tons of such nickel-steel armour, we are confronted with the extraordinary fact that if such a ship visited the Arctic regions, it would actually become some two feet longer, and the shearing which would result from the expansion of the armour by exposure to cold would destroy the ship. Before I leave the question of the nickel-iron alloys, let me direct your attention to this triple alloy of iron, nickel and cobalt in simple atomic proportions. Dr. Oliver Lodge believes that this alloy will be found to possess very remarkable properties; in fact, as he told me, if nature had properly understood Mendeléef, this alloy would really have been an element. As regards electrical properties of alloys, it is impossible to say what services the rarer metals may not render; and I would remind you that "platinoid," mainly a nickel-copper alloy, owes to the presence of a little tungsten its peculiar property of having a high electrical resistance which does not change with temperature.

One other instance of the kind of influence the rarer metals may be expected to exert is all that time will permit me to give you. It relates to their influence on aluminium itself. You have heard much of the adoption of aluminium in such branches of naval construction as demand lightness and portability. During last autumn Messrs. Yarrow completed a torpedo boat which was built of aluminium alloyed with 6 per cent. of copper. Her hull is 50 per cent. lighter, and she is 3½ knots faster than a similar boat of steel would have been, and, notwithstanding her increased speed, is singularly free from vibration.

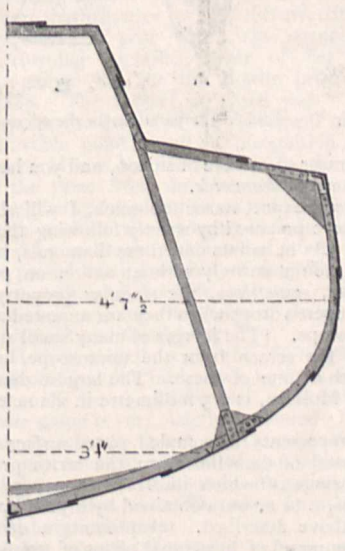

FIG. 7.—Half-section Midship of Aluminium Torpedo-boat

Her plates are $\frac{1}{10}$th inch thick, and $\frac{3}{8}$th inch where greater strength is needed. It remains to be seen whether copper is the best metal to alloy with aluminium. Several of the rarer metals have already been tried, and among them titanium. Two per cent. of this rare metal seems to confer remarkable properties on aluminium, and it should do so according to the views I have expressed, for the cooling curve of the titanium-aluminium alloy would certainly show a high subordinate freezing point.

Hitherto I have appealed to industrial work, rather than to abstract science, for illustrations of the services which the rarer metals may render. One reason for this is that at present we have but little knowledge of some of the rarer metals apart from their association with carbon. The metals yielded by treatment

[1] Weaver, "Notes on Armour." *Journal* U.S. Artillery. Vol. iii. 1894, p. 417.
[2] Brassey's *Naval Annual*, 1894, p. 367.
[3] *Engineering*, vol. lvii., 1894, pp. 465, 530, 595.

of oxides in the electric arc are always carbides. There are, in fact, some of the rarer metals which we, as yet, can hardly be said to know except as carbides. As the following experiment is the last of the series, I would express my thanks to my assistant, Mr. Stansfield, for the great care he has bestowed in order to ensure their success. Here is the carbide of calcium which is produced by heating lime and carbon in the electric arc. It possesses great chemical activity, for if it is placed in water the calcium seizes the oxygen of the water, while the carbon also combines with the hydrogen, and acetylene is the result, which burns brilliantly. [Experiment shown.] If the carbide of calcium be placed in chlorine water, evil smelling chloride of carbon is formed.

In studying the relations of the rarer metals to iron, it is impossible to dissociate them from the influence exerted by the simultaneous presence of carbon; but carbon is a protean element—it may be dissolved in iron, or it may exist in iron in any of the varied forms in which we know it when it is free. Matthiessen, the great authority on alloys, actually writes of the "carbon-iron alloys." I do not hesitate therefore, on the ground that the subject might appear to be without the limits of the title of this lecture, to point to one other result which has been achieved by M. Moissan. Here is a fragment of pig iron highly carburised: melt it in the electric arc in the presence of carbon, and cool the molten metal suddenly, preferably by plunging it into molten lead. As cast iron expands on solidification, the little mass will become solid at its surface and will contract; but when, in turn, the still fluid mass in the interior cools, it expands against the solid crust, and consequently solidifies under great pressure. Dissolve such a mass of carburised iron in nitric acid to which chlorate of potash is added; treat the residue with caustic potash, submit it to the prolonged attack of hydrofluoric acid, then to boiling sulphuric acid, and finally fuse it with potash, to remove any traces of carbide of silicon, and you have carbon left, but—in the form of *diamonds*.

If you will not expect to see too much, I will show you some diamonds I have prepared by strictly following the directions of M. Moissan. As he points out, these diamonds, being produced under stress, are not entirely without action on polarised light, and they have, sometimes, the singular property of flying to pieces like Rupert's drops when they are mounted as preparations for the microscope. [The images of many small specimens were projected on the screen from the microscope, and (Fig. 8, E) shows a sketch of one of these. The largest diamond yet produced by M. Moissan, is 0·5 millimetre in diameter.]

FIG. 8.—Preparations for the microscope of diamonds and other forms of carbon obtained from carburised iron.

A (Fig. 8) represents the rounded, pitted surface of a diamond, and B a crystal of diamond from the series prepared by M. Moissan, drawings of which illustrate his paper.[1] The rest of the specimens, C to F, were obtained by myself by the aid of his method as above described. C represents a dendritic growth apparently composed of hexagonal plates of graphite, while D is a specimen of much interest, as it appears to be a hollow sphere of graphitic carbon, partially crushed in. Such examples are very numerous, and their surfaces are covered with minute round graphitic pits and prominences of great brilliancy. Specimen E (which, as already stated, was one of a series shown to the audience) is a broken crystal, probably a tetrahedron, and is the best crystallised specimen of diamond I have as yet succeeded in preparing. Minute diamonds, similar to A, may be readily produced, and brilliant fragments, with the lamella structure shown in F, are also often met with.

The close association of the rarer metals and carbon and their intimate relations with carbon, when they are hidden with it in iron, enabled me to refer to the production of the diamond, and afford a basis for the few observations I would offer in conclusion. These relate to the singular attitude towards metallurgical research maintained by those who are in a position to promote the advancement of science in this country. Statements respecting the change of shining graphite into brilliant diamond are received with appreciative interest; but, on the other hand, the vast importance of effecting similar molecular changes in metals is ignored.

We may acknowledge that "no nation of modern times has done so much practical work in the world as ourselves, none has applied itself so conspicuously or with such conspicuous success to the indefatigable pursuit of all those branches of human knowledge which give to man his mastery over matter."[1] But it is typical of our peculiar British method of advance to dismiss all metallurgical questions as "industrial," and leave their consideration to private enterprise.

