THURSDAY, OCTOBER 15, 1903.

EGYPTIAN GEOLOGY.

Topography and Geology of the Eastern Desert of Egypt (Central Portion). By T. Barron, A.R.C.S., F.G.S., and W. F. Hume, D.Sc., A.R.S.M., F.G.S. Geological Survey Report. Pp. viii + 331. (Cairo: National Printing Department, 1902.)

THE work before us is the largest instalment yet published of the results of the explorations which have been carried on with such success by the Egyptian Geological Survey, under the able and energetic direction of Captain Lyons. The district now described was actually surveyed in the years 1897 and 1898, but there appear to have been many delays in arranging for the publication—the time of the authors being taken up by fresh work undertaken in widely distant regions. At the geological congress held in Paris in 1900, however, the two authors of the memoir were permitted to lay some of the chief results obtained from the study of this region before the geologists who had assembled there, and abstracts of their papers have appeared in the *Geological Magazine* for 1901; but the publication of this large and well-illustrated memoir has long been eagerly anticipated, and its appearance will be everywhere welcomed as a most valuable addition to the scientific literature of the district.

The authors must be congratulated upon the excellent use they have made of the vast mass of literature dealing with the geology of the area. In an appendix they have given an admirable abstract of the results obtained by De Rosière, Wilkinson, Schweinfurth, Klunzinger, Walther, and many other travellers, who have by their writings added to our knowledge of this very interesting region. The work of the geological surveyors—a very important one—has been that of correlating and correcting these various sources of information and of supplying, by actual observations in the field, the links necessary to combine the whole into a connected monograph dealing both with the topography and geology of the district.

Like the work carried on in the western territories of North America by the United States Geological Survey, the work in the Egyptian deserts has to be a combination of a geological and a topographical survey. Each working party had to consist of a geologist and a topographer, with a small caravan consisting of eleven Arabs and fifteen camels. The topographical work was done by using a measuring wheel for determining a base line, and working from this with plane-table and theodolite, frequent observations for latitude being made to correct the results; the heights were determined by the aneroid in most instances, but in important cases hypsometer and theodolite determinations were made also. The chief difficulties experienced in the topographical work—apart from those arising from traversing waterless districts—were caused by the mirage and by the frequent presence of great masses of magnetic rock.

While the topographers were engaged in making the map as complete as possible, the geologists were busy examining and recording the interesting features exhibited by the various rock-masses encountered in the different traverses. The district described includes the famous porphyry quarries of Djebel Dokhan, and the ancient upraised coral reefs and their modern representatives on the shores of the Red Sea—some of these reefs being of especial interest, owing to the partial dolomitisation which they have undergone.

The first 115 pages of the volume (which extends to 331 pages) are occupied by an account of the topography of the Red-Sea Hills, and in this part of the work there is much matter of archæological interest in the account of the numerous remains of Roman buildings, and of ancient quarrying and mining works. A very excellent account is also given of the meteorology and of the botany and zoology of the district.

The description of the geology which occupies the second and larger half of the volume deals with the Pleistocene gravels, old beaches, and raised coral reefs, the Pliocene gravels, conglomerates and limestones, the Miocene and Eocene limestones, marls, &c., the Cretaceous limestones, and the "Nubian Sandstone," which in this particular district appears to be in no part older than the Cretaceous. The sedimentary rocks of the district are about 2000 feet in thickness, and cover unconformably the metamorphic and associated igneous rocks. The latter consist of quartz-diorites or grey granites which are younger than and invade the metamorphic rocks, and are themselves intruded into by masses of red granite, with, probably associated, dykes of quartz-felsite and dolerite. These rocks with veins of diabase which intersect them have all been planed down by denudation before the deposition of the sedimentaries. The only later igneous rocks are the andesites which have been intruded into the Eocene limestones, and have produced contact metamorphism in them, and certain igneous gravels and conglomerates which unconformably overlie the sandy limestones of Pliocene age.

The volume is admirably illustrated. Besides the general topographical map of the district and the same geologically coloured, there are five geological maps of areas of special interest. There are also four plates containing coloured panoramas, which give an excellent idea of the relations of the various igneous and other rock masses in this region; and the geological structure of the district is further illustrated by eleven plates of longitudinal sections. The general aspects of this, it must be confessed, rather uninviting region are shown by nine beautiful photogravures by Dr. E. Albert and Co., of Munich, from photographs taken by the authors, while three plates and six photographs are devoted to objects of archæological and general interest.

The important palæontological researches of Beadnell and Andrews have attracted the attention of all geologists to the important work which is being accomplished by the Geological Survey of the Egyptian Government, and the present work will serve to show that every branch of geological science is receiving due attention from the officers of that survey. It is well known that important explorations have been carried on in other portions of the vast territories now under the rule of the Khedive, and it may be hoped, in the interests of science, that these results may be published with less delay than those we have now been noticing. J. W. J.

EXPERIMENTS ON HUMAN MONSTERS.

Essai sur la Psycho-physiologie des Monstres Humains. By N. Vaschide and Cl. Vurpas. Pp. 294. (Paris: F. R. de Rudeval, n.d.) Price 5 francs.

THE substance of two-thirds of this book has already appeared in various scientific and medical journals. The last ninety-four pages are devoted to the researches of other workers in the same field. The first of the two monsters examined by the authors was an anencephalous male child, which was continuously under observation during the thirty-nine hours of its extra-uterine life. An examination *post mortem* revealed the complete absence of cerebral hemispheres, cerebellum, pons, restiform body, inferior and accessory olives, and pyramidal tract. The monster's apparent lack of taste and smell is devoid of theoretical interest, as the authors omit to mention whether the trigeminal and olfactory nerves were developed. Certainly they failed to find traces of the third and fourth cranial nerves, coincident with the lack of which the infant presented exophthalmos, external squint, dilatation of the pupil, absence of the pupil-reflex, and ptosis. The cerebral hemispheres were replaced by a protruding cystic tumour; throughout the brain and cord the ependyma, neuroglia and ventricles were much hypertrophied, and atrophied degenerated nerve-cells were met with, especially in the cranial region, together with much vascular engorgement and diapedesis. In order to explain the yet healthy state of the retinæ and optic nerves, the authors conclude that the cerebral hemispheres at first developed normally, and were only later affected by "an inflammatory process of an infectious nature," which produced the anencephaly and other abnormalities. But the authors' interpretation of their histological investigations is far from convincing. It is hardly a matter for surprise to find hæmorrhages and wandering leucocytes in the profoundly disturbed nervous system of a cold, moribund, cyanotic creature that breathed only about eight times a minute, and then with a well-marked Cheyne-Stokes rhythm. Moreover, some secondary degeneration may have followed from the complete absence of the pyramidal tract. The authors allude to an insufficiency of myelinisation and to the abnormal proportions between white and grey matter. But these statements, and the rather indifferent plates and illustrations upon which they are founded, would have carried greater conviction, were it certain that the authors (of whom one is an experimental psychologist and the other a hospital resident physician) are perfectly familiar with the corresponding appearances in a healthy newly-born babe.

On pp. 47 and 48 we read:—

"It seems that a class of psychic phenomena, which hitherto have been attributed exclusively to the cerebral hemispheres, such as the special sensibility to touch, pain, and warmth . . . existed in our anencephalous subject independently of the action of the brain."

In point of fact, the reflex movements experimentally obtained by tactual, painful, and thermal stimuli, likewise the abortive attempts of the subject to swallow, its cries and convulsive seizures, one and all are just what might have been expected from a "decerebrate" vertebrate; they are quite void of "psychic" significance in the ordinary meaning of the term, and throw no fresh light on the subject whatever. Surely the presence of these reflex actions, and the integrity of the nerve-trunks, might have led the authors to suspect that nerve-cell degeneration had been neither as extensive nor as intense as they had imagined. But, on the contrary, they incline (p. 76) "to the opinion of certain authors who see in the cell a centre having a function purely trophic and in no way motor," and further urge (p. 75) the impossible view that the infant's (very doubtful) manifestations of spontaneous activity "seem to show that the pyramidal tract has a *rôle* essentially inhibitory instead of dynamogenic." The authors might to their advantage have kept in mind the words of their own preface (p. 16):—

"Nous avons laissé à dessein de côté dans nos travaux et recherches les hypothèses, . . . en nous imposant de ne pas sortir du cadre de l'expérience et des données précises."

The subject of the second far more satisfactory study was a "xiphopage," as the authors call it, in other words, an example of Siamese twins. It was composed of two perfectly formed Chinese boys, fifteen years old, of whom the right was called Liao Toun Chen and the left Liao Sienne Chen. They were united in the region of the xiphoid part of the sternum by a somewhat extensible bridge of tissue which contained cartilage, blood vessels, and very probably a remnant of hepatic substance. This bridge revealed a narrow median anæsthetic zone, surrounded on either side by a hypoæsthetic zone, cutaneous stimulation of which affected only that individual to whom the stimulated area was nearest, but never both individuals. It is, however, difficult to reconcile this interesting observation with another, viz. that if the points of Weber's compasses were separated by 15mm., and the compasses placed astride the median anæsthetic zone, so that one point rested on an area felt by one subject, and the other on an area felt by the other subject, then each child perceived that he was touched in two points. The characteristics of the two children were very different. Liao Toun Chen was mentally and physically more vigorous than his brother. He was more curious and roguish, while Liao Sienne Chen was more attentive and serious. The latter, as we should expect, gave shorter and more trustworthy reaction-times. His sensibility to stimuli was also keener. His body-temperature and his arterial pressure were higher than those of his stronger brother, who in turn breathed with greater rapidity, and had a more frequent pulse. Save in violent emotion, the respirations of the two brothers were never isochronous, but in opposite phases. Owing to congenital association, these differences of character were found to be harmonised, as might be anticipated, in action. Quarrels were rare; Liao Sienne Chén meekly followed his better half. They had from their birth eaten and performed other functions simultaneously. In waking, however, one recovered consciousness before the other, and roused him. It was found possible for one of the brothers to sleep while the other kept awake. But does this in reality, as the authors affirm (p. 175), "speak singularly against a chemical theory of sleep which makes it appear under the influence of toxic products"?

C. S. MYERS.

OUR BOOK SHELF.

Electrolytic Preparations. By Dr. Karl Elbs, translated by R. S. Hutton, M.Sc. Pp. xi + 100. (London: Edward Arnold, 1903.) Price 4s. 6d. net.

ELECTROCHEMICAL methods are now becoming of such importance, and are being so largely employed both in the laboratory and in technical processes, that the translation of Dr. Elbs's little work on electrolytic preparations—"Exercises for use in the laboratory by chemists and electrochemists"—will be sure to be welcomed by English-speaking students.

The book is divided into two parts. Part i., which is general, deals with sources of current and connections, resistances, apparatus for electrolysis, &c. Dr. Elbs considers that accumulators can alone be looked upon as a source of current for laboratory purposes, and he gives some useful hints as to coupling up and how to use the cells.

Several pages are devoted to apparatus for electrolysis. As kathode material almost any metal may be employed, unless the electrolyte is very strongly acid. But for anodes, nearly all metals, with the exception of platinum, are attacked. Lead may often be used owing to its becoming coated with a superficial layer of peroxide which prevents further action taking place.

Part ii. is devoted to the experimental portion of the work. The examples from inorganic chemistry which come first are divided into two parts. The first deals with experiments with unattackable anodes, the second portion with soluble anodes. Under the first heading are given the methods of preparation of such substances as chlorates, bromates and iodates, and persulphates, under the second heading the preparation of white lead, cuprous and cupric oxide.

On p. 47 the student is introduced to the electrolysis of organic acids. This part is well arranged, and the theoretical principles are carefully and clearly gone into. A detailed explanation is given of the various reactions which may occur in the electrolysis of organic acids. Here there seems to be a field for further research, because although many of the explanations given probably approximately explain what actually does occur, others seem hardly conclusive, so that at any rate further light upon the subject would be welcome.

No less than eighteen examples of electrolytic reduction are given, while there are only two on electrolytic oxidation. This is mainly due to the fact that reduction work, generally speaking, is much easier to carry out than work on oxidation. This applies both to pure chemistry and to electrochemistry. Further, electrochemical methods of oxidation have not been tried by chemists to anything like the same extent as have reduction methods.

The book is very well printed and got up, and Mr. Hutton has done his part—the translation of the work—very satisfactorily.

F. M. P.

A Concise Handbook of Garden Flowers. By H. M. Batson. Pp. vii + 256. (London: Methuen and Co., 1903.) Price 3s. 6d.

THIS is an alphabetical list of a large number of ordinary garden plants, together with brief indications of height, colour of flowers, native country, natural order, season of flowering, mode of propagation, and purpose for which they may be used in the garden. Within its rather restricted limitations the book seems carefully compiled, and the proofs have evidently been read with attention, for abundant as are the opportunities for falling into error, misprints are hardly to be found. The word "family" is, however, used in many cases where "genus" should be employed; thus the Galegas are styled a hardy family. Of course, Galega is a genus of the family Leguminosæ. An even more misleading statement is that in which *Narcissus Barrii* is spoken of as "a family of star-narcissus," whatever that may be.

The cultural details, though very concise, are apparently trustworthy, but there is ample room for difference of opinion about these matters. Thus the author says of *Gentiana acaulis* that "it is easy of culture." It may be so in places, but after a long experience with it under varying conditions, but in one particular garden, we have never been successful in getting it to flower, whilst in another we have experienced no difficulty. The author has succeeded in finding English names for most, if not all, of the plants he mentions. If such names are to be given, they should be employed with as much precision as the technical appellations. To call *Narcissus poeticus* the "poet's daffodil," or *Narcissus Tazetta* "the polyanthus flowered daffodil," is surely to introduce confusion where none need be experienced. A full index is added, which adds greatly to the convenience of the reader. We should like to suggest to the author that, in a future edition, he should enumerate the names of the genera in alphabetical order under the heading of the natural order to which they belong. Search for the name of a plant would by such means be much facilitated, as most lovers of plants are familiar at least with the principal natural orders.

Lavori marittimi ed Impianti portuali. By Flavio Bastiani. Pp. xxiv + 424. (Milan: Ulrico Hoepli, 1903.) Price 6.50 lire.

THIS is one of the "Manueli Hoepli," a series of pocket books in which the Italian "man in the street" can, at a small cost, obtain information on such diverse subjects as elliptic functions, Volapük, botany, oils and olives, Greek mythology, and English weights and measures. The present volume deals with the construction and working of docks, harbours, wharves, canals, lighthouses, in short all fixed structures connected with navigation. It is illustrated by 209 woodcuts, and the last part contains a summary of Italian laws relating to harbours, harbour dues, and such matters.

Il Moto degli Ioni nelle Scariche elettriche. By Augusto Righi. Pp. 66; with 3 plates and several woodcuts. (Bologna: Nicola Zanichelli, 1903.)

THIS book contains, with some amplifications, an almost verbatim report of a lecture delivered by Prof. Righi to a branch of the Italian Electrotechnical Society at Bologna. It deals with the theory of electrons, considered with special reference to kathodic rays, ionisation of gases, Lorentz's theory, and the production of electric shadows.

LETTERS TO THE EDITOR.

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

Radium and the Sun's Heat.

IN your last week's issue Mr. Hardy directs attention to the fact that no Becquerel rays can be detected from the sun, and regards this as an objection to the view that the solar heat may be accounted for by the presence of radium.

Let us attempt to calculate the effect to be expected if the sun's heat were due to this cause.

In doing this, we may assume that the sun contains 3·6 grams of radium per cubic metre. This was the amount which Mr. W. E. Wilson gave in NATURE of July 9 as required to emit the observed amount of heat. Experiment shows that when the Becquerel radiation has to pass through lead screens of thickness 1 cm. or more, the radiation transmitted is practically all of the γ variety. This is cut down to half its value by 8 cm. of aluminium, and in the case of other substances by strata of equal mass per unit area. Now the earth's atmosphere constitutes a stratum far more absorbent than 1 cm. of lead. We need, therefore, only consider the γ rays, for if these cannot be detected, it is certain that the α and β rays cannot.

For the sake of simplicity of calculation, we shall treat the sun as a cube, with its side equal to the diameter of the real sun, and so placed that the normal to one face, which passes through the centre, shall also pass through the earth. This will be for all practical purposes near enough to the truth.

Let a be the side of the cube, q the quantity of radium per c.c., and λ the coefficient of absorption of the radiation. Then, from an elementary slice, thickness dx, and distance x from the face, the intensity of radiation at a distant point will be

$$a^2qe^{-\lambda x}dx$$

if the radiation due to 1 gram of pure radium at the same (great) distance be taken as unity.

