THURSDAY, JULY 21, 1910.

A STANDARD TREATISE ON PHYSICS.

Traité de Physique. By O. D. Chwolson. Translated from the Russian and German editions by E. Davaux. Second volume, fourth fascicule. Pp. 641–1188. Third volume, first fascicule. Pp. vii+408. Fourth volume, first fascicule. Pp. vii+430. Figures in text. (Paris: Hermann et Fils, 1909.) Price 17, 13 and 12 francs respectively.

SINCE this is a French translation of a work which has already been reviewed in part as a German translation (from the Russian), we will not do more than examine those parts in which it differs from its previous forms or which have not previously been reviewed here. It is by no means a mere translation. Extensive additions have been made under Prof. Chwolson's supervision with the object of maintaining the book level with the rapid advances in physics that have taken place. These have been made with the author's usual discriminative ability. If there is one quality more than another which strikes us about this text-book it is the rare combination of knowledge and good judgment which everywhere characterises it. Other volumes which we know may be more encyclopædic. If our object is to find out *all* that has been done on any special subject we may be disappointed if we turn up the subject here. But if our object is to find a judicious selection of the best that has been thought and written on physical questions, then we know of no better source from which our object can be attained. In other words, this is a text-book of a preeminent order, written by one who has a unique command over all branches of physical science, and who is as alive to the most recent developments as to those portions which have now become classical.

Of the additions to the fourth fascicule, which deals with diffraction, double refraction, and polarisation of light, we may point out the account of recent work by Dufet on the remarkable anomalous dispersion of the optic axes in the case of the sulphates of neodymium and praseodymium which is exhibited in the region of optical absorption. Several additional pages are devoted to an account of the optical properties of liquid crystals as studied by Lehmann and others. Two lengthy paragraphs are added by the translator dealing with the reflection and refraction of polarised light according to Green, and with the gyrostatic theory of light. These paragraphs certainly supplement the rest of the chapter into which they are inserted, and, as many readers will be glad to have them, no exception can be taken in regard to their insertion. But it may be intimated that they are considerably more mathematical than the greater part of the book, and they therefore do not harmonise very well with the rest.

We are certainly surprised to find that what is essentially a distinct treatise is bound up with this fascicule, and constitutes the end of the second volume. This consists of a note on the theory of deformable bodies, by MM. E. and F. Cosserat. This note is 220 pages long, and it does not in any sense harmonise with the work with which it is incorporated. Prof. Chwolson's work is emphatically experimental in character; the note is as strikingly mathematical. We do not wish in the slightest degree to discredit either the matter or the manner of the note taken by itself. But there does not seem to be any justification for loading a text-book which is necessarily very bulky by matter which will probably never be consulted at the same time as the body of the book itself. The MM. Cosserat's note is a distinct and useful treatise, and should be quite able to stand on its own feet.

The changes in the first fascicule of the third volume are not so considerable. This part deals with thermometry, specific heats, thermochemistry, and thermal conductivity. So far as we can find, there is only one additional section, which treats in a general way of the problem of Fourier, and gives a short account of the allied researches of M. Poincaré. This is a very useful addition.

The first part of the fourth volume has not yet been reviewed in these columns, and it deserves a more extended notice. Its subject-matter is the stationary electric field. The introduction to this part is specially noteworthy. It has seemed to Prof. Chwolson necessary to commence by giving a summary of the singular and exceptional situation in which the science of electrical and magnetic phenomena now is. At the present time one may distinguish no fewer than three various points of view from which these subjects are regarded. We have, in the first place, to deal with the *external structure* of a very great number of different phenomena which, perceived by our senses, awaken in us a representation more or less definite of what is proceeding, or, more exactly, of what seems to us to proceed in a given direction and under given conditions. Thence arises a description of phenomena and of the laws and rules by which those phenomena are regulated. Secondly, we may place ourselves at another point of view, and consider the practical applications; or, thirdly, we may endeavour to *explain* these phenomena by showing that they are the necessary consequence of the existence of a certain substratum to which the laws of mechanics and thermodynamics are applicable. In regard to this third point of view, Prof. Chwolson declares that—

"Without wishing to exaggerate, we may say, after having glanced rapidly over the facts, that there does not exist at this moment in the part of this science which has for its object the *explanation* of phenomena, any theory which is firmly established upon which we may rely in a manner free from all possible doubt to give an account of *all* phenomena."

He recognises, however, three fundamental conceptions which excite three distinct images or pictures which give a more or less exact representation of the intimate cause of phenomena. These he designates by the letters A, B, and C. The image A, adopted in a general manner up to the year 1870, was constructed on the notion of two electricities, enjoying the property of acting instantaneously at a distance.

Though retained in elementary expositions, serious science has abandoned it for ever.

The image B (1870 to 1890) left entirely on one side the conception of a special electrical substance, and sought to explain electrical phenomena by the properties of the æther alone. But although this picture enabled one to form a representation of radiant electrical energy, it, too, has been found insufficient to explain a great number of phenomena.

The image C is based on the notion of *electrons*, and forms, to some extent, a combination of A and B. It supposes the existence of a special substratum, and preserves the idea of modifications produced in the body of the æther; but the electrical substance is now considered as the origin of these modifications in the æther.

We have summarised these distinctions because they characterise the entire fascicule. Prof. Chwolson adheres to these distinctions throughout, and the result is that he is able to produce a final picture which is more free from confusion than if he had attempted to remove the dividing lines between them. Again, the student will leave his perusal of these pages with a far wider conception of the general lie of the land than if one or other of these points of view had been purposely blocked out. We do not wish to disparage any recent books which emphasise one of these pictures to the practical exclusion of others. They serve their purpose. The pioneer is necessarily preoccupied with his own line of march. But there is a danger that, in the enthusiasm created by recent discoveries and the success attending the contemplation of picture C, the rest of the landscape will be forgotten. We can wish for no better training for a student than a perusal of Prof. Chwolson's treatise.

Of the general character of the book in its French form we may say that we do not like it quite so well as the German. The illustrations, which are taken from the German translation, do not show up as satisfactorily on the paper selected. But the production of a French translation will be welcomed by many to whom German is not intelligible; and it may be said without any hesitation that, in the form in which it now appears, we have a text-book of physics which is second to none in the French language. It should be in the library of every physical laboratory, and students who are taking up the subject of physics seriously will find it one of the best text-books of which to obtain private possession.

FLOWER POLLINATION.

Handbook of Flower Pollination. By Dr. P. Knuth. Based upon Hermann Müller's work, "The Fertilisation of Flowers by Insects." Translated by Prof. J. R. Ainsworth Davis. Vol. iii. (Band ii., Teil ii., of the German edition), Observations on Flower Pollination made in Europe and the Arctic Regions on Species belonging to the Natural Orders. Goodenovieæ to Cycadeæ. Pp. iv+644. (Oxford: Clarendon Press, 1909.) Price 28*s.* net.

VOL. III. of the English translation, which has now appeared, concludes that portion of Knuth's handbook for which that author was himself responsible. The later volumes, issued after Knuth's death by Dr. E. Loew, deal with observations on flower pollination made beyond the confines of Europe, while the earlier volumes contain the observations made in Europe and the Arctic regions, vol. iii. dealing with species belonging to the orders Goodenovieæ to Cycadaceæ.

The English translation, appearing, as it does, ten years after the publication of the original German edition, has been brought up to date in many respects. The arrangement of the Natural Orders has been altered in consonance with more recent classification, and some Orders have been merged as Sub-orders in the larger Families. In many instances new observations have been added, and additional literature is referred to, as, for instance, in the case of the primrose, the pollination of which has been much disputed, and also in the case of Pentstemon, of which genus Loew has latterly made a very considerable study.

This volume, like its predecessor, must be regarded as a most valuable book of reference, yet here and there are points of more general interest to which, perhaps, reference should be made. On p. 434, when dealing with the flower of the snowflake (Leucojum), Knuth gives an interesting summary of the method he has adopted to detect the presence of a nectary, when the position of that organ is not obvious at first sight. By suitable treatment of flowers with Fehling's solution or Hoppe-Seyler's sugar reagent he was able to detect the nectar-secreting part of most flowers. Sometimes even fairly conspicuous flowers, as, for instance, those of *Pyrola uniflora*, were found to be nectarless, and in this case, though the flower is otherwise obviously adapted to insect pollination, no insect visitors are recorded in the handbook. Indeed, this volume, like the preceding one, would yield much valuable information to anyone in search of opportunities of enriching botanical science by accurate observations in the field, for a number of plants, some of them quite common, still require their insect visitors to be recorded.

Some of the orders, like the Ericaceæ, are of interest, because in some genera, *e.g.* Calluna, Erica, and Cyclamen, the flowers, though adapted to insect pollination, and very eagerly visited by insects, are during their later stages anemophilous, the pollen becoming dry and powdery, and being readily carried by wind. On the other hand, some flowers normally adapted to wind pollination, like the sweet chestnut (Castanea), also attract insects, and are no doubt pollinated by them.

The translator has omitted to note the observations made recently on the dog's mercury (Mercurialis), which indicate that this plant is provided both with nectaries and sticky pollen, so that though apparently anemophilous, and probably at times wind pollinated, it is adapted to the visits of insects, and, as Knuth records, is often visited by them.