We are, fortunately, to spend, I believe, eighteen millions this year on our Navy, and yet the nation only endows experimental research in all branches of science with four thousand pounds. We rightly and gladly spend a million on the *Magnificent*, and then stand by while manufacturers compete for the privilege of providing her with the armour-plate which is to save her from disablement or destruction. We as a nation are fully holding our own in metallurgical progress, but we might be doing so much more. Why are so few workers studying the rarer metals and their alloys? Why is the crucible so often abandoned for the test-tube? Is not the investigation of the properties of alloys precious for its own sake, or is our faith in the fruitfulness of the results of metallurgical investigation so weak that, in its case, the substance of things hoped for remains unsought for and unseen in the depths of obscurity in which metals are still left?

We must go back to the traditions of Faraday, who was the first to investigate the influence of the rarer metals upon iron, and to prepare the nickel-iron series of which so much has since been heard. He did not despise research which might possibly tend to useful results, but joyously records his satisfaction at the fact that a generous gift from Wollaston of certain of the "scarce and more valuable metals" enabled him to transfer his experiments from the laboratory in Albemarle Street to the works of a manufacturer at Sheffield.

Faraday not only began the research I am pleading for to-night, but he gave us the germ of the dynamo, by the aid of which, as we have seen, the rarer metals may be isolated. If it is a source of national pride that research should be endowed apart from the national expenditure, let us, while remembering our responsibilities, rest in the hope that metallurgy will be well represented in the Laboratory which private munificence is to place side by side with our historic Royal Institution.

[1] *Comptes rendus*, vol. cxviii., 1894, p. 324.

[1] *The Times*, February 22, 1895.

ELECTRICITY AND OPTICS.

A MEMOIR of singular interest, and one of which it would be well if the contents could be made more readily accessible to students in this country, has lately been published by Prof. Righi.[2] Among the numerous papers published during the last twenty years by Prof. Righi there are several (on electric discharges, on electric shadows and photo-electric phenomena) which indicate his interest in the relations between light and electricity. Since Hertz succeeded in obtaining rays of electric force, and demonstrated the reflection, refraction and interference of electric radiation, other experimenters have endeavoured to extend and complete the analogy between electromagnetic and luminous vibrations. Thus Lodge and Howard showed that electric radiation could be concentrated by means of large lenses;

[2] "Sulle oscillazioni elettriche a piccola lunghezza d'onda e sul loro impiego nella produzione di fenomeni analoghie ai principali fenomeni dell' ottica." (Bologna: 1894).

Boltzmann appears to have performed an experiment similar to Fresnel's with inclined mirrors; Trouton has drawn attention to phenomena similar to those of thin plates; and others have experimented with wire gratings like those by means of which Hertz demonstrated the polarisation of electric radiation: but the great wave-length (about half a metre) of the oscillations used has been a stumbling-block in the way of more delicate experiments. Prof. Righi has succeeded in producing oscillations having a wave-length as small as 2·6 cm., and has devised a novel form of resonator made by taking a strip of silvered glass, dissolving away the varnish from the back, and drawing a diamond-line across. He has thus been able to demonstrate the analogy with other phenomena of optics, among which may be mentioned:—Fresnel's interference-experiments with inclined mirrors and biprism; interference by reflection from thin plates and by transmission through them; diffraction by various means (slits, edges, Fresnel's diaphragm); elliptic and circular polarisation; and total reflection. The description of the experiments is accompanied with full theoretical discussions; and if Prof. Righi does not aim at the general treatment which is suitable to a treatise like Poincaré's, he, at any rate, succeeds admirably in showing how the border-land between electricity and optics is being actually explored.

In another memoir,[1] Prof. Righi develops Hertz's equations so as to find the electromagnetic disturbance produced by the combination of two small rectilinear electric oscillations at right angles, say along the axes of z and y, having equal amplitudes but differing in phase by a quarter wave-length. Each of these might be replaced by the mechanical movement of equal and opposite electric charges, oscillating with pendular motion about the origin along one of the axes. Two such mechanical motions at right angles, differing in phase by a quarter wave-length, would compound into a motion of uniform rotation in a circle about the origin in the plane of zy. The disturbance due to such a circular motion of equal and opposite charges would, with certain limitations, be the same as the disturbance produced by the combination of the two rectilinear oscillations first considered. Prof. Righi shows that it takes the form of a spherical wave having its centre at the origin of coordinates. The vibrations are in general (to use the language of optics) elliptically polarised; in the neighbourhood of the axis of x they are circularly polarised; in the equatorial plane zy they are plane-polarised.

In a third memoir, by Prof. H. A. Lorentz,[2] an attempt is made to establish a theory of electrical and optical phenomena in connection with moving bodies. This naturally involves a discussion of the relation between the ether and ponderable bodies in motion, and of the theories proposed by Fresnel and Stokes respectively. After weighing the evidence on both sides, the Leyden professor is of opinion that Fresnel's conception offers fewer difficulties than its rival. The question is of importance in electricity as well as in optics; it is necessarily raised by a rigid examination of any electrical phenomenon, such as the motion of a charged body or of a conductor carrying a current. Prof. Lorentz bases his explanation of electrical phenomena on the hypothesis that all bodies contain small electrically charged particles, and that all electrical processes depend upon the position and motion of these "ions." This conception of ionic charges is universally accepted for electrolytes, and also forms the most probable explanation of the convective discharge of electricity in gases. It is here extended to ponderable dielectrics, the "polarisation" of which is ascribed to the existence of such particles in positions of equilibrium from which they can only be displaced by external electrical forces. The periodically changing polarisations which, according to Maxwell's theory, constitute light-vibrations, here become vibrations of the ions.

pv.

SCIENCE IN THE MAGAZINES.

A MOST interesting account of Madame Kovalevsky's eventful life is contributed to the *Fortnightly* by Mr. E. W. Carter. The sketch is based upon that gifted mathematician's own published recollections, and Madame Edgren-Leffler's biography of her lamented friend. As there are some who are not familiar with the career of the subject of Mr. Carter's article, a short summary of the chief points may be of interest. Sophie Kovalevsky was born at Moscow about 1850, where the first five years of her life were spent. Her father then removed to Palibino, in the government of Vitebsk. It was there that her bent for mathematics first showed itself. A room had been papered with old disused printing paper, amongst which were several sheets of Ostrogradski's lectures on the differential and integral calculus. "This room possessed a strong fascination for the little seven-year-old maiden. Here she was to be found daily, her attention riveted on these walls, striving to understand something of the strange figures and stranger formulas. 'I remember,' says Madame Kovalevsky, 'that every day I used to spend hours before these mysterious walls, struggling to understand some of the sentences, and to find the order of the sheets. By dint of long contemplation, some of the formulas became firmly fixed in my memory, and even the text, though I could comprehend nothing of it at the time, left its impression on my brain.' When several years later, her father was prevailed on to let her have some instruction in mathematics, the results were a surprise and a revelation to all concerned; not least to the little pupil herself. The mysteries of the walls now grew clear, and her progress was made by leaps and bounds. The differential calculus presented no difficulties to her, and her tutor found that she knew the formulas by heart, and arrived at solutions and explanations quite independent of his aid."