The radiation due to the entire mass will be

$$a^2q\int_0^a e^{-\lambda x}dx = a^2q\left[\frac{-e^{-\lambda x}}{\lambda}\right]_0^a = \frac{a^2q}{\lambda}\left(1-e^{-\lambda a}\right)$$

Now $a=1\cdot4\times10^{11}$ cm.; q, from Mr. Wilson's estimate $=3\cdot6\times10^{-6}$.

Assuming that the coefficient of absorption is proportional to the density, and taking the sun's density as 1/7, and the value of λ for aluminium as 0·086, the value of λ for the sun comes out 0·0046. Substituting these values, we find that the effect of the sun is equivalent to that of $1\cdot53\times10^{19}$ grs. of radium at the same distance, assuming this radium to be spread out into a thin layer, so that all the radiation can escape without undergoing absorption in the mass.

Now I have found that the γ radiation from 10 milligrams of radium bromide can barely be detected by the electrical method, where 10 cm. of lead intervene between it and the testing vessel. To decide whether the solar rays would be detectable, we must compare their expected effect after enfeeblement by distance, and by the absorption of the atmosphere, with this.

The distance of the sun is $1\cdot5\times10^{12}$ times greater than the distance of the radium from the testing apparatus, so that, apart from the atmospheric absorption, the effect of the sun would be equivalent to that of $\frac{1\cdot5\times10^{19}}{(1\cdot5)^2\times10^{24}}$, or $6\cdot7\times10^{-6}$ grams of radium, 10 cm. from the apparatus. This is less than one-thousandth part of the radium used in the experiment cited, and the solar radiation, instead of passing through only 10 cm. of lead, would have to pass through the atmosphere, equal in mass to 32 feet of water, or about 89 cm. of lead. This would, of course, reduce it many million times further. So that, even if all the sun's heat were due to radium, there does not appear to be the smallest possibility that the Becquerel radiation from it could ever be detected at the earth's surface.

R. J. STRUTT.

REFERRING to Mr. Hardy's experiment described in his letter in NATURE, October 8, it is easy to show that whatever the intensity of radio-activity might be at the surface of the sun, by mere surface ratios and assuming no absorption its activity per unit area at the distance of the earth must fall to about one forty-thousandth part. Now, if the sun were composed of solid radium bromide, the radiation reaching Mr. Hardy's indicator from the sun will be only about one-thousandth part of that derived from a sphere of radium bromide three millimetres in diameter and twenty millimetres distant from the indicator: the probable conditions of Mr. Hardy's experiment.

In the experiment one centimetre thickness of lead is interposed. The earth's atmosphere is equivalent in mass to 76 cm. of mercury. This supposes no absorption from, possibly, some thousands of miles of solar atmosphere. Moreover, we assume in the comparison a sun of solid radium bromide. It would appear, however, that a very small percentage of this body in the materials of the sun would suffice to account for many millions of years of solar heat.

The absence of β and γ radiations at the earth's surface is, therefore, not a weighty argument against the presence of radium in the sun.

The arguments in favour of supposing that this element exists in the sun are:—(1) The presence of radium on the earth; (2) the high atomic weight of radium; (3) the presence of helium in the sun; (4) Arrhenius's theory of the Aurora Borealis; (5) the fact that the estimate of the duration of solar heat from the dynamical source appears to run counter to geological data.

J. JOLY.

Trinity College, Dublin, October 10.

Cambridge in the Old World and in the New.

ONE of the most striking features of the universities of the United States is the wealth of their endowment. During the writer's visit to Cambridge, Massachusetts, for example, Harvard University was successfully collecting large sums towards a new building for philosophy in memory of Emerson, and within the last few months has been promised two million dollars by two millionaires towards her new medical school.

Reasons for such well-known munificence of Americans towards their universities are not hard to find. Pauperism is an almost negligible quantity in America, so that the money, which drains away on this side in charity, finds an outlet there in the advancement of education and research. Primogeniture, again, is contrary to American ideals. While the newly-made English millionaire thinks it his duty to sink a considerable part of his fortune in buying and maintaining a family estate for his son and heir, the American more often divides his property equally between his children, and feels at greater liberty to dispose of much of it in his lifetime as he pleases, for he is willing that the uphill life he has lived himself shall be lived again by his descendants. The absence of inherited titles in America tends, of course, towards the same end. Many of the younger universities, too, are in districts where huge fortunes have been rapidly made and civic pride runs high, producing numerous benefactions in the cause of local institutions. But although all these are reasons, none of them is sufficient to explain the situation satisfactorily. To find the true cause, we must enter into the differences in life and education between the older English and American universities.

The average English youth, passing from public school to Oxford or Cambridge, intends to make his living by some profession, perhaps as minister, teacher, barrister, or physician; relatively seldom has he sufficient to live upon without further exertion. He spends his three or four years in one of the seventeen or more colleges from which he has to choose, and his college becomes the centre of his social life. Probably there he makes his greatest friendships; certainly the number of men he knows outside his own college is comparatively small. In eights, elevens, or fifteens, the various colleges are pitted against one another. Nor, indeed, is inter-collegiate competition confined to athletics. Each college is continually struggling against the rest to secure the most promising boys from the public schools, and to acquire the greatest number of university distinctions. Each has to maintain a more or less separate staff, partly to supplement university lectures, but partly also to give more individual instruction to the duller or idler students. One of the results of this system can be easily seen—the average graduate quits his university with the greatest affection for his college, but with little or nothing of that broader *esprit de corps* towards his university as a whole.

In America, on the other hand, each university has only one college preparing him for the B.A. degree. Consequently, a single American college, *e.g.* Harvard College, Cambridge, contains several thousand students.[1] The centre of social life can no longer be in the college; it is transferred to the class, the class consisting of all students who are in the same year. Each class elects its own president and other officers, has its various rowing, football, and baseball teams, and holds meetings for the discussion of matters of common interest. A class in Cambridge, Massachusetts, knits the students together in somewhat the same way as does a college in Cambridge, England, although, of course, far less closely.

In the second place, there is a comparatively large number of students in American universities, who intend to lead, or finally do lead, a business life after they leave college. It is true that just now the question is being raised whether a college training is the right one for an American business man, but the only probable outcome of this discussion will be an improved adjustment of the college curriculum in the interests of those who intend to embark on a business career. Already at Harvard there is a proposal on the part of the president to make it possible for such students to complete their training in a shorter time than the usual four years.

In the end these two American features, the formation of class ties and the presence of students who are intended for a business career, combine to place a number of wealthy *alumni* at the beck and call of the universities. It is a common occurrence for the class of a certain year to defray, wholly or in part, the cost of a building of which their *alma mater* stands in need; at Cornell alone twenty-two class-gifts of this or similar kind are on record. Moreover, the *alumni* of the various universities form themselves into societies, both local and general. Every important city in America contains various associations of *alumni*, each association representing one of the more important universities. The *alumni* of various classes, dispersed throughout the States, are periodically invited to revisit their university. In some universities they directly elect a certain number of their body to serve on the board of trustees or corporation of the university. Such is the hold exercised by many American universities on their former students.

But it is not only from wealthy *alumni*, but also from citizens who have never been to college, that the universities of the United States derive their greatest benefactions. Now this would be impossible unless the American people were in full sympathy with American university work. Indeed, the university holds as warm a place in the heart of the American as the hospital holds in that of the Englishman. He feels that it is a living organisation, not an inert out-of-date machine, which is doing necessary work in the advancement of the civilisation of his country. Further, we come to understand the reason of this feeling when we contrast the undergraduate courses at the two Cambridges. At Harvard, the examination for admission consists of papers in English, history, algebra, geometry, and natural science, Latin *or* Greek, and French *or* German. After passing this, the student has to choose four courses of lectures per year in *more than one* of the following subjects:—English, German, French, Italian, Spanish, history, government, economics, philosophy, fine arts, music, mathematics, engineering, or some natural science. Apart from certain reasonable restrictions, which prevent him from acquiring a too superficial knowledge in too many subjects, the student is at liberty to select just those courses which will best suit him in after life; and, of course, he can readily obtain advice in any difficulties that may beset him when making his choice. In his second and later years he may specialise more deeply in these and other subjects. He is examined twice a year, and shows thereby whether he is capable of proceeding to more advanced courses advantageously. He obtains his degree on the result of these bi-annual examinations. For an honours degree a thesis or special examination is required.

[1] The words college and university have thus acquired a significance in America which is unfamiliar to us. No college is regarded as a university unless, besides teaching, it encourages post-graduate research.

The undergraduate of our English Cambridge, on the other hand, having mastered at school the modicum of compulsory Greek required for the previous examination, has the choice of two distinct paths. He can straightway read for an honours degree in any *one* of the triposes which suits his requirements, the classical, mathematical, theological, natural sciences, mental and moral sciences, mechanical sciences, mediæval and modern languages, oriental languages, historical or other tripos—in which case he takes his degree almost always upon the results of a single examination in a single tripos at the end of his three years[1]; or he may be content to take an ordinary degree, for which he must devote at least the whole of his first year to Greek, Latin, English, algebra, statics, hydrostatics and heat, and spend his later years preparing for examination in any *one* subject (*inter alia*) of the following:—theology, economics, law, history, logic, mathematics, classics, music, chemistry, physics, botany, physiology, zoology, or agriculture. This examination, qualifying him for the ordinary B.A. degree, is completed at the end of his third year.

Few graduates who have been educated on the basis of a Cambridge tripos would welcome changes in so admirably conceived a system of education. At one time it was believed that the student who devoted his three or four years in this manner to a single subject must suffer in general culture, whereas it is nearer the truth to believe that there is scarcely any branch of learning which cannot impart a very high degree of culture, provided only that it be taught from a sufficiently wide and liberal point of view. On the other hand, there are probably few who would not desire considerable changes in the regulations for the ordinary degree. The examination is hardly more than an advanced Little-go, ending in a feeble effort at specialisation. Instead of having to spend a year or more at Greek, hydrostatics, heat, &c., why should it not be possible for the undergraduate who is bent on an army career to qualify in modern or oriental languages, geography, surveying, and ethnology, or for him who intends to enter into finance to study mercantile law, economics, and modern languages, or for the future country squire to read straightway in history, literature, law, and agriculture? Is a university to confine herself solely to the encouragement of research and to the preparation of ministers, teachers, physicians, engineers, and musicians? Or is it impossible to prepare men for other walks of life without the sacrifice of culture in the interest of practical needs? Surely America gives us a useful lesson as to the unwisdom of driving away such embryo financiers and others elsewhere owing to the lack of attractive and useful courses of study which they could pursue after leaving school. The expenses of administration in our universities increase so enormously from year to year that, unless they are to receive State aid or to decay from sheer stagnation, they must be continually appealing to the public for support. And public interest can only be maintained when the universities are prepared to equip men appropriately for many more different walks in life than they are at present. Such changes, which involve merely the framing of new regulations, cannot fail to be followed by an increase in benefactions, whereby training in languages, archæology, history, and economics may be improved, and the teaching and laboratories be alike brought to the requisite condition of efficiency for establishing a successful school of post-graduate research.

C. S. MYERS.

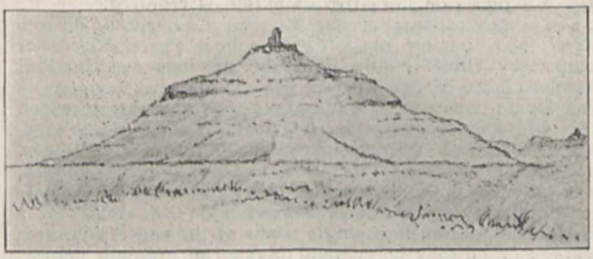
Gonville and Caius College, Cambridge.

An Ancient Lava Plug like that of Mont Pelée.

THE photograph of what is described as "a gigantic plug of solidified lava" in the centre of the new cone of Mont Pelée, which appears in NATURE of October 1 (p. 530),

[1] No mention is here made of the still more specialised second part of the triposes which corresponds in many respects to the training given in the post-graduate schools of the better American universities.

reminds me of similar columns of ancient lava not uncommon among the trap rocks of the Deccan, and I enclose a copy of a sketch I made of one of these in 1839, the re-



markable similarity of which to the column on Mont Pelée seems to be worthy of notice. A second similar column is seen in the distance on the right. RICHARD STRACHEY.

69 Lancaster Gate, W.

"Lessons on Country Life."

IN your issue of September 24 you published a review of "Lessons on Country Life," by Messrs. Buchanan and Gregory, but may I ask, with all deference, if your reviewer has not omitted to read an important part of this useful little book? He refers to Mr. Buchanan's earlier works, "Country Readers," Nos. 1 and 2, as "most excellent books for children," but had he read the *preface* to the "Lessons" he would have found that these were intended, not for children, but for teachers. Your reviewer truly says:—"Country life is a vast subject, so vast that no child can learn during his school life even a fraction of the information it may be desirable he should possess," and the same remark may be equally well applied to teachers. This book travels over much the same ground as "Reader" No. 1, but the matter is differently treated. In one case simplicity of language is aimed at, in the other the information is condensed, with a view, as it appears to me, of leaving it to the discretion of individual teachers to use such lessons, or portions of each lesson, as are most suitable to their own districts.

I do not wish wrongly to attribute ideas to the joint authors, but I fancy their intention is to put before rural teachers (many of whom have had little or no country training) as complete a summary as possible, taking it for granted that they would be able to pick out and study the essential parts.

This series of agricultural Readers and Lessons will, I think, do much to create a love of country life, may even help to counteract the attractions of town life. Rural depopulation is one of the most serious problems of the day, and if these books will assist, in only a small way, to arrest this migration, I feel sure you will not detract from their value by a few words which were probably due to a pardonable oversight.

A. H. H. MATTHEWS, Secretary.

Central Chamber of Agriculture, Broad Sanctuary Chambers, 20 Tothill Street, Westminster, S.W., September 30.

MR. MATTHEWS has hardly grasped the point of our notice—that Messrs. Buchanan and Gregory's book approaches the subject in the wrong spirit. The teacher is provided with a mass of indifferently selected information about farming matters, which he will pass on to his class instead of trying to lead it to observe and reason on its own account. The latter process is more difficult, but it happens to be education. We have of late had only too many occasions to deplore the "rural teachers with little or no country training" who hand out "condensed information" from little books about the country. It is this kind of instruction which offends both farmers and educationists, and if Mr. Matthews imagines it is going to counteract the attractions of town life and arrest rural depopulation, we can only hope that on this occasion he does not represent the opinion of the Central Chamber of Agriculture. THE REVIEWER.

CRATER LAKE IN OREGON.[1]

TWENTY years ago, as Mr. Diller informs us, this picturesque record of a strange episode in volcanic history was unknown to any but the Indians. It is still not very accessible, for it lies in an unfrequented region, deep set in the summit of the Cascade Range, some sixty-five miles north of the California line, but the United States Government, "recognising its worth as an educational feature," has already wisely secured it from the speculator and spoiler by making it a national park. An area of two hundred and fifty square miles is thus protected, of which we find a description in the present memoir. The first part, by Mr. Diller, deals with the geology and physical history of the great volcano, named after a local society Mount Mazama, which was shattered to form Crater Lake, and the second, by Mr. Patton, discusses the petrography of its rocks. It was virtually discovered by Captain Dutton, by whom and by Mr. Diller it has already been noticed; the U.S. Geological Survey has also published a special map, but the story is now completed in this excellently illustrated memoir.

The Cascade Range is largely, if not wholly, built up of volcanic material. In Cretaceous times it had no existence, "there flowed the sea"; this retreated during the Eocene, when vents opened in the Coast Range region, possibly also, though that is not yet quite certain, on the site of the Cascade. Here, however, volcanoes were in full activity during the Miocene, and built up a large part of the Range, where eruptions have continued almost to the present time. Post-Glacial outbursts occurred in some places, but seem to have ceased before history began, though hot springs and fumaroles show that the subterranean hearths are not yet cold. Some of the peaks rise above 10,000 feet, Mount Rainier even attaining 14,525 feet, and the surface of Crater Lake is rather more than 6200 feet above sea-level. It is an oval basin between twenty and twenty-one square miles in area, surrounded by cliffs which range from more than 500 to nearly 2000 feet in height, the ground falling more gradually from their rim to the present upland level. This great sheet of blue water, in places almost 2000 feet deep, is interrupted near its western margin by a pyramidal rocky mass, called Wizard Island, itself evidently a volcanic vent, and a study of the enclosing walls of the great caldera proves them to be built up in the usual way by ash-beds and lava-flows, dipping outwards from its axis, and riven by occasional dykes. The exterior slopes are dotted by parasitic cones, and exhibit occasionally moraines and Glacial striæ; they are also furrowed by valleys, which in some cases run up to and actually notch the edge of the cone, so that they evidently cannot have been formed on Mount Mazama as it now exists. They, like it, have been truncated, and the bowl occupied by Crater Lake has been formed by the destruction of a volcanic cone which must once have risen some six thousand feet above its present rim. Of this there can be no doubt; it is substantiated by numerous facts cited in this memoir, and we have only to study the geological map which it contains to see that the present lava streams are merely remnants of those discharged from sources at a greater elevation and nearer the central axis of the cone.