The anemophilous Gramineæ, too, offer many points of interest in connection with the frequent occurrence of cleistogamy and self-pollination of their flowers. Insect visits are occasionally observed in this group. Ludwig considered that the succulent shining lodicules of many grasses sometimes

attract flies, which are often imprisoned by the rapid closing of the glumes. These flies seem often affected by the entomophthora disease, and it is suggested that when so suffering they are often compelled by thirst to seek the juice of the lodicules. In other cases, no doubt, they visit the flowers for the purpose of collecting pollen.

A very valuable appendix, occupying about 100 pages, is added to the volume, and gives a systematic list of the various insects which have been observed visiting flowers and the flowers which they usually frequent. This carefully compiled list will be as informing to the entomologist as to the botanist. The index of plants described in the volume which figures in the German edition has not been added in the translation, but is probably held over for the final volume.

The style of the English rendering is fluent, and generally free from the flaws that mark some translations, though the volume opens with a serious blunder in describing the flowers of Lobelia as actinomorphous. Hälftig-symmetrisch is, of course, bilaterally symmetrical or zygomorphic, as is, indeed, indicated by the concluding portion of the sentence which describes the bifid upper and the trifid lower lip. It is unfortunate that the translator has retained the use of the word œcology as a synonym for biology, in dealing with observations on flower pollination. Though formerly used in that sense, œcology has of late years been so definitely and much more correctly applied to the study of plant-life in relation to environment that it seems out of place when used for floral biology.

Apart from such minor defects, the translation will be welcomed as rendering Knuth's monumental work accessible to a wider circle of readers and students of plant biology.

PRACTICAL WORK FOR ELECTRICAL LABORATORIES.

Leitfaden zum elektrotechnischen Praktikum. By Dr. G. Brion. Pp. xiv+404. (Leipzig and Berlin: B. G. Teubner, 1910.) Price 11 marks.

THE laboratory has always been regarded as a necessary complement to the class-room so far as physics and chemistry are concerned, but for engineering subjects it is a comparatively modern institution. There are still engineers amongst us who have had to go through their university training without enjoying the use of a laboratory, but within the last generation all technical universities and colleges have recognised the immense importance of laboratory work, and have fitted up hydraulic, heat, mechanical, and electrical laboratories on a more or less extensive scale. Teachers, as well as engineers in practice, are agreed on the necessity of supplementing the theoretical work of the class-room by experiment, and there is keen competition between the different institutions as regards the best equipment, each trying to profit by the experience of the others, and to adapt the plant to the special industrial requirements of its district.

The best equipped laboratory would, however, be of little value without good organisation in its use and scientific instruction in the way of carrying out experiments. The book under review is an attempt, and, let us hasten to say, a very successful attempt, to supply such instruction. Of all Continental technical high schools, Dresden has at the present moment the best equipped electrical engineering laboratory, and since its head, Prof. Goerges, is not only an accomplished teacher, but also an engineer of high reputation, we may expect that a book, treating of laboratory work as carried on under him, will prove a most useful publication. The author is lecturer at Dresden, and in the preface says that the methods described have been worked out from time to time by various members of the staff. This does not mean that the methods described, or even a majority of them, are new, but simply that all the methods described have actually been used in that laboratory, and that in this way the educational value of each has been put to the test.

If an author describes the equipment of and work done in the laboratory in which he works himself, there is danger that he will produce a somewhat one-sided account, but from such a reproach Mr. Brion is entirely free. All the author has to say on testing applies to any well-equipped laboratory, and there is a remarkable absence of references to special apparatus. He evidently does not hold with the custom of giving the student cut-and-dried instructions, such as "take Messrs. So and So's testing set, connect in such a manner, then turn the handle and read off the result." Wherever possible he not only lets the student build up his apparatus, but he gives him also a short theory of the test. The object of the student's work in the laboratory is primarily to verify by experiment certain physical relations of which he has heard the theory in the class-room. Since, however, the simple and fundamental physical relations are in practical machinery often overshadowed by secondary disturbing causes, it is important that these should be pointed out to the student, and that he should thus be trained to scrutinise his results so as to separate that which is important from that which is merely accidental or disturbing. In this direction, Mr. Brion has given us good advice in sufficient detail. To give such advice it is, however, necessary to introduce a certain amount of theoretical matter on a mathematical basis.

A casual glance through the pages of this book gives one more the impression of a text-book than of a laboratory manual, but on closer inspection one finds that only as much theory is introduced as is necessary for intelligent working. Among the good features of the book are the diagrammatic representations of circuits, machines, and apparatus. With a correct appreciation of the probability that the students who work now in the laboratory will in a year or two be working in practice, Mr. Brion has adopted in his diagrams the symbolic representation recommended by the Verband Deutscher Elektrotechniker. He also uses thick lines to represent wires which carry main currents and thin lines for wires carrying shunt currents or for voltmeter wires. This is apparently a small matter, but anyone who has to trace out the circuits in some complicated electrical

connection will appreciate the advantage of making the distinction. It is, however, to be regretted that in the matter of notation the author is too intensely German. He puts P for force, A for energy, L for power, D for torque, and so on, all letters which have internationally already a significance. The reader is thus put unnecessarily to the trouble and mental strain to substitute for symbols he is accustomed to use (and which, to a certain degree, have already received the sanction of the International Electrotechnical Commission) others which are unfamiliar to him.

It is not necessary to enumerate the contents of this book in detail; suffice it to say that it broadly covers the subject of laboratory tests such as are necessary for students. As to the question of which tests are necessary and which may be omitted, opinions will always differ. It would be easy to give a list of tests which, in the reviewer's opinion, ought to have been included, but such criticism would hardly be fair, for a book on testing cannot contain every possible test, but only a selection of those which the author himself has found suitable. On the whole, the author has given us a very representative and useful selection, covering a wide field. His book will be found to be a most helpful guide to electrical laboratory work generally. GISBERT KAPP.

ANCIENT HINDU CHEMISTRY.

A History of Hindu Chemistry from the Earliest Times to the Middle of the Sixteenth Century A.D., with Sanskrit Texts, &c. By Prof. Praphulla Chandra Ray. Vol. ii. Pp. xcvi+293+152+xxi. (Calcutta: The Bengal Chemical and Pharmaceutical Works, Ltd.; London: Williams and Norgate, 1909.) Price 10*s.* 6*d.* net.

IN the first volume of this book, which was published in 1902, and reviewed in these columns on May 21, 1903, Prof. Ray dealt with all the oldest (pre-Buddha) Hindu MSS., and many of the later ones. A number of MSS. remained untouched, and now that these have been examined, the concluding volume has been issued. It has been a labour of love which has occupied all Prof. Ray's spare time for the last fifteen years, and the great value of the results of his patient and laborious researches will be fully appreciated by all students of the history of chemistry.

The difficulties of determining the extent of Indian chemical lore in ancient times are profound. There is no doubt that at a very early period the Arians attained great proficiency in the manufacturing industries, which must have rested on a good practical knowledge of chemical reactions. The famous sword-blades, called by the Greeks "marvellous swords," and by the Western world "Damascened blades," were brought to Europe by way of Damascus, but were made in India. The making and polishing of glass in India, including lenses and mirrors of various kinds, spherical, oval, &c., was a well-known industry. Pliny mentions that the best glass ever made was Indian glass. In pharmacy, in dyeing, in the manufacture of perfumery and cosmetics, complicated chemical operations must have been carried out even before the time of Buddha, which is placed about B.C. 500.

There is, however, little or no trace of these things in the literature of the period. The caste system was radically opposed to the formation of a science in which practice is based on theory. The chemical industries were exercised by a despised caste, that of the *çudras*, and their labours were no doubt deemed unworthy of being described by the caste of the *Brahmins*, or priests, who alone understood the art of writing. Thus Hoefer, for example, remarks that amongst the Sanskrit manuscripts in the Bibliothèque Imperiale, of Paris, no document occurs which can be of interest to the historian of chemistry, and Berthelot in his "Origines de l'Alchemie" practically ignores India.

The MSS. patiently examined by Prof. Ray appear to consist largely of religious or philosophical reflections, with occasional somewhat obscure references to chemical subjects made for the purpose of illustration. Thus in a document called "Rasaratnakara," written by Nagarjuna, who was the High Priest of Buddha about A.D. 150, such texts as the following occur:—

"What wonder is it that cinnabar digested several times with the milk of the ewe and the [vegetable] acids imparts to silver the lustre of gold glowing as saffron?"

And a little further on:—

"Silver alloyed with lead and fused with ashes becomes purified,"

which is a clear allusion to cupellation.

It is probable that the pundits, when referring to metal-working, often knew very little of the subjects they mentioned, but Nagarjuna was celebrated as an alchemist. Prof. Ray argues at some length in favour of the indigenous origin of Indian alchemy, and, however degrading it may have been to work, it does not appear to have been derogatory to the dignity of the sages to discuss the manufacture of gold or silver. Thus—

"Tin is to be melted and one-hundredth part its weight of mercury to be amalgamated with it. This [fraudulent substitute for] silver can be used for purposes of exchange, and one can thus amass wealth."

The last 150 pages of the book consist of a reproduction of original Sanskrit texts, taken from many different MSS. T. K. R.

AN ENCYCLOPÆDIA OF THE SCIENCES.

Instruments optiques d'Observation et de Mesure. By Jules Raibaud. Pp. 380. (Paris: O. Doin et Fils, 1909.) Price 5 francs.