In October, 1868, Sophie Kroukovsky contracted the romantic marriage with Vladimir Kovalevsky, and the two went to Heidelberg as students at the University. After two terms spent at Heidelberg, she moved to Berlin, where she worked for four years under the direction of Prof. Weierstrasse, "the father of modern mathematical analysis." During this period, she was occupied in writing the three important treatises which subsequently gained for her the degree of Doctor in Philosophy at Göttingen. Passing over the next few years in Madame Kovalevsky's life, during which her husband died, we come to the winter of 1883-84, when she went to Stockholm as the "Docent" of Prof. Mittag-Leffler. A course of lectures delivered during the winter session led to her appointment to the chair of higher mathematics at the University of Stockholm, in July, 1884, a post which she occupied until her death. The crowning scientific labour of her life was the treatise which gained for her the Bordin prize of the Paris Academy in 1888. The subject proposed was "To perfect in one important point the theory of the movement of a solid body round an immovable point," and in recognition of the extraordinary merits of Mdme Kovalevsky's work, the judges raised the amount of the prize from three thousand to five thousand francs. But the distinguished authoress did not live many years to enjoy the high position she had gained. In February, 1891, she was attacked by an illness which ended fatally after three or four days. So passed away a woman of magnificent gifts, who, "Taking the direction of her life into her own hands, and choosing for herself one of the steepest paths to fame, she traversed it with swift and steady steps."

Mr. W. H. Hudson contributes to the *Fortnightly* an article on "The Common Crow," a bird which he finds from inquiries, "is no longer to be found as a breeder, or is exceedingly rare, in districts where game is very strictly preserved; but that in the wilder counties where game is not strictly preserved, in wooded hilly places, he still exists in diminished numbers as a breeding species." Another article in the same magazine, on "Danish Butter Making," by Mrs. Alec Tweedie, furnishes instructive reading for British agriculturists.

The remarkable growth of electric railroad mileage in the United States, during the past five years, is brought out in an article by Mr. Joseph Wetzler, in *Scribner*. "At the present time," he says, "there are over eight hundred and fifty electric railways in the United States, operating over 9000 miles of track and 23,000 cars, and representing a capital investment of over four hundred million dollars. What stupendous figures, when we consider that in 1887 the number of such roads amounted to only thirteen, with scarcely one hundred cars!" A quotation from a paper in the series on "The Art of Living," contributed by Mr. Robert Grant to the same magazine, is worth giving here. "There are signs that those in charge of our large educational institutions all over the country are beginning to recognise that ripe scholarship and rare abilities as a teacher are entitled to be well recompensed pecuniarily, and that the breed of such men is likely to increase somewhat in proportion to the size and number of the prizes offered. Our college presidents and

[1] "Sulle onde electromagnetiche generate da duo piccole oscillazioni elettriche ortogonali oppure per mezzo di una rotazione uniforme." (Bologna: 1894).

[2] "Versuch einer Theorie der elektrischen und optischen Erscheinungen in bewegten Körpern." (Leyden: 1895).

professors, those at the head of our large schools and seminaries, should receive such salaries as will enable them to live adequately. By this policy not only would our promising young men be encouraged to pursue learning, but those in the highest places would not be forced by poverty to live in comparative retirement, but could become active social figures and leaders."

Evolution, and problems belonging to it, crop up periodically as subjects of magazine articles. In the *Contemporary*, A. Fogazzaro, "writer of verses and novels," devotes a number of pages to the polemic battles that have been fought over the evolutionary idea, from the time of Lamarck. "For the Beauty of an Ideal" is the title of his article, which mostly aims at showing how the new wine of evolution may be put into old bottles of Catholic doctrine." A paper on "Evolution and Heredity" is contributed by Dr. G. Symes Thompson to the *Humanitarian*. An introduction to a series of articles on "Professional Institutions," by Mr. Herbert Spencer, appears in the *Contemporary*. The articles will, in their eventual form, constitute part vii. of the "Principles of Sociology."

Two papers in the *Century* call for brief notice. In one, Mr. W. E. Smythe shows how parts of the great arid region to the west of the one-hundredth meridian in the United States have been benefited by careful irrigation. "The work of reclamation has been going forward silently, but gradually and surely, for the better part of a generation. Between ten and twenty millions of acres are now under ditch, and some slight rivulets of population have begun to trickle in upon the lands. But the threshold is scarcely passed. The arid region as a whole comprises more than 800,000,000 acres. Of this empire more than half a billion acres is still the property of the Government." The second paper to which reference has been made, is a short description of three reproductions from photographs of the tree beneath which was buried the heart of Dr. Livingstone. The tree was found near the site of the deserted village of Chitambo, on the south shore of Lake Bangweolo. Upon it, Jacob Wainwright, the Nassich boy who read the Burial Service, chiselled the words, still plainly visible, "Dr. Livingstone, May 4, 1873. Jazuza, Mniasere, Vchopere."

The *Reliquary and Illustrated Archæologist* (April) contains an account, by Mr. Miller Christy, of the exploration of "Deneholes" in Essex and Kent, conducted by the Essex Field Club. Deneholes are ancient artificial caverns in the chalk, having deep, narrow, vertical entrances. They are found in various parts of England, but especially along the banks of the Thames, in Essex and Kent. Mr. Christy has explored many of them, and his opinion as to their origin is—"On the whole, the only conclusion which it seems as yet safe to arrive at is that the mystery surrounding the origin of the Deneholes and the purposes of their makers still constitutes one of the most interesting and perplexing problems yet remaining unsolved in British archæology, perhaps we may say in prehistoric British archæology."

Mr. A. Symons Eccles, in the *National*, writes on "Headaches," and, in the course of his paper, gives the opinion of a distinguished neurologist, that almost every man of science of distinction in London suffers from sick-headache, or migraine, on account of excessive intellectual activity. Mr. Eccles says if they "will sit down to dinner in a state of nervous exhaustion, or do brain work directly after taking food, they can hardly hope to escape from an attack of migraine." In the same review, Miss Balfour concludes the account of her journey through the British South Africa Company's territory, in 1894.

A brief notice will suffice for the other articles in the magazines and reviews received by us. A previously unpublished paper of Richard Jefferies' appears in *Longman's Magazine*, and also a poem by the late Dr. G. J. Romanes. In the *English Illustrated*, the articles from which natural knowledge may be gathered are "Mountaineering in Westmoreland," by Mr. J. F. Fraser; "Stalking the Haplocerus in the Selkirks," by Mr. W. A. Baillie-Grohman; and a "Moorland Idyll," by Mr. Grant Allen. In the *Quarterly Review*, the recently published biographies of Buckland and Owen are used as the basis for an article on advances in the science of biology during this century. *Good Words* contains a short illustrated paper on the Dandelion, by Dr. Hugh Macmillan, and one on "The Sea Birds of the Cape," by the Rev. W. Greswell. Another readable article on birds is Mr. C. J. Cornish's "Birds of the Cliffs," in the *Sunday Magazine*. *Chambers's Journal* has the usual complement of instructive articles on more or less scientific topics. Finally, the *Phonographic Quarterly Review* contains contributions by Dr. W. R. Gowers and Sir Henry Howorth.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Term is now in full swing, and the usual courses of lectures are being delivered in the various departments of Natural Science. The changes from last Term's list are, that Sir J. Conroy and Mr. Frederick Smith have returned to Oxford, and are lecturing on Radiation and Mechanics, respectively, at Balliol and Trinity Colleges. In the Physiological Department, Prof. Gotch has begun his duties as Waynflete Professor, and is lecturing on Mondays and Tuesdays on the Physiology of the Central Nervous System.