But the precise mode in which the upper part of the original Mount Mazama was destroyed, and Crater Lake formed among its ruins, is not quite so certain. Two explanations are possible. All the upper part of the mountain may have been hurled in shattered fragments through the air by a series

[1] "The Geology and Petrography of Crater Lake National Park." By Joseph Silas Diller and Horace Bushnell Patton (U.S. Geological Survey). Pp. 168. Plates i–xix. (Washington, 1902.)

of tremendous explosions, like those which truncated Papandayang in Java and shattered Rakata in Krakatoa, or the cone may have collapsed and been engulfed; mother earth, like the fabled Saturn, devouring her own offspring—which has happened on a smaller scale at Kilauea. Mr. Diller, after a discussion of the rival hypotheses, follows Captain Dutton in preferring the latter. Space does not allow of a full discussion of the reasons, but it may be enough to say that the explosive destruction of a great central cone might be expected to have piled up the fragments more or less symmetrically around the margin of the void; but, though much fragmental volcanic material has been scattered over not a few square miles of the surrounding region, this does not exhibit any such arrangement, and its presence may be explained by eruptions posterior to the formation of the caldera, such as that which built up Wizard Island. It must, however, be admitted that such a vast engulfment seems to demand the withdrawal of a corresponding quantity of lava from beneath the cone, and its discharge—as in the Kilauea eruption of 1840—from some distant vent, of which at present no evidence has been found. It is thus possible that each hypothesis is in part correct, for engulfment and explosion may have cooperated in the work of destruction, vast blocks of the ruined cone tumbling inwards to be blown out in shattered fragments and distributed over many miles of country—so that the volcano practically became an automatic muzzle-loader. But that Mount Mazama was not destroyed merely by an explosion like that of a colossal powder magazine, seems to be evident.

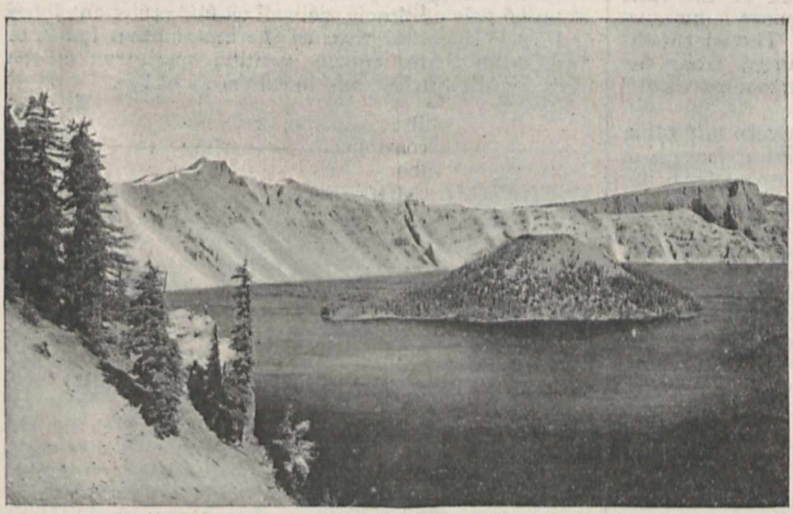


FIG. 1.—Western Border of Crater Lake with Wizard Island.

In the second part of the memoir Mr. Patton gives us a careful petrographical study of the materials of Mount Mazama. They are mostly, as is so usual with the volcanoes of the great mountain chains of the two Americas, andesites, among which the hypersthene-bearing varieties are common, though on the one hand dacites, and on the other basalts, are to be found. Full descriptions of these and their included minerals are given, as well as of certain portions of a rather different mineral character, which Mr. Patton regards as secretions. It is difficult to form an opinion without an actual study of the rock specimens and slices, but we venture to suggest that they may rather be inclusions—that is to say, material which, though it may have been originally separated by some kind of differential action, and might so far be called a secretion, owes its present position to being caught up and carried away by the general mass of molten material. This, however, is a very small criticism. The memoir is a most valuable one, and its printing and illustrations maintain the usual high standard of the publications of the United States Geological Survey.

T. G. BONNEY.

THE BRUSSELS AND TERVUEREN MUSEUMS.

FOR many years past the Royal Brussels Museum of Natural History has presented attractions for the vertebrate palæontologist which can be rivalled by few and excelled by none of the institutions of a similar nature in Europe. But those who have not had an opportunity of seeing the collections recently will scarcely fail to be surprised at the vast increase which has been made in the exhibited series, and at the excellent manner in which the specimens are displayed even in the limited space at present available. A still greater degree of astonishment, and, we may add, of admiration, will be expressed by the visitor when he is shown the new buildings, now nearing completion, designed for the housing of the entire recent and fossil fauna of the country.

When the present writer (some twelve or fifteen years ago) last saw the collection, only a single skeleton of the far-famed Bernissart iguanodons was mounted in the exhibition galleries. Now there are no less than five such skeletons set up in their natural posture, while a sixth is shown lying on a mass of Wealden rock as it was exhumed from the quarry. A more magnificent display than the one presented by the skeletons of these mighty dinosaurs can scarcely be imagined.

Next in importance to the unrivalled iguanodons and associated reptiles from the Bernissart Wealden may probably be ranked the magnificent series of mosasaurian remains which have been obtained in working the phosphatic beds of the Upper Cretaceous strata of the Maastricht district and other parts of the country. In addition to several more or less imperfect skulls and other parts of the skeleton of the typical Mosasaurus, the collection includes remains of several other generic types, some of which, such as Hainosaurus, are peculiar to Belgian territory. Unlike so many European fossil vertebrates of large size, most or all of these generic types are represented by skeletons so nearly perfect as to admit of their being set up like those of recent animals. One of the treasures of the museum is the skeleton of the fore-paddle of a representative of these gigantic marine lizards, this specimen being believed to be the only known example of this part of the mosasaurian skeleton hitherto discovered in Europe. Another noteworthy specimen in this group is the skull of Prognathosaurus, remarkable for the exquisite state of preservation of the bones of the elongated muzzle. The turtles of the Upper Cretaceous, as represented by the well-known *Chelone hoffmanni*, and a still more gigantic unnamed species characterised by the extreme flatness of the carapace, likewise form a large and interesting exhibit.

Much more might be written about the Mesozoic vertebrates, but, from exigencies of space, it must suffice to refer to an imperfect skeleton of *Plesiosaurus homalospondylus,* and another of *Ichthyosaurus platyodon* from the Lias of Luxembourg. The special interest attaching to these specimens is that, unlike the majority of "halosaurians" from the English Lias, the bones are separate, so as to admit of the skeletons being mounted after the fashion of the Oxfordian plesiosaurs in the British Museum.

Turning to Tertiary fossils, the magnificent series of cetacean remains from the Pliocene of Antwerp is too well known to need more than passing reference. Special attention may, however, be directed to the beautifully preserved skulls of long-nosed dolphins (Eurhinodelphis) from the Miocene deposits of the same locality, which have been recently described by Dr. Abel, and are some of the most interesting of all cetacean fossils. Neither is the collection lacking in valuable remains of sirenians, one case containing no less than five more or less imperfect skeletons of a representative of the widely spread Oligocene genus Halitherium, while in a second is displayed the skeleton of the body of an allied Miocene type, for which Monsieur Dollo has proposed the name of Miosiren. Evidently a large and specialised form descended from Halitherium, this genus is characterised by the enormous stoutness and solid structure of the ribs, which are so close together as to simulate a massive carapace in the region of the thorax. The specimens of the rhynchocephalian Champsosaurus, from the Lower Eocene, are likewise unique treasures of the collection.

The collection of remains from the cavern and other Pleistocene deposits forms another striking feature of the museum. Among the mounted specimens are three skeletons of the cave-bear, one of the cave-lion, and three of the woolly rhinoceros. The mammoth skeleton from a superficial deposit is one of the finest in existence out of Russia; while of especial interest is the imperfect skull of a very young individual of the same species, with the earlier milk-molars in position. A skeleton of the much rarer *Elephas antiquus* is likewise noteworthy, first, because the tusks are strongly curved, and, secondly, on account of the peculiar manner in which their tips are worn. This curvature of the tusks suggests that the title of straight-tusked elephant, which has been proposed for this species, is not so diagnostic as it might be. As regards the tips of the tusks, each has been ground into a blunt wedge—a mode of wear never observable in those of either the Indian or African species, and the cause of which is at present inexplicable.

Owing to lack of space, the fossil collections are now mingled with the series of skins and skeletons of recent animals in a manner calculated to confuse the non-scientific visitor, while at the same time the proportions of many of the specimens are not so well displayed as is desirable. All this, however, will soon be remedied, for the magnificent new wing, destined to contain the entire collection of indigenous Belgian animals, is, as already mentioned, fast nearing completion, the whole of the building itself being finished. A notable feature is the entire absence of any architectural decoration in the interior, a feature which might advantageously have been adopted in our own museums. The main hall of this magnificent building is no less than 100 metres in length by 30 in width. The floor is on four different levels, rising in terraces one above the other from the entrance. On the entrance level will be arranged the recent and Quaternary vertebrates (other than fishes); on the first terrace the Tertiary vertebrates, on the second the Upper Cretaceous vertebrate fauna, and on the third and highest the iguanodons and other reptiles of the Wealden. The visitor will thus obtain a *coup-d'oeil* of the whole effect immediately on entering. The iguanodons will be represented by no less than thirteen skeletons, of which nine are to be mounted and erect, while the remainder are to occupy a large tank-like excavation in the floor, in which they are to lie as in their native quarry. In the gallery running round this hall are to be arranged the recent and fossil fish-fauna of Belgium, while the invertebrates are to be housed on the floor above. By an ingenious arrangement of details, space has been found for a numerous series of large and well-lighted work-rooms. Some idea of the lavish scale on which the new building is planned may be gathered from the fact that the space available for the display of the Belgian fauna alone is four times as great as that allotted in the Paris Museum to the fossil vertebrate fauna of the whole world.

Eventually, I am told, it is hoped that a similar wing may be built on the opposite side of the museum for the exhibition of the fauna and products of the Congo Free State. At present the large collection from that territory (which is the private property of King Leopold) is housed at Tervueren, reached by a tram-ride of about fifty minutes from Brussels. In addition to many interesting anthropological and ethnological objects, the collection contains a fine mounted pair of okapis, as well as numerous antelopes and other representatives of the mammalian fauna of the Congo State, not to mention specimens of the birds, reptiles, fishes, and lower forms of life.

R. L.

TECHNICAL EDUCATION AND INDUSTRY.

THE national importance of a close and strong relationship between science and industry is shown by Sir William Ramsay in a letter in Monday's *Times*. Two points upon which emphasis is laid are that numerous scholarships awarded by county councils represent an expenditure of public funds which can do little to promote industrial progress, and that our manufacturers offer few openings for men who have received a sound and scientific education. Technical education, as it is understood in this country, and as most of our technical schools are compelled to understand it if they wish to obtain students, consists of lectures on the rudiments of science, illustrated by practical work of a very elementary kind. It is scarcely necessary to say that the training thus received is of little value to the students or to the community in comparison with the work carried on in the technical high schools of Germany. Sir William Ramsay recently had an opportunity of conversing with the manager of a large chemical works in Germany, which manufactures no product of which it sells less than 100 tons a year, and he directs the attention of our manufacturers to the following facts as to the connection between science and industry in Germany.

The company has seventy chemists, of whom twenty are employed in analysing the raw materials and intermediate and finished products; twenty-five are engaged in superintending the processes of manufacture; and the remaining twenty-five are exclusively employed in scientific work—*i.e.* in endeavouring to improve the present processes of manufacture, and in trying new suggestions, either their own, or those brought to the notice of the firm by patentees. Almost all these chemists have been trained in universities, but a few come from technical high schools or Polytechnika. It is common for the best of such men to receive a "call" to a chair in a university or a Polytechnikum, and it is also usual for a company to offer a lucrative post to one who already holds a chair, even though he may have had no technical experience, and in this way a close bond has been established between science and industry to the enormous advantage of both.

A large part of the duties of the director consists in attending congresses and in every way keeping abreast of the most recent discovery, with the object, of course, of gaining information which may be turned to practical utility.

While in Germany there is thus a fairly lucrative career for a young chemist, in England, although there will soon be many well-trained men, the openings are few. Such as there are are filled by men whose minds are occupied with too many things. The chemist is often analyst, works-manager, and investigator all at once; and it is no wonder that he is not a success, and that manufacturers doubt his utility in their business. Moreover, it is very desirable that a closer touch between universities or university colleges and manufactures should be brought about, if possible, for it cannot fail to be to the advantage of both industry and science—to industry, in order that technical problems may receive scientific treatment, and to science, because some of the most interesting problems are often suggested by the technologist.

Now, we are producing trained engineers and chemists quite as inventive and capable as our German competitors. But the prospect of a reasonably remunerative career is generally wanting. It would obviously be to the advantage of manufacturers to engage such young men, not expecting them, of course, to be able at first to introduce improvements which will effect a saving; but by looking out for young men with some originality, by giving them time to learn their business, and by offering an ultimate inducement in the shape of a share of profits, our manufacturers will undoubtedly reap the benefits which have given our German competitors their lead in industries in which chemistry plays a part.

NOTES.

AT the Institution of Civil Engineers on Tuesday, November 3, an inaugural address will be given by the president, Sir William H. White, K.C.B., F.R.S.; the medals and other awards made by the council will be presented, and there will be a reception in the library of the Institution.

MR. MARCONI arrived at Liverpool on board the *Lucania* last Saturday. The results of his experiments are said to have been very satisfactory; whilst in mid-Atlantic he was able to receive simultaneously communications from England and America. It is also stated that he hopes within six or eight months to re-establish commercial communication across the Atlantic.

THE trials of the high-speed electric cars on the Berlin-Zossen military line have been continued with much success. A maximum speed of 125½ miles an hour was attained by the Siemens-Halske car last week; the average speed over the whole run of 14 miles, including the time of starting and stopping, was 109¼ miles an hour. The trials of the rival car, which the Allgemeine Elektricitäts Gesellschaft is building, have yet to be made. The track has been relaid since the experimental runs last year, and it is stated that it is now thoroughly satisfactory. The result of the trials is looked upon as demonstrating the practicability of high speed working over long distances, and it is estimated that it will be possible to reduce the time taken over the journey from Berlin to Cologne from nine to three and a quarter hours.

THE secretary of the Institution of Electrical Engineers informs us that the bronze shield subscribed for by the students of the Institution at the beginning of the present year has now been placed upon the tomb of Volta at Camnago, near Como. The ceremony of fixing it in place was performed on Sunday, October 4, with many expressions of international good feeling, in the presence of Prof. Count Alessandro Volta, Cav. Franchi, the Sindaco of Camnago, with several members of the Volta family and a number of other guests. The shield is mounted on a slab of green marble supported on granite in front of the tomb. The electrotype reproduction, which was officially deposited on the tomb on the occasion of the visit of the Institution in April last, has been transferred to the Civic Museum in Como, where it is placed in the collection of Volta relics.

DR. W. A. NOYES, of the Rose Polytechnic Institute, has accepted the position of chemist in the United States National Bureau of Standards.

DR. B. A. WHITELEGGE, C.B., His Majesty's Chief Inspector of Factories, has been appointed president of the Epidemiological Society in succession to the late Dr. W. H. Corfield.

AN International Fine Art and Horticultural Exhibition is to be opened at Düsseldorf on May 1, 1904. A hope is expressed that England will contribute largely to this exhibition.

REUTER reports that Prof. Langley's aërodrome, for which the U.S. Government granted a subvention of 15,000*l*., was launched on October 7 from the railway over the flat boat on Whitewater, a section of the Potomac River. The machine balanced perfectly when it started, but soon struck the water, with the result that it was wrecked. Previous experiments have been made with models only, and this trial was the first made with the full-sized airship, which is constructed to carry a passenger.

THE Home Counties Nature-Study Exhibition, which is being organised by the Middlesex Field Club and Nature-Study Society, and delegates from the Selborne Society, will be held from October 30 to November 3 at the offices of the Civil Service Commission, Burlington Gardens, London, W. Intending exhibitors should communicate with the honorary secretary, Mr. Wilfred Mark Webb, 20 Hanover Square, London, W., who will be pleased to supply full information.