THIS volume is a unit in a somewhat extensive undertaking, no less than an encyclopædia of all the sciences, pure and applied, physical and biological, material, mental, and moral. The scheme is of a somewhat novel character; its magnitude may be judged from the fact that it involves a total of some thousand volumes, arranged in forty sections or "bibliothèques," the whole to rival, we are told, the largest encyclopædias of this or any other country—and not only in size. The novelty lies mainly in the fact that each volume is to be independent, and have its own individuality; each will be a monograph dealing with a special branch of the particular section to which it belongs. The size and price will be uniform, the number of pages approximately so. One

among the advantages of the scheme will be that each volume can be brought up to date independently of the rest.

The forty sections are classified in the two main divisions of "pure sciences" and "applied sciences." Each of these is again subdivided into mathematical, inorganic, and biological sciences. Each subdivision comprises a certain number of sections, and each section has its own editor. The general editor is Dr. Toulouse, of the École des Hautes Études, and among the editors of sections are included such names as Painlevé, Mascart, Leduc, Lacroix, Bertrand.

The volume under review belongs to the section of "Industries physiques" in the division of applied sciences—subdivision, inorganic. The section is to include volumes on such subjects as "Industrial Electricity" (two vols.), "Electric Motors," "Electric Traction," "Electric Lighting," "Rheostats," "Wireless Telegraphy," "The Liquefaction of Gases," "The Industrial Production of High Temperatures," &c. This volume on "Optical Instruments for Observation and for Measurement" would seem to be the first volume of the section to be issued.

Judged from its position in this hierarchy of scientific knowledge, Captain Raibaud's volume is perhaps a little disappointing. One might expect to find details of the most recent technical advances, of such a character that the skilled optician might there find help, whether as regards difficulties of design, or of construction, or methods of ensuring accuracy. In the present instance, however, questions not only as to calculation of the optical system, but as to construction and methods of test, are definitely excluded; the aim is thus only to give a general account of the optical properties of various types of instrument, with brief particulars of individual instruments and designs. Expressed shortly, the work is rather an educational text-book than a technical handbook.

From this point of view, however, and for the general reader who wishes to obtain an intelligent knowledge of the more essential optical properties and possible defects of an instrument which he may be in the habit of using, the book can be cordially recommended. More especially, the general conditions governing the formation of satisfactory images by an optical instrument are carefully and clearly discussed. Thus the first part of the work, more than one-third of the whole, deals with the general properties of instruments, definition and resolving power, brightness of the image, extent of field of view in breadth and depth, distortion, magnification—subordinate, as is rightly emphasised, to resolving power and definition—and the functions and limitations of the eye in conjunction with an optical instrument. The characteristics of binocular vision and of vision through a binocular instrument are also examined, and, in regard to measuring instruments, the general conditions affecting accuracy.

In the second part of the book the instruments considered are those of the telescope class, the microscope, the photographic objective, instruments for measuring angles, surveying instruments and telemeters, and, finally, instruments based on the principle of auto-collimation. The list, of course, is by no means exhaustive; laboratory instruments, the spectroscope, interferometer, &c., and photometric apparatus generally are not included, nor does space admit of detailed consideration of any one type. The book is, however, written by one who has had experience in handling the instruments he describes, and thoroughly familiar, not only with the optical theory, but also with the practical points affecting their performance.

OUR BOOK SHELF.

Methods used in the Examination of Milk and Dairy Products. By Dr. Chr. Barthel. Translation by W. Goodwin. Pp. xii+260. (London: Macmillan and Co., Ltd., 1910.) Price 7*s.* 6*d.* net.

THIS edition contains several additions to the original work of Dr. Barthel, and it will be found very useful to those engaged in examining milk and dairy products on a large scale. The general remarks in it apply more exactly to milk of German or Swedish origin than to milk from some British breeds of cows.

In the notes on the physical examination of milk are useful hints as to the estimation of dirt. For the determination of fat Soxhlet's aræometer method is still given a prominent place, though in most places it is superseded by less complicated and more certain methods. Wollny's refractometer method for the fat estimation, if carried out under exact conditions, seems to give very accurate results, but it is so sensitive that the least departure from the necessary conditions influences the results seriously; one advantage it possesses is that as many as 150 determinations may be made in an hour with the proper appliances and accommodation. The Rose-Gottlieb method, and various modifications of centrifuge methods, including some not requiring the use of strong sulphuric acid, are described. Tests for adulterations, artificial colouring matters, and preservatives are given. Saccharate of lime is said to be one of the latest adulterations of milk and cream; it increases their viscosity and gives them the appearance of being richer in fat; a method for its detection is given.

Methods for the analysis of butter, cheese, preserved milk—including Buddised milk, that is, milk treated with a small quantity of hydrogen peroxide—condensed milk, and desiccated milk are given. We find also some account of the decomposition products of milk, butter, and cheese; and, in an appendix, several tables of figures useful in calculating the results of analyses.

Norwegian and Other Fish Tales. By Bradnock Hall. Pp. x+243. (London: Smith, Elder and Co., 1910.) Price 5*s.* net.

THIS is a frankly trivial book with a quite unintelligible dedication in place of a preface. The illustrations are excellent, and the text makes good holiday reading, notwithstanding its somewhat strained humour. As the author says, "the diaries of anglers are not as a rule interesting, even to sympathetic brethren of the craft," but we think that many of the author's own experiences at least come near to proving exceptions to his own generalisation. Incidentally, we are told of certain Norwegian fish:—"Everyone thought they were salmon, but both turned out to be sea-trout when the shape of the gill covers and the tail bones were examined." It seems a pity that the precise differences between salmon and sea-trout in the shape of the gill covers and tail bones are not divulged for the benefit of fishermen and naturalists; the counting of scales in a transverse series is none too easy, and an alternative method of diagnosis (if such really exists) would be welcome.

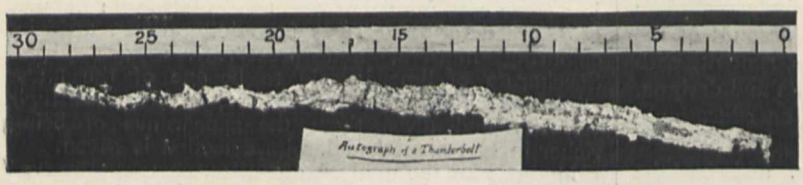
LETTERS TO THE EDITOR.

[*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.*]

Experimental Study of Fulgurites.

FULGURITES, or the tubes of fused sand which are sometimes formed when heavy discharges of lightning strike on sandy soil, are not common enough to make their study very easy. It has been frequently remarked that they usually have a spiral or cork-screw form, but, so far as I know, it has not been decided whether or not this is accidental, and whether the direction of rotation of the spiral remains constant in the same fulgurite, or whether it is always the same in the case of various discharges. Through a fortunate accident I recently hit upon a way of extending our knowledge of these curious autographs of thunderbolts. The accident referred to was the circumstance that I was standing within about 50 feet of the spot on our lawn where a rather heavy discharge struck a day or two ago. I was about to walk across the lawn at the time, but was delayed a moment to reply to a question, when the bolt fell. The report was not deafening, resembling the explosion of one of the modern dynamite cannon crackers with which we have become familiar. There was a distinct flash of fire at the surface of the ground, and a column of steam or smoke 6 or 8 feet high. On examining the spot I found three patches of withered clover in a line about 18 inches apart. At the centre of one was a hole about an inch in diameter, and in the neighbouring one a smaller hole of perhaps a quarter the size. It had been raining hard for a hour or more, and we had had much rain for the past week, which made the ground an excellent conductor, and I was surprised to find that I could pass a straw down the larger hole a considerable distance.

I melted about 15 lb. of solder in an iron pot and poured



Photograph of the cast of a hole formed in ground by a lightning discharge.

it into the hole until it was full, and then carefully excavated the cast. In digging it out, I found a lateral tube several inches below the surface joining the two holes, and one or two lateral branches to the large tube, into which the solder had not penetrated. The cast obtained was nearly 4 feet in length, and the ground was soaking wet, which surprised me a good deal, for I imagined that the discharge would spread out and become dissipated long before reaching a depth of 4 feet in wet soil. The edges of the tubes were lined with small patches of white grains of sand fused together. The metal cast had an unmistakable spiral form, which could be followed for its entire length, and was especially conspicuous at the lower or smaller end. The diameter of the artificial fulgurite increased to a depth of about 2 feet, after which it diminished gradually. The spiral form can be seen in the accompanying photograph of the cast. It was clock-wise in the downward direction, that is, it was similar to that of a cork-screw. The surface was covered with small buds, which were arranged in straight lines along its length, some of the lines 7 or 8 inches long. One of these lines can be seen in the photograph immediately to the right of the label. These lines may be due to cracks in the tube, resulting from the explosive action of the steam. The localisation of a bright light at the surface of the ground is extremely interesting. Several members of my family, who were not looking at the spot at the moment the flash struck, turned round at the report, and said that they saw a bright light and a cloud of smoke. It will be interesting to hear if others have noticed this phenomenon. It may possibly be due to the combustion of a blast of gas generated by the passage of the discharge through the soil.