Mr. H. Balfour, Curator of the Pitt-Rivers Museum, has been seriously ill, and is absent from Oxford for this Term, being obliged to go abroad for the sake of his health.

In a Congregation, held on Tuesday, May 7, the proposed Statute on Research Degrees was again under discussion, having reached what is technically known as the twelve-member amendment stage. The House reaffirmed by the narrow majority of 39 against 37, the clause which was passed by a large majority last Term, which states that Science shall be held to include Mathematics, Natural Science, Mental and Moral Science. Other clauses, mostly of consequential importance, were added or rejected, amongst them being one of some importance to intending Candidates, which allows residence in the Vacation to count towards the residence of eight terms required by the Statute.

In the same Congregation, Dr. E. B. Tylor, Reader in Anthropology, was constituted Professor in Anthropology during the tenure of his office as Reader in Anthropology.

The seventh summer meeting of University Extension and other Students will be held this year in Oxford. The meeting, as in previous years, will be divided into two parts: the first part will last from Thursday evening, August 1, to August 12, the second from August 12 to August 26. There will be lectures during both parts of the meeting on Natural Science, with classes for practical work. Among the lecturers will be Prof. Green, Prof. Odling, Dr. Kimmins, Dr. Fison, Mr. Carus-Wilson, Mr. J. E. Marsh, Mr. P. Groom, Dr. Wade, and Mr. G. C. Bourne.

The fourth "Robert Boyle" lecture of the Oxford University Junior Scientific Club will be delivered by Prof. Crum-Brown, F.R.S., on Monday next. His subject will be "The Relation between the Movements of the Eyes and the Movements of the Head."

CAMBRIDGE.—Mr. W. G. P. Ellis, of St. Catharine's College, has been appointed a Demonstrator in Botany.

Applications for permission to occupy the University's tables at the Naples Zoological Station, and the Marine Biological Laboratory at Plymouth, are to be sent to Prof. Newton, Magdalene College, by May 23.

The Syndicate for Advanced Study and Research have proposed new statutes for carrying out the scheme recently approved by the Senate, and have extended the scheme so as to include advanced students in law who are graduates of other Universities.

The honorary degree of Doctor of Science is to be conferred on Mr. Francis Galton, F.R.S.

MR. A. E. TUTTON has been appointed Inspector of Schools and Classes under the Science and Art Department.

THE Report of the Council of the City and Guilds of London Institute, upon the work of the Institute during the year 1894, has just been issued. The Council expressed their satisfaction at the renewal of the contribution of the Corporation of London to the funds of the Institute. Special subscriptions have been received, or promised, from the Salters' Company, in addition to their annual subscription, for the encouragement of chemical research; from the Cordwainers' Company, in addition to their annual subscription to the Institute, and the Leather Trades' School, for the inspection of classes in boot and shoe manufacture in connection with the Technological Examinations Department, and, for the first time, from the Tylers' and Bricklayers' and the Coachmakers' Companies. The proposal of the Salters' Company to place at the disposal of the Institute a sum of £150 a year to be applied to founding one or more Fellowships, to be entitled the Salters' Company Research Fellowships for the encouragement of higher research in Chemistry in its relation to manufactures, has already been referred to in these columns. The scheme for the

administration of this grant, prepared by a Special Committee of the Institute and adopted by the Executive Committee, has since received the sanction of the Court of the Salters' Company. The first award was made in January of the present year to Dr. Martin O. Forster. A sum of £333 4*s.* 3*d.* has also been received from the Committee of the Siemens Memorial Window Fund, "as an endowment to furnish a small sum to the recipient of the Siemens Memorial Medal, which is awarded annually to the student of the greatest merit in the Department of Electrical Engineering at the Central Technical College of the City and Guilds of London Institute." The Report deals in detail with the operations of the several colleges, schools, and departments of the Institute's work.

MISS GRACE CHISHOLM has just taken the degree of Doctor of Philosophy at Göttingen, this being the first degree obtained by a lady since Göttingen became a Prussian University. Miss Chisholm was a scholar of Girton College, Cambridge, and was placed between the 22nd and 23rd Wranglers in Part I. of the Mathematical Tripos in 1892, and in Class 3 of the Mathematical Tripos, Part II., in 1893. In 1892 she also took a first class in the Final Mathematical School at Oxford. After leaving Girton, she proceeded to Göttingen, and, receiving permission to attend the mathematical lectures, was in residence there about a year and a half. It was with the express sanction of the Prussian Minister of Education that the doctor's degree was conferred on her, and it is thought that the precedent thus established will probably lead to a substantial development in the opportunities offered for the higher education of women in Germany.

SILVER MEDALS have been awarded to Mr. R. H. Turnbull, Mr. G. F. Mair, and Mr. And. Robertson, of the Glasgow and West of Scotland Technical College. The medals were purchased with funds placed at the disposal of Prof. A. H. Sexton, by the West of Scotland Iron and Steel Institute, for the award of prizes for knowledge of the metallurgy of iron and steel.

SCIENTIFIC SERIALS.

American Meteorological Journal, April.—Recent foreign studies of thunderstorms: Switzerland, by R. De C. Ward. The systematic study of thunderstorms has been regularly carried on in Switzerland since 1883, and the results have been published yearly in the *Annalen* of the Central Meteorological Office, but there has been no general summary of the whole data. The general conditions of thunderstorm development in Switzerland are the presence of cyclonic depressions over Northern Europe, high temperatures, southerly winds and secondary depressions over Switzerland.—Note on Croll's glacial theory, by Prof. W. M. Davis. This is a reprint from the *Transactions* of the Edinburgh Geological Society (vol. vii.). The author thinks that the recent studies of Dr. J. Hann, on the origin of cyclones and anti-cyclones, suggest an amendment to Croll's physical explanation of the climate of the glacial period.

Symons's Monthly Meteorological Magazine, April.—Earth temperatures and water-pipes, by the Editor. A table shows the earth temperatures at nineteen stations in various parts of the country, from which it is seen that frost penetrated to 1 foot at eleven stations, to 1 foot 6 inches at three stations, to 2 feet at one station, and nowhere reached 2 feet 6 inches. The fact that ice formed in many pipes buried 2 feet 6 inches, and probably lower, is indisputable, but the explanation is not given of the apparent discordance between the temperature of the water and that shown by the earth thermometers.—The great gale in the Midlands on March 24, by H. A. Boys and A. W. Preston. This appears to have been, locally, one of the heaviest gales for many years. In a park near East Dereham, it is said that 1100 trees were uprooted. The worst part of the hurricane was from 1h. 30m. to 2h. 15m. p.m., and both observers state that the gusts were little short of force 12 of the Beaufort scale, which is equivalent to a velocity of ninety miles in the hour.—Snow from a cloudless sky, by C. L. Prince. The author states that at Crowborough, Sussex, on February 6, some snow crystals and minute spiculæ of ice fell at intervals, without any visible cloud.