WE learn from *Science* that the American Grape Acid Association, 318 Front Street, San Francisco, Cal., offers a premium of 5000*l*. for any person who devises a process or formula for the utilisation of California grapes containing more than 20 per cent. of saccharin, worth 2*l*. a ton, to produce tartaric acid at a price that would permit of exportation without loss. The decision in awarding the amount is to rest with a jury of five, of which Prof. E. W. Hilgard, of the University of California, is one. The offer closes on December 1, 1904.

THE first meeting of the Manchester Astronomical Society—a new local association of persons interested in astronomy and observational work—was held on Wednesday, October 7, when an address on solar parallax was given by the president, Prof. T. Gore. The Society has its centre and home in the Municipal School of Technology, Manchester, and members have the privilege of using the telescopes and other instruments in the new Godlee Observatory.

THE death is announced of Mr. Henry M. Brunel, the second son of I. K. Brunel, the engineer. Mr. Henry Brunel entered into partnership with Sir John Wolfe Barry in the 'seventies of last century, and took active interest in the scientific researches bearing upon naval architecture carried on by the late Mr. William Froude, F.R.S. He was largely associated in the work of Barry Dock, the railway bridge over the Thames at Blackfriars, the bridge erected at Connel Ferry, and with the Tower Bridge. He was a member of the Institution of Civil Engineers and of the Institute of Naval Architects.

AN excessive downpour of rain is reported from New York on October 8–9, amounting to more than ten inches in thirty hours. This is said to be the greatest fall at that place since the Weather Bureau was established there, in 1867, and has caused great damage to property. The streets resembled rivers, and in some parts the water rose waist-deep. The train service between New York and Philadelphia was temporarily suspended; the Delaware River rose to the highest level ever known, and several bridges have collapsed. Since 1889, the U.S. Weather Bureau has published tables of excessive rainfall from self-recording gauges. We have referred to these, and find that, although such excessive falls do occur from time to time, they are of rare occurrence. During the years 1889–1896, for instance, the highest record was 9·86 inches in twenty-four hours, at Jacksonsville (Florida), in September, 1894.

WE have received the report of the director of the Philippine Weather Bureau, 1902, part iii., containing very clearly printed hourly observations of atmospheric phenomena at the Manila Central Observatory, with hourly and monthly means. The extreme daily values of each of the elements are brought together in a separate table. This is one of the few observatories at which observations of ozone are taken. Parts iv. and v. still remain to be published, and will contain magnetic observations and the results for the secondary stations of the Archipelago. The complete series will form a valuable contribution to the climatology of the Far East.

WE have received the report of the Hong Kong Observatory for the year 1902, containing hourly readings of the different meteorological elements, together with some magnetic and astronomical observations. The weather forecasts issued during the year have been very satisfactory; 56 per cent. were completely successful, and 35 per cent. partially successful. According to the practice usually followed in dealing with the results, 91 per cent. of the forecasts may be therefore considered as more or less successful. The collection of observations at sea for the construction of trustworthy monthly pilot charts has been vigorously continued; the number of days' observations obtained during the year was 9073, while the total number of sets now collected amounts to nearly 261,000. The area dealt with lies between 9° S. and 45° N. latitude, and between the longitude of Singapore and 180° east.

M. K. OLSZEWSKI describes in the Cracow *Bulletin* a new apparatus for the liquefaction of hydrogen, differing from his previous models in having both regenerators and the intermediate cooler for receiving liquid air all placed in a common vacuum chamber. The apparatus is said to work faultlessly.

THE formation of "Liesegang's rings" by the precipitation of silver chromate in gelatin forms the subject of a paper by Messrs. H. W. Morse and G. W. Pierce in the *Proceedings* of the American Academy. The formation of the precipitate in rings is clearly a case of supersaturation, and the authors now obtain a definite constant value for the product of the concentrations of the silver and chromate ions in order that supersaturation may take place.

SEVERAL papers on the so-called N rays discovered by M. Blondlot are printed in the *Journal de Physique* for August. M. Blondlot shows that these rays are of common occurrence, being emitted by an Auer lamp and an incandescent silver lamina, and being present in sunlight. M. G. Sagnac describes determinations of the wave-length of these rays by means of their diffraction. It appears that the rays in question are about two octaves below the Rubens infra-red rays, and intermediate between these and the Hertzian radiations of Lampa. Their wave-length is about 0·2 of a millimetre.

SEVERAL writers have raised difficulties in connection with Boltzmann's minimum theorem in the kinetic theory of gases on the ground of the reversibility of the motions of the individual gas-molecules. Some remarks on this point are contributed by Dr. A. Pannekoek to the *Proceedings* of the Amsterdam Academy. For the case considered the author finds that when in a purely mechanical reversible process, which is repeated a number of times, a small variation in the initial data causes a large variation in the final state, the total process assumes the properties of an irreversible process.

SOME observations made in the Arosa Valley on atmospheric electricity at high altitudes are described by Mr. W. Saake in the *Physikalische Zeitschrift*, 23. The most noteworthy results were the observation of a negative fall of potential on certain clear and cloudless winter days, the facts that the coefficient of electric dispersion of electricity was increased by the Föhn and that under normal conditions the coefficient of negative dispersion attained a maximum at about 8 a.m. and between 4 and 5 p.m., and the large capacity of the atmosphere for radio-active emanation, which was about three times as great as in Wolfenbüttel.

THE Hopkins-Stanford Expedition to the Galapagos Islands in 1898–99 turns out to have been remarkably successful in the matter of new species of marine fishes from that area. According to a paper by Messrs. Heller and Snodgrass, published in the *Proceedings* of the Washington Academy (vol. v. pp. 189–229), the number of novelties is twenty-three, of which no less than five are regarded as indicating new generic types. Most of the species are figured in the plates accompanying the memoir, and we may particularly direct attention to the excellent effect produced by the sepia-like printing of plates 8 and 9.

IN the October issue of *Bird Notes and News*, attention is directed to the power now possessed by county councils of extending protection during winter to birds of any kind, and the value of this to many resident species. The introduction last July into Parliament of a Bill to abolish the pole-trap is likewise the subject of a commendatory note. A letter from Colonel Irby, which appeared in the *Saturday Review* of July 18, on the subject of taking rare birds and their eggs for so-called scientific purposes is reproduced. In this communication the writer directs attention to the shooting of a pair of pratincoles last spring near Romney, and likewise to the taking of a nest of the blue-headed wagtail near Winchelsea.

THE *Century Magazine* for October contains an account by Mr. L. O. Howard of the recent investigations which have served to connect the propagation of yellow fever with a certain species of mosquito (*Culex aeniatus*). A map (after Mr. Theobald) is given of the distribution of this mosquito, which coincides exactly with that of yellow fever. To protect oneself from the malaria mosquito, it is only necessary to use gauze curtains at night; the yellow fever mosquito, on the other hand, is a diurnal species, so that escape from its stab is a matter of much greater difficulty. In a well-illustrated article in the same journal entitled "The Wild Bird by a New Approach," Mr. F. H. Herrick comments on the revival of interest in nature generally, and natural history in particular, which has taken place of late years in the United States. Birds have been specially favoured in this respect, and the author directs attention to the amount of information with regard to their habits obtainable by the new method of photography at short distances, to which allusion has been previously made in these columns.

WE have received a copy of the eighth report on the periodic variations of glaciers, by Dr. S. Finsterwalder and E. Muret (*Arch. des Sc. phys. et nat., Genève*).

WE have received from the Queensland Department of Mines, Geological Survey Reports, Nos. 181 and 183, by Mr. Walter E. Cameron. The author deals with recent mining developments on the Ravenswood Gold Field, where rather more than 2 oz. 7 dwt. of gold per ton has been raised during the past three years. He also gives further particulars relating to coal, and gold, silver, and copper ores in the Mackay and Bowen districts.

PROF. W. M. DAVIS has sent us copies of two recent essays on earth sculpture (*Bull.* Mus. Comp. Zool., Harvard Coll., vol. xlii.). One deals with the plateau province of Utah and Arizona. Evidence is given to show that the greater part of the faulting had been accomplished before the uplift of the region by which the erosion of the Colorado canyon was initiated, but some modern faulting of large amount has taken place. The other essay is on the mountain ranges of the Great Basin, in which the author deals with the effects of erosion on faulted mountain-blocks.

THE surface geology of Cheshire in its relation to agriculture is dealt with by Mr. William Edwards (*Proc.* Liverpool Geol. Soc., vol. ix. part iii.). He refers to the Drift soils, but more especially to those derived from Triassic rocks. The Keuper Marls yield some of the best soils, owing to their mineral ingredients, to their physical properties, and in part to their colour. The author observes that most of our best soils have a deep red colour, and probably the value of this colour depends upon its power to absorb the heat rays of the sun.

THE general report of the work carried on by the Geological Survey of India for the year 1902–1903 has been drawn up by the new director, Mr. T. H. Holland. Economic inquiries have been made with regard to coal, chromite, fire-clay, gold, iron, manganese, lead, petroleum, &c. Field-work was carried out in seven districts. In the report on the Punjab area, reference is made to evidence brought forward by Dr. Noetling, that in the Salt Range the sedimentary series from Cambrian to Tertiary has been thrust bodily in a southerly direction over the salt-marl, and that the marl is not pre-Cambrian, but simply belongs to the Tertiary salt-bearing formation, like that represented at Kohat.

WE have received from Messrs. Darbishire and Stanford, of the Oxford Geographical Institute, Oxford, specimens of a new series of outline maps which they are issuing under the title of the "Autograph Handmaps," at the price of one penny each. The feature of the series is that, besides showing the coast lines and the principal rivers, the chief hill features of the country are indicated by a very expressive scheme of shading, which renders the pictorial value of the maps, and therefore their value in elementary teaching, decidedly greater than is the case where contour lines are employed. The execution is somewhat unequal, but generally good; the maps of the British Isles, Scotland, and Ireland are the best. We note that in most cases the name of the projection on which the map is drawn, the natural scale, and scales of miles and kilometres, are given. The maps are printed in a dull brown colour, so that additional matter introduced by teacher or pupil stands clearly out. The maps are a valuable addition to the equipment available for teaching geography, and as such should be heartily welcomed.

IN the Cracow *Bulletin*, Mr. Ed. Janczewski proposes a new classification of the species belonging to the genus Ribes. The author distinguishes six subgenera, four of which (Ribesia, Berisia, Grossularioides, and Grossularia) are characterised by scarious scales, while in the other two (Calobotrya and Coreosma) the scales are herbaceous.

THE early cell divisions in the germinating spore of the liverwort Pellia form the subject of a paper by Mr. C. J. Chamberlain in the *Botanical Gazette*. As Prof. Farmer originally showed, interest attaches to the nuclear divisions at this stage owing to the appearance of a centrosphere and radiations. Mr. Chamberlain holds the opinion that the radiations represent lines of streaming material.

IT is known that the red and blue colours of many flowers and fruits are due to the pigment anthocyanin, which occurs in the cell sap. Mr. T. Ischimura has examined its formation in hydrangea flowers, and describes the results in the *Journal* of the College of Science, Tokio. In conformity with the reactions obtained the author concludes that anthocyanin is a tannin, or a tannin derivative, and shows that besides tannin, light, and generally sunlight, is necessary for its formation.

IN the report for the year 1902–3, the director of the Botanical Survey of India announces the retirement of Mr. J. F. Duthie, who held the post of director of the Botanical Department of Northern India. The investigations of the various kinds of Indian yams are being continued, and cultivations of fibre plants are being undertaken in order to determine the sources of the fibres classed as Indian hemp. Mr. C. A. Barber refers to a disease known as "spike" which is destroying the sandal wood plantations of Mysore and Coorg, and also reports the appearance of a species of fungus on cholam leaves, similar to one which is very destructive to the sugar cane.

A USEFUL little book on "Hardy Perennials," by Mr. D. S. Fish, has been published in the Rural Handbook Series by Messrs. Dawbarn and Ward, Ltd. Amateur gardeners will find in the book practical hints on the selection, arrangement, and cultivation of many hardy garden flowers.

MESSRS. ROSS, LTD., have issued recently an abridged catalogue for 1903, and a new edition of their "C" catalogue. Both lists are beautifully illustrated with reproductions of photographs taken with Ross, Ross-Zeiss, and Ross-Goerz lenses, and contain full information of photographic and other optical apparatus.

WE have received a second edition of the discourses by Dr. Stephan Waetzoldt bearing the title "Die Jugendsprache Goethe's" and "Goethe und die Romantik," the first edition of which was printed in 1888. An addition has now been made in the form of a third discourse dealing with the ballads of Goethe and their origin.

ALL photographers will find something of value and interest in the first number of the *Practical Photographer*—that for October. Not only is photography regarded from its scientific side by chemists and others, but the artistic aspects of the photographer's work are dealt with in a helpful manner by experienced writers. The magazine is admirably illustrated by a profusion of well executed plates, and is published by Messrs. Hodder and Stoughton.

MESSRS. F. E. BECKER AND CO., of Hatton Wall, London, are manufacturing cheap electric switchboards for use in physical laboratories supplied with continuous current, designed by Mr. William Bennett, of the Gravesend Technical School. It is claimed that by this method it is impossible for students to short circuit the mains, as only one wire is carried round the room. A switch block is provided in each working place, and all students have the same current, but any student can switch the current on or off without interrupting others. The boards are supplied with resistances, instruments for measuring current, and other necessary adjuncts.

WE have received the thirty-sixth volume, that for 1902, of the *Journal and Proceedings* of the Royal Society of New South Wales. The original papers contained in the first part of the volume are seventeen in number, and many of them are illustrated by plates, of which there are no less than twenty-one. The volume concludes with the annual address delivered to the engineering section of the Society, and two papers also read to the same section. As abstracts of the papers read before the Society are periodically published in NATURE, it only remains to be said that the scientific work of the Society, as represented by the contents of the volume before us, does honour to the colony of New South Wales.

THE additions to the Zoological Society's Gardens during the past week include two Black Lemurs (*Lemur macaco*) from Madagascar, presented by Mr. Walter Barnes; a South African Hornbill (*Bucorvus cafer*) from South Africa, presented by Mr. W. Champion; two Larger Patagonian Conures (*Cyanolyseus byroni*) from Chili, presented by Mr. E. C. Davids; two Grey-winged Ouzels (*Merula boulboul*) from India, an Adelaide Parrakeet (*Platycercus adelaidae*) from Australia, three Derbian Sternotheres (*Sternothaerus derbianus*) from West Africa, two Adorned Terrapins (*Chrysemys ornata*) from Central America, four Brazilian Tortoises (*Testudo tabulata*), four Orbicular Horned Lizards (*Phrynosoma orbiculare*) from Brazil, deposited.

OUR ASTRONOMICAL COLUMN.

REPORTED DISCOVERY OF A NOVA.—A telegram received from the Kiel Centralstelle on October 5 announced that Prof. Wolf had discovered what was probably a new star on the evening of September 21. He found the position of the object, reduced to the equinox of 1903, to be R.A. = 20h. 14m. 6·8s., Dec. = $+37° 9' 49''$, and reported that its spectrum was of the nebular type.

A further communication received from Kiel announces, however, that a telegram received from Prof. Pickering states that the object is not a Nova, but a variable having a spectrum of the fourth type, whilst another telegram from Prof. Hale announces that Barnard has identified the supposed Nova with the star B.D. + 37°.3876 (R.A. = 20h. 14m. 6.8s., Dec. = $+37° 9' 47''$), and found the colour to be "very red." Dr. Parkhurst determined the magnitude of the variable on October 5, and found it to be 10·6.

1903–4 EPHEMERIS FOR WINNECKE'S PERIODICAL COMET.—The elements and ephemeris of Winnecke's comet for its appearance during 1903–4 have been calculated by Herr C. Hillebrand, of Graz, and are published in No. 3907 of the *Astronomische Nachrichten*. The elements and part of the ephemeris are given below:—

Epoch = 1904 *Jan.* 24·0 (M.T. *Berlin*).

$$M = 0° \ 28' \ 1''{\cdot}61$$

$$\left.\begin{aligned} \pi &= 274 \ 19 \ 45{\cdot}40 \\ \Omega &= 104 \ 12 \ 36{\cdot}44 \\ i &= 16 \ 59 \ 54{\cdot}78 \end{aligned}\right\} 1903{\cdot}0 \qquad \begin{aligned} \phi &= 45° \ 38' \ 0''{\cdot}12 \\ \mu &= 608''{\cdot}801706 \\ \text{Perihelion} &= 1904 \text{ Jan } 21{\cdot}24 \end{aligned}$$

Ephemeris 0h. (*M.T. Berlin*).