On the day after the storm I found another and much larger hole on the golf links, where a very heavy discharge had struck and demolished a wooden box of sand on the top of a banked-up tee, leaving no mark, however, on an iron cylindrical can of water standing beside and in contact with the sand box. Lateral branches had spread out in all directions over the top of the tee, making furrows similar to mole tunnels. I have not yet made a cast of this hole, which is probably 6 or 8 feet deep, pending the decision of the golf committee. Similar holes must be of very frequent occurrence, and their study by this method should prove interesting.

East Hampton, Long Island. R. W. WOOD.

Ooze and Irrigation.

THE valuable contribution to this subject contained in the letter of Mr. Horwood (July 14, p. 40) shows the importance of communicating the results of research. I am, in consequence, submitting a few further facts which have not heretofore been made public. Up till the present time it has been assumed that our British Annelids were limited to a few species of earthworms, and a few aquatic forms usually lumped together as Tubifex. So far is this from being the case that we have at least four distinct groups of indigenous worms, to say nothing of the many foreign species found at Kew, Chelsea, Oxford, and elsewhere. These are, first, the true earthworms, of which we have nearly forty species, now ranged under upwards of half a dozen genera. Secondly, certain species of semiaquatic worms, including not only the well-known Allurus (Eiseniella), but two species of Helodrilus. Of these, *H. oculatus*, Hoffmeister, is now known to be British, while a second species, *H. elongatus*, Friend, new to science, is at present known to occur in Cornwall in streams and lily ponds. These are of peculiar interest, both because they necessitate a revision of nomenclature and because they link on the earthworms with the aquatic forms.

Next come the ooze formers, which are exceedingly numerous, and occur in almost all our lakes and ponds, our rivers, streams, ditches, and pools, doing an immense work as scavengers and mould-makers. Lastly, we have to notice another series, which may be conveniently spoken of as white worms (Enchytræids). It is in relation to these that I wish especially to make one or two observations. Some years ago I carefully examined the banks of the Eden near Carlisle. I then found, not only a large series of water worms engaged in making ooze, but, at particular seasons of the year, an equally varied assortment of Enchytræids (Fridericia, Heulea, Enchytræus, and others) at the roots of grasses. By careful observation I found that these were most abundant at the time when decaying vegetable matter was in a state of fermentation, and that they were apparently engaged in clearing off this fermenting matter.

I have recently further observed on the Malvern Hills that, if the stones are lifted which have for a time been covering the grass and causing it to decay, one finds that, when a given stage of decay is reached, certain white worms always make their appearance; and that these Enchytræids are, curiously enough, almost invariably associated with a species of earthworm (*Lumbricus rubellus*, Hoffm.). Other observations, such as that relating to the amphibious nature of the tiny aster-worm (*Enchytraeus parvulus*, Friend), and the action of other forms on decaying seaweed and the like, will call for fuller treatment elsewhere. Enough has been said to show that a very wide field of observation is opened up, and that, while it has its interests for the geologist, it is of supreme importance for the biologist and the student of agriculture. I am at present engaged in a series of observations which are bringing many new facts to light.

HILDERIC FRIEND.

Malvern, July 18.

The Sterilisation of Liquids by Light of very short Wave-length.

DURING the past year several articles have appeared in the *Comptes rendus des Séances de l'Académie des Sciences*, Paris, on the sterilisation of liquids by ultra-violet light. The notes of M. Billon-Daguerre have particularly attracted my attention, since he has endeavoured to utilise the region of the spectrum discovered by Schumann for the sterilisation of water. It is obvious that the question of the transparency of water for light of very short wave-length is important in this connection, and, as there seems to be no data which bears on the matter, I have recently made some experiments.

I used a vacuum grating spectroscope arranged in the same way as when I investigated the transparency of some solid substances. The water was distilled, but without any special precautions, and was enclosed in a cell with fluorite windows. Two of these cells were employed, one giving a water column of half a millimetre, the other giving a millimetre column. With the half-millimetre cell in the light path the spectrum was cut off at λ 1792 (Ångström units), even after a prolonged exposure. It appeared that this limit of the spectrum receded rather slowly toward the red with increase in the thickness of the water column.

As M. Billon-Daguerre wished to use light of very short wave-length, he employed a vacuum tube filled with hydrogen. This substance is known to give a strong spectrum in the region between λ 1650 and λ 1030; it must not be forgotten, however, that no lines can be ascribed to it in the region between λ 2000 and λ 1650. Thus any action due to the radiation from the vacuum tube filled with hydrogen must be confined to a layer of water so thin that light of wave-lengths shorter than λ 1650 can penetrate it. Judging from my experiments, such a layer must be very thin indeed.

Several investigators have used the mercury arc in quartz as a source of light in sterilisation experiments. There are two facts which it may be interesting to mention in this connection. In the first place, fused quartz two millimetres thick is somewhat transparent so far as λ 1500; the transparency falls off rapidly with increasing thickness. In the second place, no lines more refrangible than the strong line at λ 1850 are known in the spectrum of mercury. In this second statement my own observations are confirmed by a recent investigation of Dr. Handke.

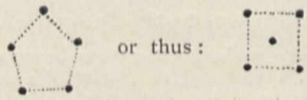
THEODORE LYMAN.

Jefferson Laboratory, Harvard University, July 8.

Elemental Weight Accurately a Function of the Volution of Best Space-symmetry Ratios.

IT is a fact little known, but of the first magnitude, that equal spheres or corpuscles cannot in space, as in one plane, be distributed at equal mutual distances. Tetrahedra, the four points of which alone are all mutually equidistant, cannot be packed so as to fill space, as their face-angles to fill one plane.[1] Icosahedral diffusion, with a central sphere, nearly achieves this, but by a cramping of the central point in the ratio 1 : 1·051460···.

Free magnetic needles in water, say five in number, may fall into position either thus:



or thus:

Their energies are a fixed quantity; so that, though they will assume either position, they are stabler in position (*a*), because here, on the whole, the lines are more equidistant; but (*b*) might become equally stable if each needle were a vortex possessing an energy *v*, capable, under heat and cold, of adapting itself to changed environment by cumulative indraught and outdraught, *i.e.* $v^{\pm\frac{n}{m}}$.

In one plane, equal spheres being equitriangularly arranged, each sphere forms a centre capable of supporting, by surface tension, an equal number of spheres around it. In space, the nearest approach to this perfect equilibrium is by means of the five best symmetries, or so-called regular solids, whereof three dominate elemental crystals.[2] Alike as to points, faces, edge-lines, and circum-radial lines, these five contain only the factors 2 and 3 (crystalline) and 5 (non-crystalline), greatly complicated, however, by the last of these:

Crystalline : *hex* $\sqrt{2:1}$; *tet* $\sqrt{8:3}$; *oct* $\sqrt{4:3}$

Non-crystalline : *ic* $\sqrt{2\left(1-\frac{\sqrt{5}}{5}\right)}:1$; *do* $\sqrt{2\left(1-\frac{\sqrt{5}}{3}\right)}:1$.[1]

Now the problem of the volutional interconversion (on the principle $v^{\pm\frac{n}{m}}$) of the three first ratios 2, 3, and 5, yields to a simple and highly accurate solution,[2] whereas adding the two last, *ic* and *do*, the solution becomes complex; but, on the lines of the simple interconversion, there are contained several approximate interconversions with *ic* and *do*, the errors of which are the precise weights of $H^{1\cdots4}$ by different syntheses:

$$\left.\begin{matrix}\frac{4}{3}\\ \text{or } oct^2\\ \text{or } \frac{tet^2}{hex^2}\end{matrix}\right\} = \left\{\begin{matrix}\sqrt[12]{2}\\ \text{or } \sqrt[8]{hex}\\ \text{or } ic\times H \text{ (i)}\\ \text{or } \sqrt[7]{\frac{hex^2}{oct^2}}\\ \text{or } ic\times H \text{ (ii)}\end{matrix}\right\} \times \left\{\begin{matrix}\sqrt[7]{5}\\ \text{or } \sqrt[7]{3}\ ic\times H^3 \quad \text{(iii)}\\ \text{or } \sqrt[7]{2}\ ic^2\times H^4 \quad \text{(iv)}\\ \text{or } \sqrt[7]{\frac{O(=16\ \times do^2}{ic^4\times oct^2}} \quad \text{(v)}\end{matrix}\right.$$

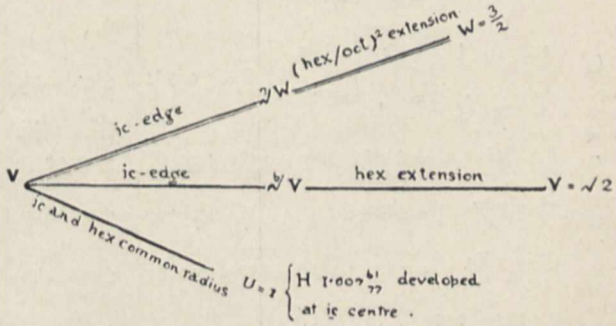
The numbers (i), (ii), (iii), (iv) refer to Morley's four experimental weights of H,[3] which the formula hits precisely:

(i) $H_2 : O$ mean = 1·00761	(iii) Gravimetry mean 1·00762
(ii) $H_2 : O$ max. = 1·00777	(iv) $H_2 : H_2O$,, 1·00765

Two basal equations are here involved,

$$(4/3)^x = 2^{\frac{x}{12}} \times 5^{\frac{x}{7}} \text{ and } 2^x(5/4)^{7x} = 3^{2x} \times 1\cdot5^{\frac{x}{7}} —$$

7 and 12 being severally the combinable group and series numbers of the table. The main equation (*threes* strong) appears accurate to some 50 decimal points; the secondary (*fives* strong) rather less so. They meet at $\sqrt[7]{1\cdot5} = \sqrt[12]{2}$; with an error of 0·00016, the crux of the hydrogen ranges. Their great accuracy points to a profound numeric and geometric principle. *Hex, hex²/oct², &c., compensation-vortices cannot evolve to their 6th and 9th roots without developing hydrogen, and thereupon compensating* ic, *&c.; and, inversely,* ic, *&c., cannot involve to their 6th and 7th powers without ultimately throwing off hydrogen and compensating hex, hex²/oct², &c.*



(i) The compensation-vortex at the end of the cubic (or tet/oct) edge-line, pulls, as required, by $\sqrt{2}:1$ against the circum-cube radius. This crystalline symmetry being disturbed by heat, the vortex unravels or evolves to its 6th root, travelling down the line to the point marked $\sqrt[6]{v}$. It there precisely compensates the *icosahedral edge : circum-*

[1] See Barlow and Pope, Chemical Society Transactions, 1907, vol. xci., p. 1152. [2] Retgers, Zeitsch. physical Chem., 1894, xiv., 1.