L'Anthropologie, 1895, tome vi. No. 1.—Note sur l'âge de la pierre en Ukraïne, par M. le Baron de Baye. The author collected the materials for this article while residing in the province of Kiev, during the years 1893 and 1894. Little Russia contains three kinds of tumuli of the Stone age: (1) Small tumuli each containing a single skeleton resting on clay or white sand, and wrapped in birch bark; and in which small stone arrow-heads are found, but no stone implements of large size. (2) Cists, constructed of stone slabs, containing vases filled with ashes and burnt bones, with which are associated polished stone weapons. (3) Tumuli containing skeletons, certain parts of which, particularly the bones of the head, are coloured red. Opinions differ as to whether this colouration has been produced naturally or artificially; but the interments may probably be referred to the end of the Stone age, as only three bronze relics have been found in sixty of these tombs opened by Prof. Antonowitch.—La sculpture en Europe avant les influences gréco-romaines, par M. Salomon Reinach. In this number the author describes and figures relics of the Bronze age, chiefly swords and dagger hilts, many of them of great beauty.—De l'art du potier de terre chez les Néo-Calédoniens, par M. Glaumont. The pots of the New Caledonians are made of clay; they are spheroidal in shape, and have large mouths, the lips of which are turned over and pierced with two, or sometimes four, holes, through which a cord is passed to facilitate transportation from one place to another. They never have feet, but, when used for cooking, are either supported on two or three stones fixed in the ground, or they are suspended from a branch driven obliquely into the earth so as to project over the hearth. The ornamentation is usually very simple, consisting merely of lines, but on one vase from the north of the island, figured by M. Glaumont, there appears a human face in relief.—Les races de l'Ogooué. Notes anthropologiques, par M. Liotard. It is now fully recognised that the population of the Gaboon consists of several peoples of different types, each having special characteristics. M. Liotard has had exceptional opportunities of studying these people, and here records some of the results of his observations.

IN Nos. 1–4 of the *Bullettino* of the *Società Botanica Italiana* for 1895 is an article by Sig. P. Voglino, on the part played by snails and toads in the propagation of certain fungi. In the digestive canal of these animals he found abundance of the spores of species of *Russula*, *Tricholoma*, *Lactarius*, and other species of Agaricini. The faculty of germination of these spores had not been destroyed by passing through the body of the animal. Sig. A. De Bonis contributes a paper on the cleistogamous flowers of *Portulaca grandiflora*, *Salpiglossis sinuata*, and *Lamium amplexicaule*. The production of these flowers he attributes to unfavourable vital conditions, especially sterility of the soil. The remaining articles are chiefly of interest to Italian botanists.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, April 26.—Mr. Walter Baily, Vice-President, in the chair.—Prof. S. P. Thompson read a note on a neglected experiment of Ampère. Ampère, in 1822, made an experiment which, if it had been properly followed up, must have led to the discovery of the induction of electric currents nearly ten years before the publication of Faraday's results. While attempting to discover the presence of an electric current in a conductor placed in the neighbourhood of another conductor, in which an electric current was flowing, Ampère made the following experiment. A coil of insulated copper strip was fixed with its plane vertical, and a copper ring was suspended by a fine metal wire, so as to be concentric with the coil, and to lie in the same plane. A bar magnet was so placed that if an electric current was induced in the suspended ring, a deflection would be produced. No such deflection, however, was observed. In 1822, in conjunction with de la Rive, Ampère repeated this experiment, using in place of the bar magnet a powerful horse-shoe magnet. He describes the result in the following words:—"The closed circuit under the influence of the current in the coil, but without any connection with this latter, was attracted and repelled alternately by the magnet, and this experiment would, consequently, leave no doubt as to the production of currents of electricity by induction if one had not suspected the presence of a small quantity of iron in the copper of which the ring was formed." This closing remark shows that they were looking for a permanent deflection. When, however, Faraday's results were published in 1831, Ampère, after again describing the experiment made in 1822 by himself and de la Rive, says:—"As soon as we connected a battery to the terminals of the conductor the ring was attracted

or expelled by the magnet, according to the pole that was within the ring, which showed the existence of an electric current produced by the influence of the current in the conducting wire. Verdet, when describing the above experiment, falls into a curious error. He says the apparatus consisted of a ring of fine copper wire, suspended by a silk thread in front of the pole of an electromagnet in such a way that the plane of the ring was parallel to the plane of the turns of wire on the electromagnet. On "making" the current the ring is said to have been repelled, but this deviation did not persist, and on "breaking" the current the ring was attracted, also only momentarily. Mr. Blakesley did not feel quite confident that in Verdet's form of the experiment there could ever be attraction. He also pointed out that with an alternating current the disc would tend to set itself parallel to the lines of force of the electromagnet. With reference to repulsion by alternating currents in one of Elihu Thompson's experiments where a sphere is supported over an alternating pole, a screen being placed so as to partly shield this sphere, there is generally a misstatement as to the direction in which the sphere rotates. It rotates in such a direction that the part of its surface next the magnet moves towards the edge of the screen. Dr. Burton said that from the fact that when the current in the electromagnet in Verdet's experiment is broken, the induced current in the ring is in the same direction as the current in the magnet, the ring will be attracted. Mr. Boys confirmed Dr. Burton's statement. He recommended setting the ring at an angle of 45° to the lines of force, under which circumstances a rotation would be obtained. A distinction must, he pointed out, be drawn between such an experiment as that of Verdet and those of Elihu Thompson. The repulsions observed in these latter were only due to the "lag" in the induced currents caused by self-induction. The best materials to use for all such experiments were magnesium and aluminium, since for a given mass these had the highest conductivity.—Mr. W. G. Rhodes read a paper entitled "A theory of the Synchronous Motor." The object of this paper is to give as simple a treatment as possible of the mathematical part of the subject, and to give theoretical proofs of some experimental facts. Starting from the energy equation