1903	α app. h. m. s.	δ app. ° ′ ″	log *r*	log Δ
Nov. 1	13 35 54·28	+1 11 47·0	0·166981	0·374761
,, 3	13 41 49·41	+0 35 3·6		
,, 5	13 47 50·73	−0 2 5·9	0·155366	0·366226
,, 7	13 53 58·38	−0 39 40·7		
,, 9	14 0 12·47	−1 17 39·6	0·143512	0·357652
,, 11	14 6 33·07	−1 56 2·0		
,, 13	14 13 0·47	−2 34 46·1	0·131432	0·349133
,, 15	14 19 34·92	−3 13 50·8		
,, 17	14 26 16·54	−3 53 13·8	0·119153	0·340701
,, 19	14 33 5·45	−4 32 53·3		
,, 21	14 40 1·91	−5 12 46·9	0·106706	0·332417
,, 23	14 47 6·18	−5 52 52·6		
,, 25	14 54 18·36	−6 33 7·1	0·094136	0·324344
,, 27	15 1 38·61	−7 13 27·7		
,, 29	15 9 7·05	−7 53 50·7	0·081493	0·316550

DIAMETER OF NEPTUNE.—Herr C. W. Wirtz, Strassburg, publishes the results of a series of measurements of the diameter of Neptune, made by him during the period December, 1902–March, 1903, in No. 3907 of the *Astronomische Nachrichten*. As the mean result of forty-nine measurements, made on twenty-six evenings, he obtained $2''{\cdot}303$ with a possible error of $\pm 0''{\cdot}044$ for the value of the diameter.

Taking the value of the solar parallax as $8''{\cdot}80$, and Bessell's dimensions for the earth, this gives the actual diameter of Neptune as 50,251 km. and the mean density of the planet as 1·54, the density of the earth being taken as 5·53.

THE OPPOSITION OF EROS IN 1905.—In No. 73 of the Harvard College Observatory *Circulars* Prof. Pickering publishes an ephemeris for Eros during the opposition of 1905.

This ephemeris gives the Julian Day, the date, the R.A. (1900) and Dec. (1900), the logarithms of the distances from the sun and earth respectively, and the computed magnitude for every tenth day from November 21, 1903, to December 20, 1905; it has been obtained by interpolation from an ephemeris, for intervals of forty days, computed by Mr. F. E. Seagrave from the elements published in the *Berliner Jahrbuch* for 1905.

As seen from the ephemeris, the opposition of Eros during 1905 will be one of the most unfavourable oppositions that can possibly occur, for the computed magnitudes never exceed the twelfth. Prof. Pickering recommends that observations of the light variations, both photographic and visual, should be made during the opposition, although Prof. Bailey, working with the 13-inch Boyden telescope at Arequipa during the present year, has obtained an excellent set of light-curves of this planet. In general the position of the planet in the sky, during the 1905 opposition, will be nearly opposite to that which it occupied during the spring of 1901, when its variability was discovered.

THE ROYAL UNIVERSITY OBSERVATORY, VIENNA.—The sixteenth annual volume of the Vienna Observatory *Publications* contains the details of the "zone observations" for the zone −6° to −10°, made in accordance with the programme of the Astronomische Gesellschaft for its star catalogue, and collected by Dr. Johann Palisa. The observations were made with the 11¾-inch Clark refractor, and the tables give the position for 1875·0, together with the usual reductions.

The same instrument was also used by Herr J. Rheden for observing the opposition of Mars during the period December 21, 1898–March 16, 1899, and the results of these observations, including eight excellent coloured reproductions of Herr Rheden's drawings, form the second part of the publication.

The third and last section is devoted to the meteorological observations made during the years 1897, 1898, 1899 and 1900.

THE BRITISH ASSOCIATION.

SECTION L.

EDUCATIONAL SCIENCE.

OPENING ADDRESS BY SIR WILLIAM DE W. ABNEY, K.C.B., D.C.L., D.Sc., F.R.S., PRESIDENT OF THE SECTION.

THE Section over which I have the honour to preside deals with every branch of education. It is manifest that in an Address your President cannot deal with all of them, and it remained for me to choose one on which I might remark with advantage. As my official work during the last thirty-three years has been connected with education in science, I think I cannot do better than take as my subject the action that the State has taken in encouraging this form of education, and to show that through such action there has been a development of scientific instruction amongst the artisan population and in secondary day schools. The development may not indeed have been to the extent hoped for, but it yet remains that solid progress has been made.

I have chosen the subject deliberately, as I find that there are very few of those who have the interests of education strongly at heart, or who freely criticise those who have borne the burden of the past, that have any knowledge of the trials and difficulties (some of its own creating, but others forced on it by public opinion) which the State, as represented by the now defunct Science and Art Department, had to contend with in its unceasing missionary efforts in the cause of scientific instruction. I shall not attempt to do more than show that whatever its defect may have been in tact, whatever its shortcomings in method, that Department still deserved well of the country for the work that it did in regard to the fostering of scientific instruction in the country at large.

As far back as 1852 the Government of the day, influenced very largely by the Prince Consort, realised that it had an educational duty to perform to the industrial classes. Whether it was influenced by philanthropic motives or from the evidence before it that if Great Britain was to maintain its commercial and industrial supremacy scientific instruction was a necessity, it matters little. The fact remains that it determined that the industrial classes should have an opportunity of acquiring that particular kind of knowledge which would be of service to them as craftsmen. In this year 1852 the Speech from the Throne contained these words: "The advancement of Fine Arts and of Practical Science will be readily recognised by you as worthy of a great and enlightened nation. I have directed that a comprehensive scheme shall be laid before you, having in view the promotion of those objects towards which I invite your aid and co-operation."

It is somewhat remarkable that the then Ministry, of which Lord Derby was the chief and Mr. Disraeli the Chancellor of the Exchequer, did not survive to promulgate the scheme, which proposed theoretical rather than practical science, but that their successors, under Lord Aberdeen, issued it and commenced to carry it into effect. In 1853 the Department of Science and Art was established under the direction of Mr. Cole. Since 1835 so-called Schools of Design had been in being. These came under the new Department, and it was determined to establish science classes for instruction in science, Dr. Lyon Playfair, the well-known chemist, being charged with the duty. Playfair resigned in 1858, and in 1859 Mr. Cole induced a young Engineer officer, Lieut. Donnelly, to undertake the inspection and organisation of science instruction throughout the country. It was through this officer's untiring energy and zeal that the classes in science flourished and were added to at this early stage of the new Department's history. The same energy was displayed by Donnelly during the whole of his long career in the service of the State, and I feel that it was fortunate for myself to have served so many years as I did under one to whom the country at large owes a deep debt of gratitude.

Not long ago he passed away from us, and there will be no more lasting memorial to him than that which he himself erected during his lifetime in the fostering of that form of education which is of such vital importance to the national well-being.

To revert to history, I may record that the first science examinations conducted by the State took place in May, 1861, and, the system of grants being made on the results of examination having been authorised, the magnificent sum of 130*l*. was spent on this occasion on the instruction of 650 candidates, that number having been examined. Thus early was the system of examination commenced in the Department's career, and the method of payments on the results of these examinations stereotyped for many years to come. There is reason to believe that the educational experts of that day considered that both were essential and of educational value, a value which has since been seriously discounted. Employers of labour in this country were not too quick in discerning the advantages that must ultimately ensue from this class of education if properly carried out and encouraged. Theoretically they gave encouragement, but practically very little, and this survives to some extent even to the present day. Some of the foremost employers, however, gave material encouragement to the formation of classes, insisting on their employees attending evening instruction; but conspicuous above all was Mr. Whitworth, who, in 1868, placed in the hands of the Department the sum of 100,000*l*., to be devoted to the creation of scholarships, which were to be awarded at the annual May examinations. The proviso made by him was that all competitors were to have had experience in practical work in an engineering establishment. Such candidates, it was evident, must have found out their own weakness in education, and, by working in science classes, could make up their deficiencies, and the award of these scholarships would enable them to study further. Sir J. Whitworth was far-seeing and almost lived before his age, but the benefits that he has conferred, not only on individuals, but on science and industries, by his generosity will make his name to be remembered for generations to come. To have been a Whitworth scholar gives an *entrée* into various Government and engineering posts, and we have in the front rank of science men who have held these scholarships and whose names stand prominent in the development of engineering.

Incidentally, I may say that no country but this, for very many years, considered that instruction in science for the artisan was a large factor in maintaining and developing industry. The educational interests of the employer and the foreman were, in some countries, well provided for, but the mechanic was merely a hand, and a "hand" trained in merely practical work he was to remain. He could not aspire to rise beyond. We may congratulate ourselves that such a "caste" system does not exist amongst ourselves.

For the first twenty-five years of the Department of Science and Art the grants given by Parliament for science instruction were distributed almost entirely amongst those who were officially supposed to belong to the industrial classes, and no encouragement was offered to any higher class in the social scale.

It would take me too long to show that at first the industrial classes were very shy of seizing on the advantages offered them. Suffice it to say that they had to be bribed by the offer of prizes and certificates of success to attend instruction, and it was not for several years that the evening classes got acclimatised and became popular.

The evening instruction was then largely attended by adults. That this was the case may be judged by the fact that the average age of candidates who obtained successes in advanced chemistry was about twenty-five and in elementary chemistry about twenty-one. I have alluded to the apathy displayed by employers and by the artisans in the early days of the Department of Science and Art. The causes which dispelled it in both employers and employed, in regard to science instruction, will be found in the following extract from a report by the Department of Science and Art:—

"The Paris Exhibition (1867) caused the work of this country to be brought into close comparison with that of the rest of the Continent, and in many points both of manufacture and of skilled labour it was found England did not stand in such a good position as she had done a few years back. Dr. Playfair, in a letter to the *Times*, drew attention to this, attributing much if not all the evil to the deficiency of our technical education among the artisan class. The substance of this letter was taken up by many persons of influence during the autumnal recess, and it led to a sort of educational panic, the cry for technical education becoming quite the absorbing topic among all circles and forming a considerable portion of the contents of all periodicals. Meetings were convened and addresses delivered all over the country, and the question was so much ventilated that important changes were anticipated in the educational arrangements of the country during the coming session of Parliament, which unfortunately were put off on account of the debates on the Reform Bill of 1868.

"The agitation necessarily brought forward the work of the Science Division of the Science and Art Department, and it is not a little remarkable how completely the system which had been growing up since 1860 seemed to meet all the requirements of the case, and at the same time how few persons had any idea of its provisions in spite of all that had been done to spread a knowledge of the scheme.

"There can be no doubt, however, but that this six years' work had silently, though materially, effected a change in the general tone of feeling on the subject of scientific education, and had been the means of preparing the country for the 1867 agitation. The different feeling among the working-classes on the subject is forcibly shown in the Annual Report of the Science and Art Department. From this it appears that in 1860 a pupil in one of the science classes in Manchester, a town usually looked upon as in advance of others, could hardly continue his attendance at the class owing to the taunts of, and ill-treatment by his companions. Nevertheless, in the autumn of this year, 1867, hardly enough could be said or done to satisfy the desire for science classes being formed for those very persons who, but six years before, had considered attendance at a Government science school as almost against the rules of their trade."

Such was the account of 1867 given by Mr. G. C. T. Bartley (now Sir G. Bartley, M.P.). The plan adopted by the Science and Art Department for encouraging instruction in science was perhaps the best that could be devised at the time, though we now know that it was capable of improvement. It may be mentioned that an improvement in it was made the next year by the introduction of a very large system of scholarships, scholarships which have enabled the possessors in some instances to continue their studies at universities, and several distinguished men owe their positions to this aid. It was in this same year that Mr. Whitworth established his scholarships, as before described.

I have endeavoured to give a brief *résumé* of what was done during the first fifteen years of the existence of the Science and Art Department, and it continued to expand its operations after 1868 on the same lines for another ten years. In 1876 your President became connected with the Department as a Science Inspector. I am sure the Section will forgive me if I am somewhat personal for a few moments. During the previous eight years I had had the honour of being a teacher of some branches of physical science at the School of Military Engineering, and my own training was such that I had formed a very definite opinion as to how science instruction should be imparted, both to those who had a good general education and also to those who had not. The method was the same in both cases: it should be taught practically. I may say that though I had not myself had the advantage of being taught it at school, I had learned all the science I knew practically, and I entered the Department fully impressed with this view. Whenever possible I have until the present time endeavoured to impress this view on all who were interested in the work of the Department. Much of the science that was taught in State-supported classes was largely book work and cram, and the theoretical instruction as a rule was unillustrated by experiment. This was undoubtedly due to the system of payments being based on success at the examinations. I must here say that there were honourable exceptions to this procedure. There were teachers, then as now, who knew the subjects they taught, and who were inspired by a genuine love of their calling. I can in my mind's eye recall many such, some of whom have joined the majority and others who are still at work and as successful now as then in rousing the enthusiasm of their students.

I am not one of those who think, as some do, that cramming is entirely pernicious. A good deal of what used to be taught at public schools in my days was cram. It served its purpose at the time in sharpening the memory, and was a useful exercise, and it did not much matter if in after years much of it was forgotten. If the cramming is in science, a few facts called back to mind in after life are better than never having had the chance at all. In fact, as the faded beauty replied to the born plain friend, it is better to be one of the "have beens" than a "never wasn't."

It was determined to make a vigorous onslaught against teaching that was unillustrated by experiment and to encourage practical teaching as far as could be done. Proper apparatus for illustrating lectures was insisted upon, and, with aid from the Department, was eventually provided, though in some instances several years' pressure had to be exercised before it was obtained. I am bound to say that in many instances after it had been procured a surprise visit by the inspector during the hours of instruction often found that the lecture table was free from all encumbrance, and that the dust of weeks was upon the apparatus that should have been in use. This was sometimes due to the inability of the teacher to use the apparatus rather than to a wish to disregard the rules laid down by the Department; but usually it was due to the fact that the teacher found cram paid best. I should like to say here that this state of things does not exist at the present time, and that the training of science teachers by the Royal College of Science and by other institutions has completely broken down the excuses that were often offered at that time.

The first grants for practical teaching were paid for chemistry. The practical work had to be carried out in properly fitted laboratories. There were not half-a-dozen at the time which really answered our purpose, and one of the earliest pieces of work on which I was engaged was in assisting to get out plans for laboratory fittings. These were very similar to those which I had designed for the School of Military Engineering several years before. Thanks to the Education Act of 1870 (I speak thankfully of the work that some of the important School Boards have done in the past in taking an enlightened view of science instruction) there were some localities where the idea of fitting up laboratories was received with favour, and it was not long before several old ones were refitted, in which instruction to adults was given, and new ones established in Board Schools for the benefit of the Sixth Standard children. At that time an inspector's, like the policeman's, lot was not a happy one. We had to refuse to pass laboratories which did not fulfil conditions, though we left very few "hard cases."

Until after the passing of the Technical Instruction Act in 1887 the Department aided schools in the purchase of the fittings of laboratories (both chemical and others), and year after year this help, which stimulated local effort, caused large numbers of new laboratories to be added to the recognised list. After six or seven years we had a hundred or more laboratories at work of what I may call "sealed-pattern efficiency." I am not very partial to sealed patterns, but they are useful at times, for they tell people what is the least that is expected from them. The pattern was not without its defects; but laboratories, like other matters, follow the law of evolution, and the more recently fitted ones show that the experience gained whilst teaching or being taught in a sealed-pattern type has led to marked improvements. Personally I am of opinion that only necessaries should be required, and I rebel against luxuries; for a student trained by means of the latter will, as a rule, in after life fail to meet with anything beyond the mere essentials for carrying on his scientific work.

The sealed pattern is practically in abeyance, though it can be trotted out as a bogey, and any properly equipped laboratory is recognised so long as it meets the absolute necessities of instruction.

The half-dozen chemical laboratories which existed in 1877 have now expanded to 349 physical and 774 chemical laboratories. These are spread over all parts of England. I leave out Scotland and Ireland, as the science teaching is no longer under the English Board of Education.

It is only fair to say that many of this large number of laboratories are at present in secondary schools, regarding which I shall have to speak more at length. But the fact remains that in twenty-seven years there has been such a growth of practical science teaching that some 1120 laboratories have come into being. My predecessor in the Chair likes to call laboratories "workshops." I have no objection, but the reverse; for the word "laboratory," like "research," sounds too magnificent for what is really meant, and all education should more or less be carried out in workshops.

The increase is as satisfactory as it is remarkable. It was only possible to increase the numbers in early days by gentle pressure and prophesying smooth things which, happily, did eventually come to pass. In later days the increase has been almost automatic. The Technical Instruction Act has called into being technical instruction committees who in many cases have taken up science instruction in their districts in earnest. They, too, have had public money to allocate, and not a little has gone in the encouragement of practical education. It may, however, be remarked that had it not been for the preliminary work that had been done by the Science and Art Department it is more than probable that the Technical Instruction Act of 1887 would never have seen the light.