[1] *Tet, hex, oct, ic,* and *do* here stand for the ratios, or the weights compensating the ratios, *edge-line : circum-radius* (*i.e.* the radius of a circumscribed sphere) severally of the regular tetrahedon, cube, octahedron, icosahedron and dodecahedron.

[2] A log-algebraic problem of eight terms unknown, it was soluble only by reference to philosophical considerations anterior to those now discussed.

[3] Morley, confirmed by Thomsen, Keiser, Guye and Mallet. See International Committee's Report, *Chemical News*, February 12, 1897, May 5, 1899, June 11, 1897, and May 12, 1905; or Freund's "Chemical Composition," 1904, p. 220.

radius ratio; but so that there is developed at the icosahedral centre, a deficit or gravitative pull equal exactly to the hydrogen mean weight by $H_2 : O$, viz. 1·00761.

$$ic = 2^{\frac{1}{12}}[= 1{\cdot}059462\ldots] \div 1{\cdot}00761.$$

(ii) The vortex compensating the ratio of cube-edge to octahedral-edge—*i.e.* $hex^2 : oct^2$—both having a common or equal circum-radius, unravels down the cube-edge to its 7th root, and at $\sqrt[7]{w}$ becomes an icosahedral compensation vortex; the octahedral-edge becomes or equals the icosahedral circum-radius; and the hydrogen pull is developed at the icosahedral centre; but at $H_2 : O$ max. 1·00777. Cases (iii), (iv), and (v), and all the coalition permutations (see below), are to be interpreted like (i) and (ii), though more complex.

In cases (i), (ii), (iii), and (iv) we have severally $H^{1\cdots4}$; and, similarly, in the coalition formulæ *ic* or H are never in excess by more than the valency numbers 1 to 4 —1 to 8 in the cross-formula (No. 4).[1] This, probably, is attributable to the multiple radial lines. For we are concerned with powers, not multiples. Each central vortex does not need to pull against the sum of all its surrounding vortices as isolated units, because these latter too are themselves centres, and correspondingly weakened. The contraction of the crystalline ratios under heat is consistent with the entropic or adiabatic phenomena of H_2O; and for many reasons it is believed that the weight deviations are a function of entropy. When (see below) the line is crossed, the signs change, contraction becomes expansion, and along the lines of the *pari passu* increase of exponents, the VD, entropically disturbed, gradually becomes constant.

Morley's ranges are severally ±0·00016, ±0·00033, ±0·0007, and (*means*) 0·00004. By coalition of the fractures of the main formulæ, we derive the following, *in all which formulae, ±x being high, the mean is attained, and the maxima and minima when ±x is low; so that the formulae can never transcend the experimental range, and always tend to its means.* (Compare entropy):—

Formula		*x* high	Range
(1) $5/2^{\frac{27-x}{12}}$	$= ic^{x+1} \times H^x$	H = 1·00761	±0·00033
$2^{\frac{28+x}{12}}/5$	$= ic^x \times H^{x+1}$	H = 1·00761	±0·00016*
(2) $3^{\frac{4}{7}}/2^{\frac{10-x}{12}}$	$= ic^{x+1} \times H^x$	H = 1·00761	±0·00004
$2^{\frac{11+x}{12}}/3^{\frac{4}{7}}$	$= ic^x \times H^{x+1}$		
(3) $5/2^{\frac{17-x}{12}} \times 3^{\frac{4}{7}}$	$= (ic \times H)^x$	H = 1·00761	±0·00030
$2^{\frac{17+x}{12}} \times 3^{\frac{4}{7}}/5$	$= (ic \times H)^x$		
(4) $5^{\frac{3}{7}}/2^{\frac{19-x}{12}}$	$= ic^{x+1}/\ H^{7-x}$	H = 1·00761	±0·0005
(5) $2^{\frac{6\pm x}{7}}/3^{\frac{3\pm x}{7}}$	$= ic^{2\mp x} \times H^{3\mp x}$	H = 1·00777	±0·00015
(6) $5^{\frac{6\mp x}{7}}/2^{\frac{13\mp x}{7}}$	$= ic^{2\mp 2x}/\ H^{1\pm 4x}$	H = 1·00765	±0·00017
(7) $5^{\frac{6}{7}}/2^{\frac{7+x}{7}} \times 3^{\frac{3-x}{7}}$	$= ic^{4+x} \times H^{2+x}$	H = 1·00777	±0·00033
(8) $5^{\frac{6+x}{7}}/2 \times 3^{\frac{3+x}{7}}$	$= ic^{4+x} \times H^{2+3x}$	H = 1·00762	±0·00020

* $x = 2$.

A comprehensive deduction from the general formula is the following:

$$H(1{\cdot}00761) \times \frac{do^2}{ic^3} = \frac{oct^{4^2}}{hex\ 3^2} = \frac{tet^{4^2}}{hex\ 5^2}, \text{ \&c.}$$

Provisionally, upon examination of four out of the eight combinable groups, the elemental weights are found expressible in like terms to these, *i.e. the elemental weights are such that, multiplied into the simple volution of one or more of the symmetry line-ratios, they yield accurately the simple volution of one or more other symmetry line-ratios, each expression having its exact equational variant, like elements yielding to like expression, but not mechanically so* (see *Chem. News*, April 22, May 6, and June 10). This is deduced from the basal-equations with *x* as 1··8, the formula not being constructed (or rather discovered) empirically to yield any given weight, but rationally to meet the whole problem of weight compensation. That, *x* being 1, the H weights were with perfect exactitude obtained, chanced to be a fact almost the last discovered.

[1] $H^{1\cdots4+0,\ 1,\ 2,\ 3}$ are virtually $H_{1\cdots4}$.

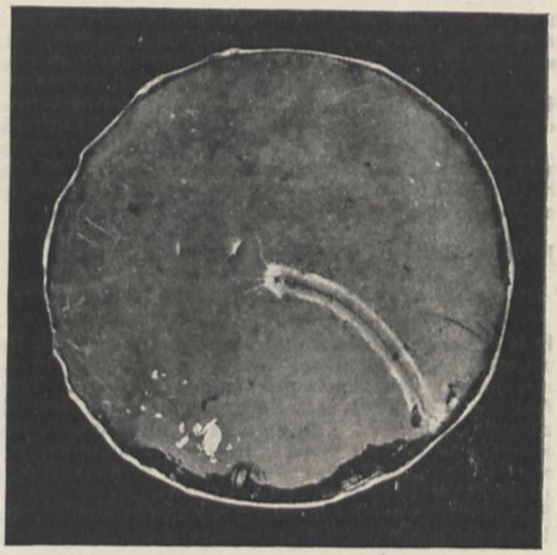
Considering the hydrogen solution alone, the rational postulate of vortex compensation for inequidistance (as contrasted with the crude Democritan hard-atom hypothesis) hits precisely—with the odds 100,000 to 1 against each hit—in the four corners of the basal-equation, the four means of hydrogen; and by coalition, all their deviations. *The postulate is thus, on the one element, proved true by the odds* $100{,}000^4$ (10^{20}) *to* 1.

Corroboration is glimpsed in the spectrum-line ratios.

H. NEWMAN HOWARD.

Electrical Discharge Figures.

MR. A. W. PORTER gave in NATURE of March 31 (vol. lxxxiii., p. 142) an account of his experiments on electric discharges over photographic plates, made in order to ascertain what is due to the luminosity of the discharge and what to the discharge itself. Knowing that the disruptive discharge carries metallic particles from the electrodes, and that in the silvering of mirrors by the wet processes the silver begins to set at every metallic particle



Electrical discharge figure developed by wet silvering process.

which clings to the surface of the glass because of the action of local couples, I ventured to develop the invisible image of the discharge on a clean glass plate by the silvering solution.

The effect was a very striking one; instead of the broad band of the trunk discharge, a clean band was left, surrounded by two sharp, dense lines of deposited silver. The thin ramifications were still visible, but the splendid display of surrounding figures is lacking. The two unsatisfactory paper prints that I send [one is here reproduced] were made from developed plates, and are therefore negatives. It is impossible to get better results now, because the laboratory is closed for the summer holidays.