$$p + c^2 R = c E \cos \psi$$

where p is the output of the motor, R the resistance of the armature, c the current through the armature, E the E.M.F. applied to the motor terminals, and ψ the phase difference between c and E the cases of maximum output, zero output, minimum current at zero power, and maximum phase difference between c and E are considered. These results are, for the most part, obtained directly from the energy equation. The latter part of the paper is devoted to a discussion of the phase relationships between the current and the E.M.F.s in a plant consisting of a generator and motor, and to the variations in the armature reactions in both generator and motor. A theoretical proof is given of the fact, observed by Prof. Silvanus Thompson and others, that an over-excited synchronous motor acts as a condenser, and tends to make the current lead before the generator's E.M.F. Prof. S. P. Thompson said that the mathematical part of the paper was much simpler than that in previous investigations on this subject, and the method of arriving at the results by rejecting imaginary roots of the equations was particularly neat and instructive. The part of the paper relating to armature reactions and phase relationships was quite new. Two results deserved special attention: first, that the maximum current at zero power was the same as if the circuit was non-inductive; second, that the maximum current zero power was double the current corresponding to maximum output. Mr. Blakesley said that the paper did not consider the stability of the system, and he thought some of he results corresponded to regions of unstability.—A paper by Mr. Bryan, "On a simple graphical interpretation of the determinantal relation of dynamics," was, in the absence of the author, read by Dr. Burton. The relation is worked out for two specially simple systems possessing one degree of freedom: (1) a particle moving in a straight line with uniform acceleration; (2) a particle moving to and fro along a straight line with an acceleration directed towards a fixed point on the line, and proportioned to the distance from that point (simple harmonic motion). On constructing a diagram in which the abscissæ represent values of the single coordinate of the particle, and the ordinate's corresponding values of the momentum, the determinantal relation becomes equivalent to the constancy of the area of a certain elementary parallelogram. In case (1) this parallelogram moves along a parabola, experiencing a shear as it goes, while in case (2) there is no distortion, the (rectangular) parallelogram revolving about the origin of the diagram as if rigidly attached to an inextensible radius vector.

Linnean Society, April 18.—Mr. C. B. Clarke, F.R.S., President, in the chair.—In view of the approaching anniversary meeting, the election of auditors was made, when Mr. A. D. Michael and Prof. J. R. Green were nominated on behalf of the Council, and Messrs. E. M. Holmes and H. Groves on behalf of the Fellows.—Mr. T. B. Blow exhibited specimens of the river-weed *Mourera fluviatilis*, Aublet, from the River Essequibo, with observations on its life-history, and lantern slides illustrating the natural haunts of the plant.—Mr. J. E. Harting exhibited and made remarks upon a collection of West African Lepidoptera which had been collected and forwarded by Mr. J. T. Studley from Old Calabar, and was to be presented to the British Museum.—Mr. Howard Saunders exhibited a specimen of the European white-winged Crossbill, *Loxia bifasciata*, which had been shot in co. Fermanagh in February last, and was lent for exhibition by Mr. C. Langham.—Some photographs of English Red-deer heads, showing successive growths of antlers in the same stag by comparison of the shed horns, were exhibited on behalf of Mr. Lucas, of Warnham Court, Horsham.—A paper was then read by Mr. F. W. Keeble, entitled "Observations on the *Loranthaceæ* of Ceylon," in which country the author had made a short sojourn in 1894. After remarking that in Ceylon many species of *Loranthus* have large and conspicuous flowers, with the corolla-tube brightly coloured, more or less tubular and lobed, he pointed out that certain deviations from the typical regularity of the corolla-tube were correlated with the mode of fertilisation of the flower by Sun-birds (*Nectarineæ*), and this was made clear by diagrams and some excellent coloured drawings. Discussing the mode of distribution of the seeds, Mr. Keeble first quoted the views of Engler and Prantl, and the remarks in Kerner's "Pflanzenleben" (English edition), on the dissemination of the European Mistletoe, and then detailed his own observations in the case of tropical *Loranthaceæ*. The modes of germination of various species of *Loranthus* and *Viscum* were then described, as well as the curvature and growth of the hypocotyl, and the effect of contact on the latter, and on its suctorial disc; the paper concluding with some remarks on the forms of fruit and seed of Cinghalese species of *Loranthaceæ*.—Mr. A. Trevor-Battye exhibited and made remarks upon a collection of plants obtained during his sojourn on the Island of Kolguev.

Entomological Society, May 1.—Prof. Raphael Meldola, F.R.S., President, in the chair.—Dr. C. G. Thomson, of the University, Lund, Sweden, was elected an Honorary Fellow, to fill the vacancy in the list of Honorary Fellows caused by the death of Pastor Wallengren.—Mr. Waterhouse exhibited a living larva of a Longicorn Beetle. This larva was found in a boot-tree which had been in constant use by the owner for fourteen years, the last seven of which were spent in India. The specimen was brought to the British Museum on May 6, 1890, and was put into a block of beech wood in which it had lived ever since; it did not appear to have altered in any way during these five years. It had burrowed about eight inches, and probably made its exit accidentally. Mr. Blandford referred to a similar case which had come under his notice.—Mr. C. G. Barrett exhibited a long series of the dark and strongly-marked varieties of *Agrotis cursoria* and *Agrotis tritici*, taken on the sand-hills of the north-east coast of Scotland by Mr. Arthur Horne, of Aberdeen.—Mr. Dale exhibited a specimen of a Sesia—supposed to be a new species—from the New Forest.—Mr. O. E. Janson exhibited a remarkable species of *Curculionidæ* from the island of Gilolo, having exceedingly long and slender antennæ and legs; it was apparently an undescribed species of the genus *Talanthia*, Pascoe.—Mr. Nelson Richardson called attention to a paper by himself, in the *Proceedings* of the Dorset Natural History and Antiquarian Field Club, on the subject of Dorset Lepidoptera in 1892 and 1893.—Mr. W. L. Distant communicated a paper entitled, "On a probable explanation of an unverified observation relative to the family Fulgoridæ." In the discussion which ensued, Mr. Blandford said he thought further evidence was required on the subject of the alleged luminosity in the Fulgoridæ before the statement contained in Mr. Distant's paper could be accepted.—Mr. J. J. Walker, R.N., contributed a paper entitled, "A preliminary list of the Butterflies of Hong-Kong, based on observations and captures made during the winter and spring months of 1892 and 1893."—Prof. Meldola

commented on the interesting character of the paper from an entomological point of view, and the value of the observations therein on the geology, botany, and climate of Hong-Kong.

Geological Society, April 24.—Dr. Henry Woodward, F.R.S., President, in the chair.—On the shingle beds of Eastern East Anglia, by Sir Henry H. Howorth, F.R.S. The author has carefully examined the country around Southwold, where the beds known as Westleton beds (which might well have been associated with the name of Southwold) are developed. He alluded briefly to the recent shingle, the pebbles of which are derived from the ancient shingles of the cliffs; the formation of this shingle, he maintained, may belong to a time not far removed from our own day. Turning to the Westleton beds, he noticed that they were essentially "drifts," the component pebbles not having been shaped on the spot, but brought as pebbles from elsewhere; and he gave reasons for supposing that they were derived from pebbly beds in the Lower London Tertiary group and in the Red Crag. He also maintained that the shells of the Westleton beds and Bure Valley beds were derived from crag deposits. Reasons were given for supposing that the pebbles of the Westleton shingle of East Anglia came from the west, and that this moved eastward from the plateau of Suffolk towards the sea. It was considered that these beds can only be explained by a tumultuous diluvial movement.—Supplementary notes on the systematic position of the Trilobites, by H. M. Bernard. Since the publication of a paper by the author in the *Quarterly Journal of the Geological Society* for 1894, two important papers by Dr. Beecher have appeared, giving details as to the structure and appendages of *Triarthrus*. The author, therefore, returned to the subject, and discussed in detail the more recent discoveries in the light of the affinity between *Apus* and the trilobites. He endeavoured to show how the results obtained by Dr. Beecher bear on the larger question as to the suggested origin of both of these animals from a chætopod annelid modified in adaptation to a new manner of feeding.—An experiment to illustrate the mode of flow of a viscous fluid, by Prof. W. J. Sollas, F.R.S. The author, recognising that it is by a knowledge of the laws of viscous flow that we must seek to extend our information concerning the movements of flowing ice, conducted an experiment, the details of which were described, with a model of a glacier composed of the modification of pitch usually known as "cobbler's wax." In the model the pitch moved under its own weight over the horizontal floor of a trough, which was crossed by a barrier to represent an opposing mountain or the rising end of a lake. The results of the experiment showed that the movement of the pitch-glacier was not confined to that portion of it which rose above the barrier, but extended throughout its mass, and that an upward as well as forward movement took place as the barrier was approached. Thus the transport of stones by glaciers from lower to higher levels was by no means an incredible phenomenon, but a necessary concomitant of such simple conditions as those assumed in the experiment.