A reference must now be made to the removal of what anyone will see was a great bar to the spread of sound instruction in every class of school where science was taught. So long as the student's success in examination was the test which regulated the amount of the grant paid by the State, so long was it impossible to insist on all-round practical instruction. It was impracticable to hold practical examinations for tens of thousands of students in some twenty different subjects of science. The practical examination in chemistry told its tale of difficulties. It was only when the Duke of Devonshire and Sir John Gorst in 1898 substituted for the old scheme of payments payment for attendance, and in a large measure substituted inspection for examination, that the Department could still further press for practical instruction. For all elementary instruction the test of outside examination does more harm than good, and any examination in the work done by elementary students should be carried out by the teacher, and should be made on the absolute course that has been given. It seems to be useless or worse that an examination should cover more than this. Instruction in a set syllabus which for an outside examination has to be covered spoils the teaching and takes away the liberty of method which a good teacher should enjoy. The literary work involved of answering questions, for an outside examiner, is also against the elementary student's success, and cannot be equal to that which may properly be expected from him a couple of years later.

Advanced instruction appears to be on a different footing. The student in advanced science must have gradually obtained a knowledge of the elementary portions of the subject, and it is not too much to ask him beyond the inspection of his work to express himself in decent English and to submit to examination from the outside; but even here the payment for such instruction should be by an attendance grant tempered in some degree by the results of examination, since examiners are not always to be trusted.

The attendance grant was not viewed by some with great favour at first, and protests were received against its adoption, a favourite complaint being that it was sure to entail a loss of grant. One became suspicious that some of those who protested were aware that the last bulwark which defended the earning of grants by cram was being removed, and that inspection might prove more irksome than examination. This is past history now, and the new system works as smoothly as the old and with not more complaints than are to be always expected.

As I have said, grants were for very many years supposed to be confined to aiding the instruction of the industrial classes, but this limitation was more nominal than real. It might probably be imagined that it was no very difficult task to distinguish an artisan and his children from students who belonged to the middle classes. This was not the case, however. Children belonging to the industrial class were, on joining a science class, obliged to state the occupation of the father, and it was no uncommon thing for fathers to be given brevet-rank by their children. Thus, a bricklayer's son would describe his father as a "builder," which, if true, ought to have brought him into the ranks of the middle class. These unauthorised promotions were one of the difficulties the inspector had to face when judging as to the status of the parents. This difficulty was largely met by a rule that all those who attended evening classes were supposed to be of the industrial class; but as day classes increased the numbers of those who by no possibility could be of the artisan class also increased, and it became a very invidious duty of the inspector to put M.C. (Middle Class) against the names of many. It was determined by superior authority that only those students or their parents who could claim exemption from income-tax should be reckoned as coming within the category of industrial students. In early days the qualification for abatement on income-tax was a much lower figure than it is to-day, and almost each succeeding Chancellor of the Exchequer has raised the figure of the income on which the abatement could be claimed. To-day it is, I believe, 700*l.* a year, bringing the official definition as to membership of the industrial classes to an absurdity. It became evident to the official mind, which some people are good enough to say works but slowly, that the definition must be amended or the limitation abolished. The progress of events happily made the abolition the better plan, and was the means of allowing inroads of science instruction to be made into secondary day schools.

The history of these inroads I shall now give. Instruction given in so-called organised science schools was originally aided by the Department by means of a small Capitation Grant. These schools were supposed to give an organised course of science instruction, and the successes at examination determined the payment. They were not satisfactory as at first constituted, and they so dwindled away in numbers that in 1890 only some one or two were left. A small increase in Capitation Grant in 1892 revived some of them, and a fair number existed in the following year. There was no doubt, however, that the conditions under which they existed were most unfavourable for a sound education, which ought not only to include science but also literary instruction. The latter was, in many schools, wholly neglected, owing to the fact that the grants earned depended on the results of examination, and so all the school time was devoted to grant earning.

Mr. Acland, at this time Minister for Education, was made aware of this neglect to give a good general education, and as I was at that time responsible for science instruction I was directed to draw up a scheme for reorganising these schools and forcing a general as well as scientific education to be carried out. Baldly the scheme abolished almost entirely[1] payments on results of examination, and the rate of grant depended on inspection and attendance. Further, a certain minimum number of hours had to be given to literary subjects, and another minimum to science instruction, a great deal of it being practical and having to be carried out in the "workshop." The payments for science instruction were to be withheld unless the inspector was satisfied that the literary part of the education was given satisfactorily.

The scheme was accepted and promulgated whilst the Royal Commission on Secondary Education was sitting, and, if I may be allowed to say so, Mr. Acland's tenure of office would be long remembered for this innovation alone, since in it he took a wide departure from the traditional methods of the Department and created a class of secondary school which differed totally from those then existing. Needless to say the scheme was not received with favour on all sides, more especially by those who thought that serious damage would be done to secondary schools by the competition from this new development of secondary education. I am not ashamed to say that the disfavour shown on some sides made me rejoice, as it indicated that a move had been made in the right direction. At first it was principally the higher-grade Board Schools that came under the scheme, and in the first year there were twenty-four of them at work. This type of school gradually increased until about seventy of them, and chiefly of a most efficient character, were recognised in 1900. Their further increase was only arrested by the Cockerton judgment, now so well known that I need only name it. But here we come to a most interesting development. State aid, as already said, was at first limited to the instruction of the industrial classes, but no limitation as to the status of the pupil was made in this new scheme for the schools of science, and logically this freedom was extended in 1897 to all instruction aided by the Department—the date when all limitation

1 Within the next four years they will entirely cease.

as to the status of the pupil was abolished, the only limitation being the status of the school itself. Thus, if a flourishing public school, charging high fees for tuition, were to apply to participate in the grant voted by Parliament, it may be presumed, it would have to be refused. The abolition of the restriction as to the status of the pupils left it open to poorly endowed secondary grammar schools to come under the new scheme. To a good many the additional income to be derived from the grant meant continuing their existence as efficient, and for this reason, and often, I fear, for this reason alone, some claimed recognition as eligible.

Such is an outline history of the invasion of science instruction into certain secondary schools—an invasion which ought to be of great national service. In my view no general education is complete without a knowledge of those simple truths of science which speak to everyone, but usually pass unheeded day by day. The expansion of the reasoning and observational powers of every child is as material to sound education as is the exercise of the memory or the acquisition of some smattering of a language. I am not going into the question of curricula in schools, as I hope, regarding them, we shall have a full discussion. But of this I am sure, that no curriculum will be adequate which does not include practical instruction in the elementary truths of science. The President of the Royal Society, in his last Annual Address, alluded to the mediæval education that was being given in a vast number of secondary schools. Those who planned the system of education of those times deserve infinite credit for including all that it was possible to include. Had there been a development of science in those days, one must believe that with the far-seeing wisdom they then displayed they would have included that which it is the desire of all modern educationists to include. Observational and experimental science would have assuredly found a place in the system.

One, however, cannot help being struck by the broadening of views in regard to modern education that has taken place in the minds of many who were certainly not friendly to its development. Perhaps in the Bishop of Hereford, when headmaster of Clifton, we have the most remarkable early example of breadth of view, which he carried out in a practical manner, surrounding himself with many of the ablest teachers of science of the day. There are other headmasters who, though trained on the classical side, have had the prescience to follow in his footsteps, and of free will; but others there are who have neither the desire nor the intention, if not compelled to do so, to move in the direction which modern necessities indicate is essential for national progress. I am inclined to think that the movement in favour of modernising education has been very largely quickened by the establishment of schools of science in connection with endowed schools and the desire for their foundation by the Technical Instruction Committees, who had the whisky money at their disposal, and who often more than supplemented the parliamentary grants which these schools were able to earn. It was the circumstance that the new scheme was issued when many endowed schools were in low water that made it as successful as it has been.

The number of schools of science increased so rapidly that it appeared there might be a danger of too many of this type being started on sufficient educational grounds. Science instruction was carried in them to such an advanced point and so many hours of the week were spent on it that they became in some degree specialised schools. At least eight hours a week had to be devoted to science, ten to literary instruction, and five to mathematics—any further time available could be spent on any section that was considered desirable. For some pupils the time devoted to science is barely enough, but for others who intend to follow careers in which the literary section should predominate it appeared that some curtailment of hours in the science section might be usefully allowed, and it became a question how far such instruction might be shortened without impairing its soundness. After much anxious thought it was considered that four hours per week, besides mathematics, was the very least time that ought to be devoted to such instruction, and that the latter part of it should be practical work. A scheme embodying this modification was approved by the Lord President and the Vice-President whilst I was Principal Assistant Secretary for Secondary Education, and smaller grants than those for schools of science were authorised in 1901 for those schools which were prepared to adopt it. By the scheme instruction has to be given only in such subjects and to such an extent as is really necessary to form part of that general education of ordinary students who might not have to follow in industrial pursuits. This modified and shortened course has met with unqualified success. Some 127 schools came under the scheme the first year, and I gather that there will be a considerable increase in numbers in the future. The establishment of schools of science and of these schools may be considered to be a great step taken in getting practical instruction in natural knowledge introduced into secondary schools. The leaven has been placed in some 300 of them, and we may expect that all schools which may be eligible for State aid will gradually adopt one scheme or the other. Though it is said that there is nothing in a name, I am a little doubtful as to whether the earmarking of science education as distinct from secondary education is not somewhat of a mistake at the present day. For my own part, I should like to think that the days have passed when such an earmarking was necessary or advisable. The science to be taught in secondary schools should be part and parcel of the secondary education, and it would be just as proper to talk of Latin and Greek instruction apart from secondary education as it is to talk of science instruction. One of the causes of the unpopularity of the Science and Art Department was its too distinctive name. At the same time it would be most unwise at the present time, when the new Education Committees are learning their work and looking to the central authority for a lead, for the State to alter the conditions on which it makes its grants to these schools. It will require at least a generation to pass before modernised education will be free from assault. If science instruction is not safeguarded for some time to come it runs a good chance of disappearing or being neglected in a good many schools. As to the schools which have no financial difficulties, it is hard to say what lines they may follow. Tradition may be too strong in them to allow any material change in their courses of study. If it be true that the modern side of many a public school is made a refuge for the "incapables," and is considered inferior to the classical side, as some say is the case, such a side is practically useless in representing modern education in its proper light. Again, one at least of the ancient universities has not shown much sympathy with modern ideas, and so long as she is content to receive her students ignorant of all else but what has been called mediæval lore, so long will the schools which feed her have no great inclination to change their educational schemes.

If we would only make the universities set the fashion the public schools would be bound to follow. The universities say that it is for the public schools to say what they want, and *vice versâ*, and so neither one nor the other change. It appears to me that we must look to the modern universities to lead the movement in favour of that kind of education which is best fitted for the after life of the large majority of the people of this country. If for no other reason, we must for this one hail the creation of two more universities where the localities will be able to impress on the authorities their needs. The large majority of those whose views I share in this matter are not opposed to or distrust the good effects of those parts of education which date from ancient times. The great men who have come under their sway are living proofs that they can be effective now as they have been in times past, but we look to the production of greater men by the removal of the limitations which tradition sets. I myself gratefully acknowledge what the public school at which I had my early education did for me, but I think my gratitude would be more intense had I been given some small elementary instruction in that natural knowledge which has had to be picked up here and there in after life.

There is one type of college which I have not alluded to before, and that is the technical institutes. These have been fostered by the localities in which they are situated, and been largely supported by the whisky money, supplemented by Government aid. I am glad to see that in the last regulations of the Board of Education these colleges will receive grants for higher scientific instruction, and I have no doubt that in the near future such institutions and schools of science will receive a block grant, which will give them even still greater freedom than they now enjoy. These are colleges to which students from secondary schools will gradually find their way, where they wish for higher education of a type different from that to be gained at a university.

I have endeavoured to give a brief historical sketch of what the State has done in helping forward instruction in natural knowledge amongst the industrial classes, adults and children, and how gradually its financial aid has been extended to secondary schools. I have also endeavoured to indicate the steps by which practical instruction has been fostered by it. I have done this because I am confident that ninety-nine educationists out of every hundred have but little idea what the State has been doing for the last fifty years. Some connected with secondary schools—I have personal knowledge—were until lately ignorant that the State had offered advantages to them of a financial nature. I may say that the work of the late Science and Art Department was largely a missionary work. It was abused, sometimes rightly but more often wrongly, for this very work, and it had more abusers at one time probably than any other Government Department. Even friends to the movement of modernising education found fault with it as antiquated and slow, but I can assure you that no greater mistake can be made in pressing forward any movement by any hurried change of front or by endeavouring to push forward matters too rapidly. In the first place, the Treasury naturally views untried changes with suspicion, and this fact has to be dealt with more particularly when there is no great expression of public opinion to reckon with. At the same time it cannot be stated too strongly that the Treasury has in recent years dealt in a friendly and enlightened spirit with all matters which could affect the spread of science. Again, there is a hostility to great and rapid changes in the minds of those whom such changes affect.

The policy must always be to progress as much as is possible without rousing too great an opposition from any quarter, and I think it will be seen that the progress made during the last twenty-five years has, by the various annual increments, been perhaps more than could have been hoped for, and gives a promise for even more rapid advances in the future.

As an appendix to this Address I have given a brief epitome of the increases in students, in schools, in laboratories, and in grants which have taken place since 1861. If to the last be added the amount spent out of the whisky money an additional half million may be reckoned.

It will be seen that the progress made has been gradual, but satisfactory, and that, if we showed some of the results graphically, weighted according to the circumstances of their date, and dared make an extrapolation curve of future results, we should have a complete justification for prophesying hopefully.

The question of the supply of science teachers has already been referred to. My remarks I should like to supplement by saying that in the greater number of schools teachers are to be found who have been trained at the Royal College of Science, and mostly at public expense—some through scholarships gained by competition and some through training selected teachers. The success of the movement for the introduction of science instruction in schools depended on the proper supply of teachers, and even now the demand for men possessing the highest teaching qualifications in science is greater than the supply. It may be said, I think, that our science teachers from the college have one special qualification, and that is, that besides the knowledge of science, practical and theoretical, that they have acquired they have lived in an atmosphere of what is called research, and which might be called original investigation. Professors, assistants, and students alike are impregnated with it, and when the teacher so trained takes up his duties in his school he still retains the "reek" of it. True instruction in science should, as I have before said, be practical, and practical instruction should certainly include original inquiry into matters old or new. The teacher who retains the "reek" is the teacher who will prove most successful. It will thus be seen that the State had the task before it, not only of introducing instruction in science, but of training teachers to give such instruction. This problem is the same as now exists in Ireland, and the experience gained in England cannot but be of the greatest use to those at the head of Irish technical education.

Before concluding there is one subject that I must lightly touch upon, and that is the supply of teachers other than science teachers. The Education Act of 1870 gave the power to elementary schools to train pupil teachers, who in the process of time would become teachers, either by entering into a training college by means of a King's Scholarship or, less satisfactorily, by examination. In large towns the need of a proper training for pupil teachers has been felt, and gradually pupil teacher centres were established, principally by School Boards, where the training could be carried out more or less completely; but in the rural districts and smaller towns the pupil teacher has had to be more or less self-taught, and except in rare cases "self-taught" means badly taught. The Training College authorities make no secret of the fact that one of the two years during which the training of the teacher is carried out has to be devoted more or less to instructing the pupils in subjects they ought to have been taught before they entered the college. Thus all the essential and special instruction which is given has to be practically shortened, and the teacher leaves the college with less training than he should have.

The new Education Act has put it in the power of the educational authorities to rectify the defects in the training of pupil teachers. It is much to be hoped that Councils will separately or in combination either form special centres for the training of all pupil teachers or else give scholarships (perhaps aided by the State) to them, to be held at some secondary school receiving the grant for science and recognised by the Board of Education as efficient. The latter plan is one which commends itself, as it ensures that the student shall associate with others who are not preparing for the same calling in life, and will prevent that narrowness of mind which is inevitable where years are spent in the one atmosphere of pedagogy. The non-residential training college, where the training of the teacher is carried on at some university college, is an attempt to give breadth of view to him, but if attempted in the earliest years of a teacher's career it will be even more successful. All teaching requires to be improved, and the first step to take in this direction is to educate the pupil teacher from his earliest day's appointment, for his influence in after years will not only be felt in that elementary, but will also penetrate into secondary education. In regard to the additions which are required in elementary education, and which require the proper training of the pupil teacher, I must refer you to a report which will be presented to the Section. The task of training pupil teachers is one which requires the earnest and undivided thought of the new Education Committees.