The acid intensifier for the collodion plates, acting in the same way as the wet silvering mixture, was also tried by me, but the result was worse.

W. LERMANTOFF.

University of St. Petersburg, Russia.

It is necessary to know more concerning the precise conditions under which the images referred to above were obtained before one can discuss them with safety; but they are interesting as apparently indicating that the axis of the trunk discharge *may* be free from metallic particles.

In this connection, however, it must be added that when one directly observes a negative discharge over a photographic plate from an electrode of zinc or magnesium, every line in the fan-like discharge is seen to have the bluish tint characteristic of the metal. Whatever, then, may be the reason for the absence of these fan-like figures from Mr. Lermantoff's images, it must certainly not be attributed to the absence of metallic particles from them.

ALFRED W. PORTER.

An Interesting Occultation.

MAY I direct attention to an interesting phenomenon which will take place on the morning of July 27, viz. the occultation of the star η Geminorum by the planet Venus, the particulars of which are as follows:—

Apparent place of η Geminorum (mag. 3·2–4·2), July 26, R.A. 6h. 9m. 26·6s.; dec. 22° 32′ 6·24″ N. Apparent place of Venus (geocentric), July 26, 14h. 57·7m. G.M.T., R.A. 6h. 9m. 26·6s., dec. 22° 32′ 7·2″ N. Declination at Greenwich, corrected for parallax, 22° 32′ 2·3″. Semidiameter 6·14″. At Greenwich the occultation commences at 14h. 55m., and ends at 14h. 58m. The planet rises at 13h. 43m., and the sun at 16h. 17m.

On the afternoon of July 28, Venus is in very close conjunction with μ Geminorum, the positions of the two bodies at 4h. 27m. being as follows:—

♀. R.A. 6h. 17m. 30·9s., dec. 22° 33′ 58″ N., declination (corrected for parallax) 22° 33′ 53″. μ Geminorum, R.A. 6h. 17m. 30·9s., dec. 22° 33′ 43″. As the semidiameter of the planet is 6·1″, the star will be within about 4″ from the southern limb. This, of course, occurs during daylight, but the planet will be above the horizon at the time. It sets about 6h. 8m.

Dr. Crommelin has kindly looked through these figures and verified them.

ARTHUR BURNET.

52 Prospect Terrace, Hunslet.

Pwdre Ser.

THE curious belief that shooting stars, when fallen to earth, become lumps of jelly may possibly be explained in the following manner:—

The jelly is very probably the plasmodium of a Myxomycete, such as Spumaria or Physarum. The plasmodia occur most frequently in damp weather, but are found in lesser numbers throughout the year. Shooting-stars are also seen at all times in the year, but most plentifully in the autumn. In these islands, the greatest rainfall is also in the autumn months.

Consequently, by a purely fortuitous coincidence, meteors and plasmodia are most plentiful in the latter part of the year, the former because the main meteor swarms, in their annual revolution, cross the earth's track at that time, and the latter on account of the greater rainfall. Two striking phenomena are forced on the rustic attention at the same time, the brilliant display in the sky and the mysterious jelly on the grass. Very naturally the two are considered as causally connected, and so the belief may have arisen. An analogous case is that of "cuckoo-spit," the frothy exudation of the larval frog-hopper, *Philaenus spumarius*, which appears at the time of the arrival of the cuckoo and disappears about the period of the bird's departure.

W. B. GROVE.
B. MILLARD GRIFFITHS.

University Botanical Laboratory, Birmingham.

IN connection with the article on "Pwdre Ser" in NATURE of June 23, it is interesting to find, in Admiral Smyth's "Sailor's Word-Book"—one of the richest repositories of quaint facts and fancies—the term "fallen-star" defined as "A name for the jelly-fish or *medusa*, frequently thrown ashore in summer and autumn."

C. FITZHUGH TALMAN.

U.S. Department of Agriculture, Central Office of the Weather Bureau, Washington, D.C., July 11.

HOUSE-FLIES AND DISEASE.

ALTHOUGH the verification of the belief that the commonest, most widely distributed and truly domestic of insects, *Musca domestica*, Linn., was capable of carrying the germs of certain infectious diseases has been one of the noteworthy accomplishments of medical science in the last decade, it is a mistake to attach all the credit to those who, within the last few years, have removed the idea from the realms of hypotheses into the world of facts.

As early as the seventeenth century, Sydenham associated unhealthy conditions with flies. Lord Avebury, in 1871, regarded flies as "winged sponges spreading hither and thither to carry out the foul behests of contagion." In addition to other early suggestions, Nicholas, in 1873, indicated the possible connection of flies with the dissemination of cholera from a case observed by him in 1850; Raimbert in 1869 experimentally proved that the house-fly and blowfly were able to transmit the anthrax bacillus; Davaine in 1870, and Bollinger in 1874, also showed that the blowfly could carry the anthrax bacillus, an important practical observation. Laveran in 1880 demonstrated the ability of flies to carry the infectious discharge of conjunctivitis in Egypt on their proboscides and legs. All these observers assisted in

FIG. 1.—*Musca domestica*, Linn.

the gradual growth of the belief; but it was in the 'eighties of last century, however, that several investigators adduced more convincing bacteriological proof as to the ability of flies to carry pathogenic and other bacteria. In 1886, Tizzoni and Cattani obtained the cholera spirillum from flies caught in cholera wards. In the same year, Hoffmann found tubercle bacilli in the excreta of flies caught in a room which had previously contained a phthisical patient. Two years later, Celli showed that the typhoid bacillus was able to pass in a virulent condition through the digestive tract of the fly.

Since the above observations, which are selected from many others, were made, it has been repeatedly shown and proved that house-flies are able to carry these and other bacterial and fungal organisms. What has not been demonstrated is the extent to which flies are *not* able to carry such micro-organisms. When the habits of flies are considered, it is not a little remarkable that no serious attention was paid to the possibility of flies having any considerable relationship to the dissemination of disease until within the last twelve years. The excessive mortality from typhoid which occurred in the Spanish-American war was the means of directing the attention of such observers as Vaughan and Veeder to the possible relationship of flies to this disease, especially as

statistics showed that water was not a sufficiently important factor in, and was not explanatory of, the typhoid epidemics occurring in certain of the national encampments. Later, in the South African war, the same conditions were present, and enteric fever was responsible for a very heavy death-roll; those who were present directed attention on their return to these conditions, which, as circumstantial evidence, would convince the most sceptical as to the important *rôle* that flies played in the spread of the disease. These conditions are well known now; open latrines swarming with incredible numbers of flies in all stages of development; these latrines frequented by incipient cases of enteric; myriads of flies in the mess tents, defiling all kinds of food, and in many cases distinguishable by the lime which they bore on their appendages from the latrines, as were the typhoid patients in the hospitals also distinguishable by the number of flies clustering about their mouths while in bed.

From the setaceous character of the appendages and bodies of flies it is only to be expected that when allowed to have access to infected material they would be able to carry the bacilli on their appendages, bodies and in their digestive tracts, and the transference of flies from infected substances to culture media are really unimportant experiments compared with those of capturing the flies under normal conditions near sources of infection and determining the presence and identity of the micro-organisms on these insects, as certain investigators have done. It would

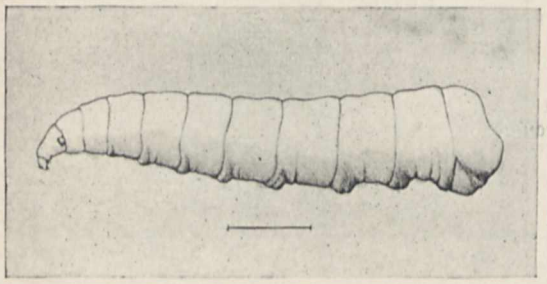


FIG. 2.—Larva of *M. domestica*.

be found impossible to obtain a specimen of *Musca domestica* which was not carrying bacteria or fungal spores.

Though externally they may be almost sterile when they emerge from the pupa, the fly after emergence immediately becomes contaminated, and during the remainder of its varied existence serves as a collector and disseminator of any bacterial or fungal organisms with which it comes into contact. One of the most important and convincing experiments is that of Güssow (hitherto unpublished), who obtained thirty colonies comprising six species of bacteria and six colonies comprising four species of fungi from a single fly caught in the living-room of a house and allowed to walk over a culture plate of agar-agar. From a fly caught in the open he obtained forty-six colonies comprising eight species of bacteria and seven colonies comprising four species of fungi. The tracks of a house-fly caught in a household dustbin yielded 116 colonies of bacteria comprising eleven species, and including such species as *B. coli, B. lactis acidi,* and *Sarcina ventriculi,* and ten colonies comprising six species of fungi.

Such experimental results render further argument as to the frequency with which house-flies carry bacteria and the spores of moulds and other fungi unnecessary. Flies captured near excremental products are most frequently found carrying bacteria characteristic of the alimentary canal or putrefactive bacteria, and it is only to be expected that should such sources of contamination be infected with pathogenic bacteria, for example, from an incipient case of typhoid or from a typhoid "carrier," the bodies of the flies would become infected. As an instance of this, Hamilton recovered *B. typhosus* five times in eighteen experiments from flies caught in two undrained privies, on the fences of two yards, on the walls of two houses, and in the room of an enteric fever patient, and others have obtained positive results in similar experiments.