Malacological Society, April 19.—Dr. H. Woodward, F.R.S., Vice-President, in the chair.—In addition to specimens in illustration of authors' papers, the following were shown: Mr. A. S. Kennard exhibited a series of Mollusca from a Pleistocene deposit at Crayford; Mr. S. Pace exhibited two species of *Estheria* from Persia and S. Algeria; Mr. W. M. Webb exhibited mollusca from a Pleistocene deposit at Chelmsford; Mr. E. R. Sykes exhibited a distribution chart of *Clausilia*.—The following communications were read:—On some new species of British Mollusca from the *Triton* Expedition, by H. K. Jordan.—The Anatomy of *Natalina caffra*, Fer, by M. F. Woodward.—Descriptions of new species of Mollusca of the genera *Bullia*, *Mangelia*, *Trochus*, &c., from the Mekran Coast, by G. B. Sowerby.—List of Land and Freshwater Mollusca from New Providence Isle, Bahamas, by W. Bendall.—Notes on two cases of the transport and survival of Terrestrial Mollusca in the New Forest, by T. Leighton.

Royal Microscopical Society, April 17.—Mr. A. D. Michael, President, in the chair.—The Secretary said they had received a valuable donation from the South London Microscopical and Natural History Club, in the shape of a lantern with microscope attachment.—Mr. A. Letherby read a short paper upon the structure of the Podura scale.—The President read a paper on the structure of the brain in the Oribatidæ and in some other Acarina.

CAMBRIDGE.

Philosophical Society, April 29.—Exhibition of *Palophus tiaratus* (a stick-insect from Mashonaland), by Dr. D. Sharp.—A modified method of finding the specific gravities of tissues, by Dr. Lazarus-Barlow. The author showed an improved method of finding the specific gravity of tissues. In a research on the pathology of the œdema which accompanies passive congestion, published in the *Philosophical Transactions* of the Royal Society, he used the solutions made up with glycerine introduced by Roy for the estimation of the specific gravity of blood, but found that difficulty arose from the large quantity of muscle used in obtaining the correct specific gravity, and from the fact that the glycerine abstracts water from the muscle with such rapidity that after a very few seconds the piece of muscle invariably sank. He therefore has used for the past year solutions of various specific gravities made with gum arabic, which he arranges in a wide test-tube in their order of density. Alternate layers are coloured blue. Diffusion occurs with extreme slowness, so that 48 hours after arranging the test-tube the various layers are quite evident. The special advantages of the method are that one piece of muscle is sufficient for an estimation, as it sinks through the layers of lower specific gravity until it reaches that layer with which it is identical; that water is abstracted from the muscle by gum much more slowly than by glycerine, and that, as has been shown by Heffter, the vitality of cardiac muscle is better maintained by gum arabic solutions than by any other solution.—Crania of native tribes of the Panjab, by Prof. Macalister.

PARIS.

Academy of Sciences, April 29.—M. Marey in the chair.—A projected balloon expedition to the Arctic regions, by M. S. A. Andrée. The author defines the conditions necessary to be fulfilled by a balloon destined for Arctic exploration, and shows that such conditions can be fulfilled. He has succeeded in obtaining a certain amount of directive power by using a rope drag to retard the progress of the balloon relatively to the wind, and then using a sail in the ordinary way. By this device a mean deviation of 27° has been secured. Sometimes a deviation of nearly 40° has been obtained. M. Émile Blanchard in connection with this paper calls attention to the probability of existence of an open polar sea, and points out the support this view receives from the many flocks of web-footed birds observed making their way northwards by explorers when nearest to the pole.—On the double points of a group of algebraical surfaces, by M. G. B. Guccia.—On the types of groups Ω of substitutions, of which the order equals the degree, by M. R. Levavasseur.—On an application of M. Darboux's method (mathematical analysis), by M. Beudon.—On the rotation of solids, by M. R. Liouville.—On a class of periodic solutions in a particular case of the problem of three bodies, by MM. J. Perchot and J. Mascart.—Measurements of the intensity of gravity in Russia, by M. G. Defforges. Data are given for Pulkowa, Tiflis, Ouzoun Ada, Bokhara, and Tashkend, from which it is shown that the negative continental anomaly is very pronounced at Ouzoun Ada and Tashkend, and at Bokhara is of the same order as at Paris; the positive anomaly is greater than previously observed at Pulkowa.—On the specific heat of superfused liquids, by M. Louis Bruner. Thymol and paracresol give specific heats increasing with the temperature range when cooled without solidification to approximately the same extent below their melting-points for each experiment. Menthol and bromal and chloral hydrates cannot be obtained superfused by cooling.—On the solidification of some organic substances, by M. Louis Bruner.—On the regularity of luminous movement, by M. Gouy.—On the electric resistance of saccharine liquids, by MM. Gin and Leleux. Expressions are given showing the relationships between resistance and the concentration and temperature of saccharine solutions. The resistance is shown to be a function of the current density. This result is explained on the Arrhenius hypothesis as due to the state of ionisation of the badly conducting electrolyte.—New researches on the heats of combination of mercury with the elements, by M. Raoul Varet.—On the action of the halogen compounds of phosphorus on metallic copper, by M. A. Granger. Copper phosphide, CuP_2, is produced by passing phosphorus trichloride vapour in carbon dioxide over slightly heated copper; cuprous chloride is formed at the same time and deposited at the end of the tube. PBr_3 and PI_2 give the same compound. PF_3 needs a red-heat, and produces Cu_5P_2.—Researches on manganese, by M. Charles Lepierre. The manganic-ammonium