In the earnest Address given by my predecessor in this Chair he brought forward the shortcomings of secondary education and of the requirements for a military career in a trenchant manner and with an ability which I cannot emulate. With much of what he said I agree heartily, but I cannot forget that, after all, the details of education are to some extent matters of opinion, though the main features are not. We must be content to see advances made in the directions on which the majority of men and women educational experts are agreed. Great strides have already been made in educating the public both in methods and subjects, but a good deal more remains to be done.

It may be expected, for instance, that the registration of teachers will lead to increased efficiency in secondary schools, and that the would-be teacher, fresh from college, will not get his training by practising on the unfortunate children he may be told off to teach. It may also be expected that such increased efficiency will have to be vouched for by the thorough inspection which is now made under the Board of Education Act, by the Board, by a university, or by some such recognised body. It again may be expected that parents will gradually waken up to the meaning of the teacher's register and the value of inspection, and that those schools will flourish best which can show that they too appreciate the advantages of each.

I have to crave pardon for having failed to give an Address which is in any way sensational. I have thought it better to review what has been done in the past within my own knowledge, and with this in my mind I cannot but prophesy that the future is more than hopeful, now that the public is beginning to be educated in education. It will demand, and its wants will be supplied.

APPENDIX.

Number of Schools of Science and their Grants.

Year	Higher Grade Schools	Endowed Secondary Schools	Technical Institutes	Total Schools	Total Grants
					£
1895	53	30	29	112	39,163
1898	69	50	49	168	98,849
1901	63	106	43	212	118,833
1903	50	119	57	226	Not yet known[1]

Number of Schools teaching Shortened Course of Science.

Year	No.
1902	127
1903	184

Number of Laboratories recognised.

Year	Chemistry	Metallurgy	Physics	Biology	Mechanics
1880	133	—	—	—	—
1900	669	37	219	17	4
1901	722	37	291	26	10
1902	758	39	320	34	14

Grants paid for Science Instruction.

Year	Amount	Year	Amount
	£		£
1860	709	1890	103,453
1870	20,118	1895	142,543
1875	42,474	1901	212,982
1880	40,229	1902	240,822
1885	63,364		

[1] In 1902 124,300*l.* was paid.

THE GERMAN ASSOCIATION AT CASSEL.

THE seventy-fifth meeting of the German Association for the Advancement of Science and Medicine took place in brilliant weather in the picturesque town of Cassel. By Saturday evening, September 19, members and associates began to arrive, and on Sunday a large number of gaily coloured "rosettes" were visible in the streets. Advantage was taken of this gathering of men of science to present to Prof. Graebe, of Geneva, an address on the completion of the twenty-fifth year of occupancy of his chair of chemistry, and M. Moissan, of Paris, on behalf of the Chemical Society, conveyed to him the Lavoisier medal of the Institute of France. Prof. Graebe, who, in conjunction with Prof. Liebermann, of Berlin, achieved the first important chemical synthesis—that of artificial alizarine—was an old assistant of Prof. v. Baeyer, of Munich, who then occupied the chair of chemistry in the Gewerbe Akademie in Berlin. Prof. v. Baeyer, in his opening address, directed special attention to the cooperation of men of science with technologists, which was the fruit of this important synthesis—a cooperation which has had enormous influence on the development both of German science and industry. The rector of the University of Geneva followed, and he mentioned that, during the twenty-five years of Prof. Graebe's tenure of the chair, he had published 196 memoirs on chemical subjects, while more than 400 papers were published by workers in his laboratory. Prof. Moissan, who, as delegate of the Académie des Sciences, handed to Prof. Graebe the Lavoisier medal, referred in an eloquent speech to the great influence which Graebe's work has had in developing synthetical organic chemistry, and after the presentation of addresses from the Royal Academy of Sciences of Bavaria, from the German Chemical Society, from the Societies of Geneva and Frankfort, and from the University of Lausanne, Prof. Graebe received from the chairman a gold plaque, engraved with his portrait, and from M. Amé Pictet, on behalf of his old students, a bound copy of his own papers. Dr. Brunck, on behalf of the "Badische" Chemical Company, of which he is managing director, added a tribute to Graebe from the point of view of technology, and in an eloquent reply Prof. Graebe expressed his gratitude and thanks. About sixty of the audience remained to a dinner given in honour of Prof. Graebe, at which numerous toasts were drunk, and the proceedings were kept up until a late hour.

The members and associates met for the first time on Sunday evening, September 20, in the grounds of the Hessian Brewery, where a large hall had been adapted for the purpose of the general meetings, and on Monday morning, after words of welcome from Prof. Hornstein, of Cassel, the local secretary, from President von Trott zu Solz, from the mayor and others, the president of the Association, Prof. van 't Hoff, returned thanks in the name of the Association. An address was then delivered by Prof. Ladenburg on the influence of science on our views of life. The address treated of the gradual development of scientific knowledge and its opposition by the church; the necessity of education in the phenomena and laws of nature, and the insignificant position of man among natural phenomena; the doctrine of the immortality of the soul and the dicta of science on the subject. He contended that Christianity alone had been unable to induce mankind to accept the doctrine of liberty, equality, and fraternity, and that this doctrine, indispensable for our future progress, must be the future object of scientific endeavour. The general opinion of the audience appeared to be that Prof. Ladenburg's address was unnecessary, and that he had assumed for science an infallibility similar to that claimed by the Apostolic See. The second address, by Prof. Ziehen, of Utrecht, treated of impressions and sensations, and their connection with the surface of the brain. Sensations may be termed positive or negative, according as they produce pleasant or unpleasant emotions, and their intensity depends less on the degree of excitability of the regions of the brain affected than on the capacity for "discharge" or communication with other regions. "Negative" sensations are more numerous than positive; the lecturer attempted to prove this by the fact that, in German, words denoting unpleasant are more numerous than those which denote pleasant sensations. But up to now it had been impossible to bridge the gap between the mechanism of the brain and the sensations and perceptions.

In the afternoon the sections met, and in the evening the opera of "Tannhäuser" was well performed in the theatre. September 21 was devoted to sectional meetings, and in the evening the members and associates dined together in the "Festhalle," and many toasts were proposed. On the morning of the next day addresses were delivered by Prof. Penck, of Vienna, on geological time; by Prof. Schwalbe, of Strassburg, on the early history of man; and by Dr. Alsberg, of Cassel, on inherited degeneration as a consequence of social influences. On the morning of September 24 the medical side of the congress was represented by Dr. Allan Macfadyen, who gave an address on intercellular toxines; by Dr. Paul Jensen, on the physiological action of light; and by Dr. Rieder, on the curative results obtained by treatment with light.

Later in the morning, in order to open a discussion on the place of mechanics in our views of nature, papers were read by Dr. Schwarzschild, of Göttingen, on astronomical mechanics, by Prof. Sommerfeld on technical mechanics, and by Prof. Otto Fischer on physiological mechanics. Dr. Schwarzschild began by stating that Newton's law of gravitational attraction still remains the leading factor in astronomy, and every observation only serves as a confirmation of its correctness. It has been proved to be correct to two parts in one hundred millions. The chief aim of astronomical mechanics is to represent exactly the actual path of the planets. But the classical "Mechanics of the Heavens" fails, if it is applied to very long periods of time. The formulæ which are applied would, if extended, point to a destruction of the planetary system. There are, however, two reasons for believing that such a conclusion would be incorrect. The problem of "secular disturbances" was solved by Lagrange, and that of "commensurabilities" has made great progress during the last thirty years. Under the last head may be grouped periodic and asymptotic paths, the problem of the gaps in the asteroids and the ring of Saturn, and the theory of the libration of the moons of Jupiter and Saturn. When these are carefully considered, they appear to point to the stability of the planetary system for all time. This conclusion is, indeed, rendered less general by Poincaré's proof of the divergence of series in the theory of disturbances, but it can nevertheless be shown that, during a long period of time, for which it is possible to give a lower limit, changes in the planetary system are unimportant. The problems which still face the astronomer who undertakes similar investigations were exemplified by Lexell's comet and Darwin's periodic paths.

Prof. Sommerfeld, in indicating the direction in which mechanics comes into technical use, spoke of the confirmation of experimental principles and the greater use of theory. He gave an account of the teaching of mechanics in the universities and Polytechnika of Germany, entering somewhat into detail as regards the order of presentment of various conceptions. Dr. Otto Fischer discussed the necessity of determining the dimensions, the mass, the centre of gravity, and the moment of inertia of various portions of the living body, and the effects of external and internal forces in altering these properties.

On the morning of September 25 Sir William Ramsay lectured on the periodic system of the elements, Prof. Griesbach on school hygiene, and Prof. von Behring on the fight against tuberculosis. Ramsay spoke of the various attempts which have been made to ascertain whether mass and inertia, on the one hand, are invariable, or, on the other, whether the atomic weights show signs of variation. On the whole, the evidence is negative. He then described the spontaneous change of the emanation from radium bromide into helium, and concluded with some speculations as to the possible formation and decomposition of what are at present regarded as elementary bodies. The subject of school hygiene, though a very important one, has little scientific interest, but the lecture of von Behring was listened to with the greatest attention. Prof. von Behring has a large estate at Marburg where experiments on tuberculosis are carried out on animals. For example, he has rendered it very probable that vaccination of cows with the tuberculosis antitoxin renders their milk immune, and that the milk, in its turn, may render human beings immune. He believes to have shown that infants acquire tuberculosis through milk, and that even before birth the skin of infants is penetrable by the tubercular bacillus. If such infants are nourished on the milk of cows which have been injected with tubercular bacillus, the milk contains an antitoxin, and the tendency towards tuberculosis is obviated. He advocated the view that adults seldom acquire tuberculous diseases unless they are early predisposed to receive them by infection as infants. But this tendency can be combated by feeding infants with milk from cows which, through vaccination with tubercular matter, have developed the suitable antitoxin.

Prof. van 't Hoff, the president of the Association, then concluded by giving a short account of the most important papers which had been communicated to the sections, after which he thanked the town of Cassel, in the name of the Society, for its hospitable reception.

The German "Naturforscherversammlung," unlike the British Association, includes many sections which treat of medical subjects. Only those lectures which are of general interest are delivered before the Association as a whole. The proceedings of the medical sections will doubtless find their way into the medical journals, and only the proceedings of scientific interest will be treated of here. Through the courtesy of the president and of Prof. Rassow, of Leipzig, abstracts of the more noteworthy of the papers in each section were furnished to the writer.

Of the mathematical section, it was merely stated that in all five meetings were held, in which twenty-eight papers were read, three being of some length. It would appear that mathematicians are too modest to thrust their views on the scientific brethren, or perhaps they doubt if they would be understood.

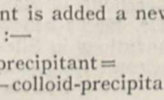
The most noteworthy papers in the physical section were, first, a confirmation by Prof. Rubens of Maxwell's theory by experiments on the optics of metals—their refractivity, and behaviour to electric currents; and, second, a paper by Prof. Nernst, in which he described and showed his iridium apparatus, by means of which a temperature of 2000° C. has been attained, and determinations of vapour density carried out. Nernst's "furnace" consists of an iridium tube about 10 inches long and 1½ inches diameter. By means of a powerful current which passes through the walls of the tube the temperature can be raised to any desired degree, short of the melting point of iridium. A small "bulb" of iridium, similar to that used for Victor Meyer's density apparatus, hangs inside the tube, and attains the temperature of the iridium tube. Nernst's balance, by means of which a couple of milligrams of substance can be correctly weighed to within a half per cent., consists of a glass fibre suspended by a quartz fibre at right angles to it; from one end hangs a small iridium capsule counterpoised by a small weight; the other end of the glass fibre projects over a mirror-scale; the balance acts partly by torsion of the quartz fibre, partly like a steelyard. The density of vapours of "non-volatile" substances is determined exactly as with a Victor Meyer apparatus, and while that of sulphur was found to correspond to S_1, that of phosphorus gave negative results in an atmosphere of nitrogen, due, no doubt, to the formation of a compound of phosphorus with nitrogen, stable only at a high temperature. Nernst also described his method of measuring high temperatures by noting the intensity of the radiation from the interior of the tube.

In the section of applied mathematics, Dr. Otto Thilo spoke of the necessity of a knowledge of mechanics for the investigator. By help of preparations and models he demonstrated the relation of sinews to bones, especially those which confine the motion to one plane, the mechanism for getting over the "dead-point," and those for restraint, so that muscular power is saved, for example, when a man is standing erect. He further went on to demonstrate the mechanism by which the pressure of air in the swimming-bladder of fishes is communicated to the brain. His contention was that even biologists must be instructed in mechanics if they wish to study the movements of living organisms.

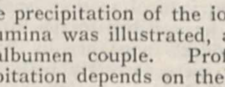
In the chemical section, Prof. Biltz spoke about the precipitation of colloids by salts. He advanced the theory that a colloidal solution consists of a colloid suspended in an electrolyte; when a precipitant is added a new form of combination occurs, for instance:—

Electrolyte − colloid + colloid-precipitant = colloid − colloid-precipitant + electrolyte.

The precipitation of the iodine-starch substance by means of alumina was illustrated, and also of the meta-phosphoric acid-albumen couple. Prof. Ostwald suggested that the precipitation depends on the relative velocity of the two reactions, and that that reaction which takes place most rapidly gives rise to the formation of stable substances. Prof. Wedekind showed isomeric organic ammonium salts containing radicals of high molecular weight, and Prof. Ladenburg also read a paper on asymmetric nitrogen. Prof. Wallach mentioned a new instance of optical isomerism, in which, if the molecular weight of the substituting group is low, no isomerism is noticeable, but if high, isomerism exists. For example, the compound



gives us isomerides (the benzene nucleus is here seen in perspective), while the similar compounds



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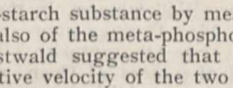

are isomeric.

Prof. Nernst read a paper on the theory of ozone formation. The potential difference between the system O_3, O_2|electrolyte|O_2 is 0·57 volt, and this corresponds with the heat of formation of ozone, for the couple has practically no temperature-coefficient. He calculated that if oxygen is heated to 6400° it should contain 10 per cent. of ozone, at 3230° 1 per cent., and at 2183° 0·1 per cent. In the sun the oxygen must be wholly in the state of ozone, owing to the high temperature and the enormous gravitational pressure. Prof. Abegg spoke of two cases of heterogeneous equilibrium, and other papers treated of the ring formula for benzene, the use of the spectroscope in the determination of atomic weight (Runge), fluorescence and chemical constitution (Richard Meyer), &c.

In the section of applied chemistry, Prof. König spoke of the determination of fibre, cellulose, and lignin in plants, and of the decomposition of fodder by microbes, and Dr. Marquart, of Cassel, gave an account of Dr. Schenck's red-phosphorus. This variety is produced at a comparatively low temperature—about 180°—by heating a solution of yellow phosphorus in phosphorous bromide. It is precipitated out of the solution, and must be filtered off and washed with carbon disulphide to free it from yellow phosphorus. Its point of inflammation is that of ordinary red phosphorus, but it is in a state of such fine division as to be readily set on fire by rubbing if it be mixed with potassium chlorate; at the same time it gives off no fumes, and is therefore harmless to operatives who dip matches. The light red powder is soluble in caustic soda (for it probably contains an atom of replaceable hydrogen), and is reprecipitated by acids. Dr. Marquart spoke especially of the future of this substance in the manufacture of matches which ignite when rubbed on any surface, and which, at the same time, are without danger to workpeople.

In the section of geophysics, Dr. Mansing exhibited an apparatus for determining the ebb and flow, and also the direction and velocity, of currents, and likewise the pressure in deep water. The apparatus is electrically connected with a ship, and registers for thirty days. The advantage over apparatus which registers only in shallow water is obvious. Dr Nippolt read a paper on terrestrial magnetic variations, citing observations made partly by himself, but mainly by others. The curves which he obtained point to changes which occur simultaneously at different spots of the earth's surface; he interprets such changes as significative of changes in the internal nucleus of the earth, and of displacements of the relative positions of the earth's crust and the magma which he believes to exist in the interior. Prof. Krebs treated of subaqueous volcanic regions, and suggested that they may be points of connection between the sea-water and the earth's internal magma; he advocated that their position and nature deserve careful investigation on account of danger to passing ships. In another paper Dr. Krebs believed he had found an explanation of the inundations in Silesian Austria, in certain long areas of low barometric pressure from which regions of low pressure in Silesian Galicia can be deduced.

Dr. Wolkenhauer, in the geographical section, spoke of the oldest German maps, which he ascribed to the fifteenth and sixteenth centuries. The oldest maps are by Erhard Etzlaub; those of Cuza, which were formerly believed to have been published in 1491, appear to be as late as 1530. The attendance in this section was very small, owing to the meeting this year of geographers at Cologne.