The habits of these insects are most perfectly suited for the dissemination of pathogenic bacteria. On one hand, they seek all kinds of excrementous and decaying vegetable and other matter, chiefly for the purpose of depositing their eggs; and, on the other hand, they fly with perfect freedom on to food such as milk, sugar, &c., much of which forms an excellent medium for the deposition of whatever bacteria they may have become contaminated with during their ubiquitous wanderings.

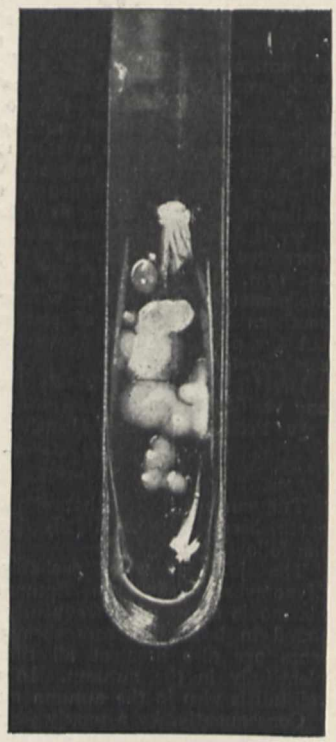


FIG. 3.—Agar-agar Slope culture of bacteria deposited by *M. domestica* in a single journey over the medium.

Not only during the summer, but also during the winter months, house-flies, if they are active, normally carry on their bodies and appendages bacteria and the spores of moulds, and Fig. 3 shows an agar slope culture obtained by allowing a fly caught in the writer's laboratory at the end of January, 1910, to walk up the agar slope; the comparatively large number of colonies which developed in the tracks of a single journey can be easily seen.

The eggs of the house-fly are deposited on most decaying vegetable substances, especially if they are in a fermenting condition; the influence of fermentation is of considerable importance; in one instance the maggots developed in germinating wheat. Of all substances they prefer horse manure, and this is most suitable for the development when it occurs in heaps as stable refuse, supplying as it does both moisture and heat, the two great essentials for a rapid development. They will also choose the excrements of man and certain other animals. Newstead found them in such animal and vegetable substances as rotting feathers, flocks, and paper, in which substances, when soiled with excrementous matter, they have also been found by the writer, and such conditions not infrequently occur in refuse heaps. Wherever there are collections of these substances, in such places will flies be found, not only depositing their eggs, but contaminating their appendages and bodies with putrefactive and other micro-organisms which abound there. Ficker and others have shown that typhoid bacilli can pass through the digestive tract

of the house-fly and retain their virulence for more than three weeks, but the more recent discovery by Faichne, that flies bred from larvæ which have developed in infected material carry the typhoid bacilli in their digestive tracts, is one of great importance in its practical bearing.

The most important factor which affects the numbers, activity, and potential danger of flies is temperature. Experiments show that at a high temperature the whole life-history can be passed in eight days. Further, it was found that the second generation of flies are able to begin to deposit their eggs as early as the fourteenth day after emerging from the pupa; in short, the second generation of eggs may be deposited in about three weeks after the deposition of the first. Each fly is able to deposit from 100 to 150 eggs in a single batch, and at least six batches are laid during the lifetime of a single female. It is not difficult, in view of these facts, to understand the production of enormous numbers of flies during hot weather, and how the activity and numerical abundance of flies increases with the rise of temperature. During the hot months of July, August, and September flies are most abundant, and it is a significant fact that in those years when the temperature is high during those months, that is, during the third quarter of the year, there is almost invariably a high mortality from typhoid fever and the infantile disease, summer diarrhœa. In connection with summer or infantile diarrhœa, a curve prepared from statistics covering the last twenty years showed, with the exception of one year, that a rise or fall in the number of deaths per thousand living in a large English city was associated with a rise or fall respectively in the temperature.

The relation of flies to summer diarrhœa is practically based on epidemiological and other circumstantial evidence, since the specific cause of the disease has not yet been determined with certainty. Morgan, however, has found a bacillus occurring in a large percentage of the cases of the disease, and the same bacillus has been isolated from flies captured in infected houses. An objection has been made to the idea that the house-fly is a carrier of the cause of summer diarrhœa, this objection being founded on the fact that at the end of the summer the fall in the fly curve follows the fall of the curve representing the diarrhœa mortality, the flies being still more numerous than they were earlier in the season, when the diarrhœa curve was rising. In meeting such an objection it may be pointed out that we are not considering the numerical abundance of the flies in the houses only; it should be remembered that with a decline of temperature the activity of the flies, especially out of doors, which is important in this case, is not so great, even though their numbers may be considerable indoors. With the fall of the temperature, therefore, the possibility of their carrying the infection decreases without a necessarily corresponding decrease in their numbers, and the diarrhœa curve will fall in consequence.

The fly problem, which is more serious in the United States and Canada than in England, is one that may be attacked and solved in cities and towns, provided that the authorities will take the necessary steps. As in districts previously infested with mosquitoes, these insects have been reduced to a negligible quantity by the abolition of their breeding-places or the rendering of the same unsuitable for the larvæ; so also the number of flies and their danger could be lessened very considerably by the removal of their breeding places, by preventing their access to the breeding places, or by treating these with substances noxious to the larvæ or flies. Flies are a public nuisance, and, therefore, to maintain places where flies are able to breed should be made a misdemeanour. Stable refuse should not be left exposed for a longer period than six or seven days in the summer, but should be removed from the vicinity of dwellings or treated with such a substance as chloride of lime, which will prevent the breeding of the flies, the refuse being kept in a closed fly-proof chamber. The presence of mews and stables with their exposed rubbish heaps will always account for the abundance of flies. The household dustbin or other repository for kitchen refuse, unless securely closed or screened and regularly emptied, also forms an excellent breeding ground. Public tips on to which all kinds of organic and decaying matter is deposited produce their flies in myriads; it is invariably found, where actual investigation has been made, that the percentage of cases of zymotic diseases of an enteric nature is abnormally high in the neighbourhood of public refuse tips and depôts where rubbish is allowed to accumulate.

In considering the relation of house-flies to disease, although the one species of fly, *Musca domestica*, usually constitutes from 90 to 98 per cent. of the fly population of houses, certain other species are also found to occur. The lesser house-fly, *Homalomyia canicularis*, has the next place in the scale of frequency, and is generally mistaken by the uninitiated for a young house-fly, on account of its general resemblance. Although both the adult fly and the larva have pronounced structural differences, the habits of the larva and the economic relationships of the fly resemble those of *M. domestica*. The blood-sucking fly, *Stomoxys calcitrans*, is not infrequently mistaken for the true house-fly, which has adopted vicious habits. *M. domestica*, however, is unable to pierce the most delicate skin, and *S. calcitrans*, which frequently enters and is found in houses in the spring and also in the autumn, especially in rural houses, presents considerable differences, the chief being the possession of an awl-like, piercing proboscis, a more robust build, and its coloration. Not infrequently inflammatory swellings, sometimes of a serious nature, result from the "bite of a fly," and such cases are instances of the mechanical transference of such bacteria as the Streptococci from infected material to a healthy human being by a blood-sucking fly. Malignant pustule may be caused by the mechanical transference of the *Bacillus anthracis* by a blood-sucking fly, or it may be by a non-blood-sucking fly, such as the blowfly, *Calliphora erythrocephala*, if the skin is broken to provide entrance for the bacillus.

Wherever there is filth, suppuration, or purulent discharge, flies are invariably attracted, and as they are cosmopolitan in their attentions and no distinguishers of persons, they are potential disseminators of such bacteria as these substances may contain. It is not a question of eradication in the case of this insect; such is impossible. Control and prevention, however, are within the bounds of possibility, and these will be regarded as essential when the facts are more generally realised. C. GORDON HEWITT.

THE NEXT TOTAL ECLIPSE OF THE SUN.

ON April 28 of next year there will occur a total eclipse of the sun which will begin on the earth generally at 7h. 49·2m. G.M.T., the central phase commencing at 8h. 46·1m. G.M.T. The path of the moon's shadow is restricted for the most part to the equatorial regions, and is confined to the longitudes between Australia and South America, so that as far as Europe or Asia are concerned the eclipse cannot be observed there even in a partial phase.

The actual line of central eclipse commences on

the south-east portion of Australia, and passes in a north-eastern direction, crossing the equator in about longitude 154° W. It then sweeps round in an easterly direction, terminating in about longitude 90° W. just off the west coast of Central America. The line thus extends over the full width of the Pacific Ocean, and it is therefore from islands in that ocean that the expeditions which may be sent out will have to make their observations. While there is a great number of islands in this ocean, there are, unfortunately, remarkably few which lie in the narrow band of the totality track. Following the line from west to east, the first that one finds on the Admiralty chart is Tofua, in the Tonga or Friendly Islands. The next that is met with is Vavau, in the same group, and also close to the central line of totality. Much further eastward we reach Nassau, which lies a little to the south of the central line, but well within the central zone, and not far away are the Danger Islands, which are situated to the north, but further away from the central line. Thus, so far as is indicated on the chart, there are only four available points from which observations can be made.

In order to find out the suitability of these islands for eclipse parties, Mr. F. K. McClean determined to make detailed inquiries on this point on his way out to the recent eclipse, travelling from England *via* San Francisco and New Zealand specially to gather this information. Particulars are now to hand, and at his request they are published here so that intending observers may benefit thereby.