sulphate is described in addition to hydrated and anhydrous ammonium-manganous sulphate.—Campholenic acids and amides, by M. A. Béhal. Isomeric acids and amides have been obtained. The solid acid was thought to be the racemic form of the liquid acid, but all attempts to separate optical isomers have failed.—Double combinations of anhydrous aluminium chloride with nitro-compounds of the aromatic series, by M. G. Perrier. A series of compounds of the type $Al_2Cl_6 . 2C_6H_4 . CH_3 . NO_2$ (1 : 4) are described, and it is shown that with nitro-derivatives of the type of paranitrotoluene, Friedel and Crafts' reaction fails.—On a possible error by the use of Fehling's solution for the estimation of sugar in urine from persons submitted to treatment with sulphonal, by M. Ph. Lafon.—On the panification of brown bread, by M. James Chappuis.—On the causes which produce the colour of brown bread, by M. Léon Boutroux. Gluten may give the colour in bread by desiccation, but not by fermentation. By oxidation with air in presence of water, bran may produce the colouration of bread; but, again, fermentation has no such effect. The acidity of the yeast is a protection against browning.—On the ethology of the genus *Thaumaleus Kröyer*, by M. Alfred Giard.—Observations on the hornets, by M. Charles Janet.—New researches on "la brunissure," by M. F. Debray.—Action of static sparks on the local temperature of regions submitted to this method of franklinisation, by M. H. Bordier.—Treatment of a case of sarcoma by serotherapy, by MM. J. Héricourt and Ch. Richet.—The catastrophe of Laibach, April 14, 1895, by M. Ch. V. Zenger.

WASHINGTON.

National Academy of Sciences, April 16–20.—On some variations in the genus Eucope, by A. Agassiz and W. McM. Woodworth; notes on the Florida reef, by A. Agassiz; the progress of the publications on the expedition of 1891 of the U.S. Fish Commission Steamer *Albatross*, Lieut.-Commander Z. L. Tanner commanding, by A. Agassiz; on soil bacteria, by M. P. Ravenel; a linkage showing the laws of the refraction of light, by A. M. Mayer; on the colour relations of atoms, ions and molecules, by M. Carey Lea; mechanical interpretation of the variations of latitude, by R. S. Woodward; on a new determination of the nutation-constant, and some allied topics, by S. C. Chandler; on the secular motion of a free magnetic needle, by L. A. Bauer; on the composition of expired air, and its effect upon animal life, by J. S. Billings; systematic catalogue of European fishes, by Th. Gill; the extinct cetacea of North America, by E. D. Cope; on the application of a percentage method in the study of the distribution of oceanic fishes—(1) definition of eleven faunas and two sub-faunas of deep sea fishes, (2) the relationships and origin of the Carribeo-Mexican and Mediterranean sub-faunas, by G. Brown Goode; on the two isomeric chlorides of ortho-sulpho-benzoic acid, by Ira Remsen; on some compounds containing two halogen atoms in combination with nitrogen, by Ira Remsen; presentation of the Watson Medal to Mr. Seth C. Chandler, for his researches on the variation of latitudes, on variable stars, and for his other works in astronomy; biographical memoir of Dr. Lewis M. Rutherfurd, by B. A. Gould; relation of Jupiter's orbit to the mean plane of four hundred and one minor planet orbits, by H. A. Newton; orbit of Miss Mitchell's Comet, 1847 VI, by H. A. Newton.

NEW SOUTH WALES.

Linnean Society, March 27.—Prof. David in the chair.—The President delivered the annual address, in the course of which reference was made to the recent suit in the Equity Court, in which the Society was defendant, brought by the University of Sydney to obtain the declaration of the Court as to the construction of so much of the will of the late Sir William Macleay as relates to his bequest of £12,000 for the endowment of bacteriology; and the full text of the judgment of his Honour the Chief Judge in Equity was read. After summarising the contributions to science made during the year by the various local scientific institutions and departments, the President passed on to consider at some length the subject of recent research in the Arctic and Antarctic regions, and especially the important question outlined by Dr. John Murray, namely, that of the desirability of a laborious and systematic exploration of the whole Antarctic region with all the appliances of the modern investigator. The following gentlemen were elected office-bearers and Council for 1895. President: Henry Deane. Vice-Presidents: Dr. James C. Cox, Prof. W. A. Haswell, Prof. T. W. E. David. Treasurer: The Hon. James Norton. Council: John Brazier, Cecil W. Darley, Thomas Dixson, J. R. Garland, Arnold U. Henn, A. H. S. Lucas, J. H. Maiden, C. J. Martin, Perceval R. Pedley, P. N. Trebeck, Thomas Whitelegge, Prof. J. T. Wilson.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Elements of Health: Dr. L. C. Parkes (Churchill).—A Treatise on Practical Chemistry: Dr. F. Clowes, 6th edition (Churchill).—Chemical Technology, edited by Groves and Thorp. Vol. 2. Lighting (Churchill).—Fern-Growing: E. J. Lowe (Nimmo).—Le Centenaire de l'École Normale (Paris, Hachette).—Le Cause dell' Era Glaciale: L. de Marchi (Pavia, Fratelli Fusi).—Die Lehre von der Elektrizität und deren Praktische Verwendung: Th. Schwartze (Leipzig, Weber).—Physikalische Krystallographie: P. Groth, Dritte Auflage, 3 Abthg. (Leipzig, Engelmann).—Low's Chemical Lecture Charts (Low).—Die Photographie ein Handbuch für Fach-und Amateur-Photographen: A. Hertzka (Berlin, Oppenheim).—Object-Lessons in Botany: E. Snelgrove, Book 2 (Jarrold).—Dakota Grammar, Texts and Ethnography: S. R. Riggs (Washington).—Eleventh and Twelfth Annual Reports of the Bureau of Ethnology: J. W. Powell (Washington).

PAMPHLETS.—Royal Gardens, Kew: Official Guide to the Museums o Economic Botany, No. 2 (London).—The Franklin Institute: W. H. Wahf (Philadelphia).—Royal Gardens, Kew: Hand-List of Ferns and Fern-Allies cultivated in the Royal Gardens (Eyre and Spottiswoode).—Myodes lemmus, its Habits and Migrations in Norway (Christiania).—List of the Publications of the Bureau of Ethnology, &c. (Washington).—An Ancient Quarry Indian Territory: W. H. Holmes (Washington).

SERIALS.—Humanitarian, May (Hutchinson).—Record of Technical and Secondary Education, April (Macmillan).—British Moss-Flora: Dr. B Braithwaite, April (the Author, Clapham Road).—Botanische Jahrbücher für Systematik, Pflanzengeschichte und Pflanzengeographie, Zwanzigster Band, 3 Heft (Leipzig, Engelmann).—Fortnightly Review, May (Chapman).—Internationales Archiv für Ethnographie, Band viii. Heft 2 (Leiden, Brill).—Philosophical Society of Washington, Bulletin Vol. xiii. pp. 31–76 (Washington).—Zeitschrift für Physikalische Chemie, xvi. Band, 4 Heft (Leipzig, Engelmann).—L'Anthropologie, tome vi. No. 2 (Paris, Masson).—Scribner's Magazine, May (Low).—Geological Magazine, May (Dulau).—Quarterly Journal of the Geological Society, Vol. li. Part 2, No. 202 (Longmans).—Geographical Journal, May (Stanford).

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