In the botanical section the most important papers were by Prof. Kohl, who offered a proof that the central bodies of the Cyanophyceæ cells possess the properties of cell nuclei, and he expressed the belief that in the closely allied Schizomycetæ a similar proof could be found. Numerous experiments on Mycorrhizen, an account of which was given by Prof. Möller, proved that the existence of fungi on the roots of plants must be regarded as a case of parasitic existence, but not of symbiosis. Prof. Drude, who has made numerous experiments in the botanic garden at Dresden, contended that mutation cannot be sharply distinguished from variation, as De Vries believes, but that the difference is only one of degree. To prove his contention, he exhibited living specimens of *Oenothera Lamarckiana*, grown from seed which De Vries had given him.

In the zoological section only one meeting was held, at which lectures were delivered by Prof. Klunziger, Dr. Thilo, Dr. Eysell, and Dr. Basse. They were illustrated by demonstrations, but appear not to have contained any specially new matter.

The anthropological section excited a good deal of interest. Among the more important papers was one by Prof. Hagen, in which he demonstrated that the eight months' fœtus of the Malay and Melanesian races differed from the European fœtus by the shortness of the body compared with the limbs, and the greater diameter of the body in the region of the false ribs, &c. The Melanesian fœtus showed peculiarities from which he deduced the conclusion that the genus man became differentiated from other mammals at a very early period of history. On the other hand, Prof. Schwalbe, from investigation of the frontal sutures of apes and their comparison with those of man, contended that there is a close relationship to be observed between man and old-world apes. Prof. Gojanovic-Kramberger had examined human remains recently discovered in Croatia—the so-called *Homo crapinensis*—and concluded from his researches that in the Ice age two races were alive; the differences in the form of the jaws and teeth, the shape of the collar-bone, the upper arm and parts of the skull, were adduced as proof of his view. One of these races, he believed, showed analogy with the owner of the Neanderthal skull and the skeleton from the grotto of the Spy, so far as the morphological relationship could be traced.

One of the sections dealt with the teaching of mathematics and science in schools, and there Prof. Grimsell demonstrated the use of new apparatus designed to illustrate terrestrial magnetism and the mechanical equivalent of heat, and he showed a lantern which gave good images with an ordinary incandescent gas flame. Prof. Schotten gave a lecture which was largely attended, and at which much discussion took place on the suitability of zoology as a school subject. While most of the speakers agreed on its being easily taught and useful, doubt was expressed whether it was wise to add another subject to the already heavy load which a German boy is expected to carry. On the whole, the latter opinion was the more widely held.

After the meeting the members made excursions to objects of interest in the neighbourhood of Cassel. About seventy chemists and physicists visited Göttingen and inspected the laboratories of Profs. Nernst, Voigt, Rieke, and Wiechert; the last has been created only a few years, and is devoted to the investigation of the problems of "terrestrial physics." It is furnished with seismographs, instruments for investigating terrestrial magnetism, atmospheric electricity, &c., and good work is already being done in it. It is a handsome building at some distance from the town, and it may be held up as an example of the way in which the Germans leave no stone unturned to be first in the investigation of natural phenomena of all kinds. Some of the associates, chiefly medical, visited Marburg, in order to inspect Prof. von Behring's institute for the study of tuberculosis. The buildings and equipment must be characterised as magnificent. Here, again, is an instance of the cooperation of the scientific man and the manufacturer, for Dr. von Behring was for long scientific adviser to the firm of Höchst, which erected the laboratories, and undertook the manufacture of the antitoxin serum. Would that a similar spirit of cordial cooperation between English men of science and "practical" men could become more common!

W. R.

FORTHCOMING BOOKS OF SCIENCE.

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The list of the Cambridge University Press includes:—"Micro-cosmographie, or, a Piece of the World discovered; in Essays and Characters," by John Earle, printed from the sixth augmented edition of 1633; "Principia Ethica," by G. E. Moore; "The Algebra of Invariants," by J. H. Grace and A. Young; "The Collected Mathematical Papers of James Joseph Sylvester, F.R.S.," edited by Dr. H. F. Baker, F.R.S.; "Radio-activity," by Prof. E. Rutherford, F.R.S.; "The Fauna and Geography of the Maldive and Laccadive Archipelagoes. Being the Account of the Work carried on and of the Collections made by an Expedition during the years 1899 and 1900 under the leadership of J. S. Gardiner," vol. ii. part ii., illustrated; "Reports of the Anthropological Expedition to Torres Straits by the Members of the Expedition," edited by Dr. A. C. Haddon, F.R.S.; "Immunity in Infectious Diseases," by Prof. E. Metchnikoff, authorised English translation by F. G. Binnie, illustrated; "Rabies, its Place amongst Germ-diseases, and its Origin in the Animal Kingdom," by Dr. D. Sime; "The Natural History of some Common Animals," by O. H. Latter; "A Systematic Account of the Seed-Plants," by Dr. A. B. Rendle, vol. i.; "Fossil Plants, a Manual for Students of Botany and Geology," by A. C. Seward, F.R.S., vol. ii.; "The Morphology of Plants," by J. C. Willis; and new editions of Scott's "A Treatise on Determinants," by G. B. Mathews, F.R.S.; and "A Manual and Dictionary of the Flowering Plants and Ferns," by J. C. Willis.

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The Walter Scott Publishing Company, Ltd., are adding to their "Contemporary Science Series":—"Morals: a Treatise on the Psycho-Sociological Bases of Ethics," which is a translation, by W. J. Greenstreet, of Duprat's "La Morale"; "Consumption, its Nature, Causes, Prevention, and Cure," by Dr. S. de Plauzoles; "Indigestion, its Prevention and Cure," by Dr. F. H. Alderson; and a new edition of "An Introduction to Comparative Psychology," by Prof. C. Lloyd Morgan, F.R.S.

Messrs. Smith, Elder and Co., give notice of:—"A Naturalist in the Guianas," by E. André, illustrated; "Doctors and their Work, or Medicine, Quackery, and Disease," by R. Brudenell Carter.

The announcements of Messrs. Swan Sonnenschein and Co., Ltd., include:—"A History of Contemporary Philosophy," by Prof. M. Heinze, translated by Prof. W. Hammond; "Physiological Psychology," by Prof. W. Wundt. A translation of the fifth and wholly rewritten (1902–3) German edition, by Prof. E. B. Titchener, in three volumes, vols. i. and ii., illustrated; "The Philosophy of Auguste Comte," by Prof. L. L. Bruhl, translated with notes and index by the Hon. Mrs. de Beaumont-Klein; "Some Popular Philosophy," by G. H. Long; "The Student's Text-book of Zoology," by A. Sedgwick, F.R.S., vol. ii., illustrated; "The Fourth Dimension," by C. H. Hinton, illustrated; "Fatigue," by Dr. Mosso, translated by W. B. Drummond, illustrated; "Cancer: Nature's Own and Only Remedy," by Dr. C. Carillo; "Specimens of Bushman Folklore," by Dr. W. H. J. Bleek and Miss L. C. Lloyd; and a new edition of "Introduction to the Study of Organic Chemistry," by J. Wade, illustrated.

The list of the University Tutorial Press, Ltd., comprises:—"Modern Navigation," by Rev. W. Hall; "The Shilling Arithmetic"; "The Key to the New Matriculation Algebra"; "The School Arithmetic," by W. P. Workman; "Advanced Botany," by J. M. Lowson; "Graphical Representation of Algebraic Functions," by C. H. French and G. Osborn; and new editions of "The Tutorial Dynamics" and "The Tutorial Statics," by Dr. W. Briggs and Prof. G. H. Bryan, F.R.S.; "Advanced Magnetism and Electricity," by Dr. R. W. Stewart; "First Stage Magnetism and Electricity," by Dr. R. H. Jude; "Advanced Mechanics," vol. i., Dynamics; vol. ii., Statics, by Dr. W. Briggs and Prof. G. H. Bryan, F.R.S.; and "A Higher Text-book of Magnetism and Electricity," by Dr. R. W. Stewart.

Mr. T. Fisher Unwin gives notice of:—"Big Game Shooting and Travel in South and East Africa," by F. R. H. Findlay, illustrated; "The Mystics, Ascetics and Saints of India," by J. C. Oman, illustrated; "Bird Life in Wild Wales," by J. A. W. Bond, illustrated.

Messrs. Whittaker and Co. will issue:—"Electric Traction, a Practical Handbook on the Application of Electricity as a Locomotive Power," by J. H. Rider; "Electric Lighting and Power Distribution," by W. P. Maycock, vol. ii.; "Friction and its Reduction," by G. U. Wheeler; and new editions of "The Dynamo," by C. C. Hawkins and F. Wallis; "Electricity in its Application to Telegraphy," by T. E. Herbert; and "The Alternating Current Circuit and Motor," by W. P. Maycock.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The election of a professor of physiology in succession to Sir Michael Foster will take place on November 6, and the election to the chair of mechanism and applied mechanics, vacant by the resignation of Prof. Ewing, on November 14. Candidates are requested to communicate with the Vice-Chancellor.

Mr. J. M. Dodds, Peterhouse, and Mr. E. W. Barnes, Trinity, have been appointed moderators, and Mr. A. Berry, King's, and Mr. A. S. Ramsey, Magdalene, examiners for the mathematical tripos, 1904.

Mr. J. E. Wright, senior wrangler 1900 and Smith's prizeman 1902, and Mr. H. A. Webb, third wrangler 1902, have been elected to fellowships at Trinity College.

THE Duke of Norfolk has contributed 8000*l.* towards the endowment of a university in Sheffield, if the charter be granted. Sir F. Mappin, Sir H. Stephenson, and the Sheffield Corporation Tramways committee have also each given 5000*l.*

IN some American colleges there is a system by means of which the work done throughout the various terms of the college course is taken into account in awarding a student a degree. The plan adopted is known as the credit system. Thus in the current "Year Book" of the Michigan College of Mines, there is published an outline list of courses of instruction arranged in order of sequence, and under each main subject is given the number of attendances which must be made at the classes in different branches of that subject in order to secure certain credits. To take two instances, under the heading mathematics we find "spherical trigonometry, six times a week, five weeks; to count as three-tenths of a credit." Or, under physics, "light, six hours a week, twelve weeks; to count as two-tenths of a credit," and so on. By some such plan in this country regularity of attendance by students at their classes would be quite assured.

MR. S. D. CHALMERS has been appointed head of the new department of technical optics at the Northampton Institute, Clerkenwell. Evening classes in technical optics were started at the Northampton Institute as part of the work of the Applied Physics Department in the session 1898–99. In the first session the students largely consisted of those who desired to take the examinations of the Spectacle Makers' Company, and the work was confined to lectures and laboratory work. In the following session an optical workshop was added, and an increasing number of students engaged, professionally or otherwise, in optical work have in recent years been enrolled as students. Owing to the assistance of the London Technical Education Board, it has now become possible to separate the department of technical optics from that of applied physics, and place it in charge of a responsible head who can devote his whole time to its organisation and development.

THE following entrance scholarships in connection with medical schools have been awarded:—St. Mary's Hospital Medical School—natural science scholarship, 145*l.*, G. E. Oates, St. Paul's School; natural science scholarships, 78*l.* 15*s.*, (1) J. E. L. Johnston, Epsom College and St. Mary's Hospital, (2) W. E. Haigh, Bradford Technical College; natural science scholarship, 52*l.* 10*s.*, D. W. Daniels, Wyggeston Schools, Leicester; university scholarships, 63*l.*, (1) W. A. E. Dobbin, University College, Cardiff, (2) E. Beaton, Portsmouth Grammar School and Caius College, Cambridge. London Hospital Medical College—first prize, entrance science scholarship, 120*l.*, W. H. Palmer; second prize, entrance science scholarship, 60*l.*, J. E. Scudamore; third prize, entrance science scholarship, 35*l.*, J. P. Johnson; anatomy and physiology prize, scholarship open to students of Oxford and Cambridge, scholarship, 60*l.*, H. S. Souttar, University of Oxford. King's College, London (Faculty of Medicine)—medical entrance, 50*l.*, W. T. Briscoe and W. D. Sturrock (equal); Sambrooke (science), 100*l.*, E. Gauntlett; Warneford (arts), 100*l.*, O. J. W. Adamson.

PROF. E. A. SCHÄFER, F.R.S., delivered the introductory address to the medical students at the Yorkshire College, Leeds, at the opening of the winter session on October 1. The object of the address was to offer practical suggestions with regard to the manner in which a medical curriculum might be mapped out in existing circumstances. It was appalling to think, said Prof. Schäfer, that many people who passed as highly educated had absolutely no knowledge of any of the sciences except, perhaps, mathematics. He went on to say that, as a subject of general education, scientific knowledge was an absolutely essential preliminary to the study of medicine, and that because such knowledge was not imparted in our schools it had become necessary to incorporate into the medical curriculum, and in so far to burden it with, courses of preliminary science.

THE distribution of medals, prizes, and diplomas to the students of the Royal College of Science, South Kensington, took place on October 8, when Prof. J. B. Farmer, F.R.S., delivered an address, in the course of which he said it was still unfortunately true that many people of influence, while freely admitting the claims of science as a factor of ever-growing importance in the world of production and industry, nevertheless, when they said they wanted more technical education in the country, did not really want either science or education at all. What they did desire was merely some ready means of instruction that should adapt the knowledge already in sight to industrial and technical purposes. He believed in securing a more widespread and intelligent interest in the meaning of science and the modes by which knowledge might be really advanced. Chief among these was assuredly research.

IN distributing the prizes to the successful students of the Halifax Municipal Technical School last week, Mr. Bryce, while commending the study of commerce as a matter of science and philosophy, urged the authorities at Halifax to fix their attention principally to applied science. "But," he added, "our experience, and that of Germany and the United States, has shown that applied science, to be valuable, must be in connection with theoretical science, and in this country there must be ampler provision for teaching the higher branches of theoretical science if we are to make progress with those branches of science concerned with the practical arts. There is no reason in the world why England should not have as great a career in commerce and manufactures in the future as in the past. A country which wishes to keep abreast of modern trade must keep abreast of modern science. We have been falling behind in the study of science and its application to our industries in this modern world of ours. Science is king, and the commercial and industrial future is with the nations able most completely to master and apply the forces of nature in the most economical way."

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, October 5.—M. Albert Gaudry in the chair.—The influence of water on the structure of the aërial roots of orchids, by M. Gaston **Bonnier.** Contact with water produces an effect on the aërial roots of many orchids, either by preventing the sclerification or lignification of the tissues of the central cylinder, a result which seems natural when compared with the modifications of the roots of aquatic plants, or by provoking a reaction tissue in the pericycle, capable of protecting the rest of the cylinder against the action of water.—On a class of linear differential equations, by M. Alexander **Chessin.**—The conditions which determine the sign and the magnitude of electrification by contact, by M. Jean **Perrin.** The contact charge between a solid and a liquid can be readily studied by means of electrical osmosis, the charge being always greater when the body is a good ioniser, such as water.—The heats of combustion of organic compounds considered as additive properties; alcohols and phenols, ether-oxides, aldehydes and ketones, by M. P. **Lemoult.** By assigning definite values to certain atomic groupings it is possible to calculate the heats of combustion of organic compounds of the above-mentioned classes with considerable accuracy.—The action of phosphorous acid upon mannite; remarks on mannide, by M. P. **Carré.** The ether

$$P_2(OH)_4.O_2(CH_2)_2.(CH.OH)_4$$

is first formed, a phosphite of mannide being ultimately produced.—Derivatives and products of oxidation of nitropyromucic acid, by M. R. **Marquis.** This acid is totally destroyed by oxidation with permanganates, chromic acid or nitric acid, but with sodium peroxide gives nitrous and fumaric acids.—Researches on the formation of azo-compounds. The reduction of ortho-nitrobenzyl-methyl ether oxide, by M. P. **Freundler.**—On the affinities of the genus Oreosoma, by M. G. A. **Boulanger.**—The action of solutions of salts of the alkalis and alkaline earths on fish, by M. Michel **Siedlecki.**—On the genus Ascodesmis, by M. P. A. **Dangeard.**—Researches on the transpiration of green leaves, either the upper or lower face of the leaf being illuminated, by M. Ed. **Griffon.**—On the development of the embryo of the rush, by M. Marcellin **Laurent.**—On ægyrine granites and riebeckite in Madagascar and their contact phenomena, by M. **Lacroix.**—On the functions of the *Charriages* in the delphino-provençal Alps and of the fan-like structure of the Alps of the Briançonnais, by M. W. **Kilian.**

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