With regard to Tofua the information is brief and concise. It is that Tofua is an active volcano and high, and therefore unsuitable. As regards Vavau he says very little, because, as he knows, it is generally recognised as being a good place for observation. He adds, however, that there are hills there several hundred feet in height; that the island is called at by mail steamers; and, finally, that there are many small and low islands in the neighbourhood.

Coming now to Nassau and Danger Islands, these are described as "difficult, but possible by using owner's boat and landing tackle." As observing stations he defines them as "good." The mode of procedure to utilise these islands is suggested by him in the following words:—

> A small steamer of several hundred tons (*The Dawn*), belonging to Captain E. F. Allen, runs to both Nassau and Danger. He does the whole of the landing and embarking of copra, &c. This steamer would have to be chartered at approximately 40*l.* per day when under steam and 20*l.* when not under steam. . . . Captain Allen says that he would undertake to get all cases on shore in good condition if they were water-tight, but he cannot undertake to keep them dry. If for any reason he could not land on one island, he could on the other in any reasonable weather conditions.

In most of the Pacific islands the chief difficulties to be met with are confined to the landing and embarking of the *personnel* and material. As many of the islands are fringed with coral reefs, with only small, narrow passages through them, in some cases natural, in others made by blasting operations, considerable skill is required in negotiating the breakers, and special surf boats are usually required. Mr. McClean's advice, therefore, is that it is almost imperative to employ someone accustomed to such work, "as certainly no one unused to the conditions could do it."

Should any of the parties who intend to go out on the occasion of this eclipse wish to locate themselves on some island other than Vavau, then Nassau and Danger Islands are their only alternatives. It is hoped, however, that one or other of these will be made use of, as they are sufficiently distant from Vavau to be subject to different weather conditions should the parties at Vavau be clouded out.

WILLIAM J. S. LOCKYER.

GLACIERS, GOLDFIELDS, AND LANDSLIDES IN NORTH AMERICA.[1]

AS an example of organised public research, the U.S. Geological Survey is unparalleled in its activity. Bulletins, professional papers, monographs and reports flow from the Government Printing Office at Washington in a stream that is well-nigh overwhelming to the student who tries to arrest it for systematic examination. Written, or brought by capable editing, to a standard of lucidity that is positively monotonous, well printed, lavishly illustrated, and distributed with enlightened generosity, these publications contain a store of precise information which illuminates every branch of earth-knowledge. The range of subjects which they cover is no longer confined even within the spacious limits of geology, palæontology, petrology, mineralogy and physiography;—it has overspread into many cognate branches of applied science, such as analytical chemistry, hydraulics, mechanics, engineering, metallurgy and mineral statistics.

FIG. 1.—Margin of Atrevida Glacier west of Esker Stream. Trees being buried by the ice.

The three handsome memoirs before us are good examples of the broad spirit in which the work is carried out; each, while dealing primarily with a particular district, is a notable addition to our knowledge of the continent as a whole; and each finds room for matter likely to be interesting to any educated reader, along with that which appeals directly to the specialist. In the first and third, the physio-

1 Professional Papers of U.S. Geological Survey. (Washington, 1909.)
(1) No. 64, "The Yakutat Bay Region, Alaska: Physiography and Glacial Geology." By Ralph S. Tarr; "Areal Geology." By R. S. Tarr and Bert S. Butler. Pp. 183; with 37 plates and 10 figures.
(2) No. 66, "The Geology and Ore Deposits of Goldfield, Nevada." By F. L. Ransome, assisted in the field by W. H. Emmons and G. H. Garrey. Pp. 258; with 2 maps, 33 plates and 34 figures.
(3) No. 67, "Landslides in the San Juan Mountains, Colorado, including a Consideration of their Causes and their Classification." By E. Howe. Pp. 58; with 20 plates and 4 figures.

graphical study of the subject is made paramount; in the second, petrology, mineralogy and mining receive the fullest treatment.

(1) Of especial interest is the professional paper first on our list, containing the results of Prof. Tarr's recent investigation of the great glaciers in the Yakutat Bay region of Alaska. We may congratulate ourselves, and Prof. Tarr also, on the happy mischance which took him to this region at a critical time in the history of its ice-fields.

Ever since the famous explorations of the late Prof. I. C. Russell, twenty years ago, we have known that where the greatest of these ice-rivers left the mountain valleys and deployed as "piedmont" glaciers on the low ground bordering the ocean, they were characterised by their peculiarly stagnant condition. The anomaly of dense living forests covering their surfaces over large areas where the ice was hidden beneath a thick blanket of moraine was one of the many surprises brought to our knowledge by Russell; and later investigations confirmed the idea that in such cases the ice was truly "dead" and would remain where it was, a waning relic of severer bygone times, until gradually dispersed by liquefaction.

Such was still the state of affairs when Prof. Tarr began his survey-work in the region in the summer of 1905, and he confidently planned a programme for the following year which depended for its fulfilment on the "deadness" of the ice. On his return in 1906 he was naturally astonished to find that all was in a turmoil of change—familiar features obliterated—routes impossible. The "dead ice" in many places had sprung to life again—the plains that had formed the highways of former travel were broken into an impenetrable wilderness of crevasses—the blanket of moraine was sliding out of sight into the yawning chasms—the green forests that covered it were sharing the same fate—the snouts of the glaciers were being thrust forward destructively into the timbered belt surrounding them—the enormously augmented streams issuing from the ice were impassable, and were flinging out huge delta-fans that buried everything in their path; and, altogether, nature in one of her most vigorous moods was enacting a grand transformation scene on the lonely shores of Yakutat Bay. All the eastern portion of the great Malaspina Glacier was a maze of crevasses, and its end—formerly an easy slope—an insurmountable cliff of tumbling ice, trees, and moraine. The Atrevida (see Fig. 1), the Variegated, the Marvine and the Haenke Glaciers were in the same state of rapid disruption; while others, including the Lucia and the Seward, though not so fully aroused, showed symptoms of impending change.[1]

FIG. 2.—View looking west from Hidden Glacier showing the Fosse and the Pitted Plain.

Yet there were other glaciers in the region that had not participated in this energetic outburst, but still kept to the habit of recession which had been regarded as the normal behaviour of all these Alaskan glaciers.

Here, then, was the unexpected problem that confronted Prof. Tarr in 1906 and richly recompensed him for the destruction of his original plans. His solution of it is remarkably simple, and seems to fulfil all the conditions. It is well known that in 1899 the region was affected by a sharp earthquake, which caused displacements recognisable on the coast-line

[1] In the *National Geographic Magazine* for January last Prof. Tarr and Prof. L. Martin give an account of their later visit to the region in the summer of 1909, when further changes were noted. The Lucia Glacier had become unpassable; the Hidden Glacier had undergone the full cycle of change; the Hubbard seemed to be on the eve of great movement; while the four mentioned above as active in 1906 had relapsed into stagnation.

and shook up the famous Muir Glacier so thoroughly that its seaward end was disintegrated, filling Glacier Bay with icebergs that barred out all shipping for some years. Prof. Tarr gathered evidence proving that the earthquake brought down huge avalanches of snow and rock from the mountain-sides into the glacier-basins, and he considers that the sudden accession of material has exerted a thrust which has swept slowly forward as a wave throughout the length of the glaciers. He strengthens his conclusion by showing that, at least in some cases, the unaffected glaciers are those fed from gentler slopes from which avalanches would be less likely.

The explanation raises many knotty points in the still imperfectly understood physics of glacier-movement, while the new facts constitute a very important element to be taken into account in all future discussions of ice-flow. In reading the descriptions we are reminded of the abnormal conditions found by Garwood and Gregory in the Booming Glacier of Spitsbergen (Quart. Journ. Geol. Soc., vol. liv., 1898, p. 207), and of the rapid advance and subsequent recession of the Hispar Glacier in the Karakoram Range (*Geographical Journal*, vol. xxxv., February, 1910, p. 108). Is it possible that a great mass of ice may become suddenly more mobile when its temperature as a whole reaches some critical point short of the melting stage? The glacial geologist could find ready application for some such proposition if it were presented to him with the requisite Q.E.D.

Besides these features of central interest, Prof. Tarr describes many other phenomena that will arrest the attention of the geologist; for example, the rock-channels cut by streams running along the margins of glaciers, which remind us of the old "overflow channels" lately recognised in many parts of Britain and Ireland; the "pitted plains," where morainic deposits have been spread out by streams in great "apron-fans" incorporating hidden masses of ice (see Fig. 2); the sudden slipping of a small mountain-glacier *en masse* from its high corrie into the waters of Disenchantment Bay, causing huge waves that swept destructively on to the land; and the spread of vegetation over the areas abandoned by the ice. His re-discussion of the efficacy of the glaciers as erosive agents should also be read by everyone who has shared in the long debate on this subject. The memoir concludes with a short account of the solid geology of the region, which is of less general moment.

We have scant space in which to deal with the other two memoirs, and must perforce dismiss them summarily.

(2) Mr. F. L. Ransome's monograph describes an area around Goldfield, on the hilly desert-plateau country near the border of south-western Nevada, which has recently sprung into prominence as a gold-mining centre. His historical narrative has a touch of romance in it—vast treasure lying close to the surface, yet passed over again and again by eager prospectors; then, in 1902, discovery—excitement—and disappointment; in 1903–5, renewed search crowned by success; great fortunes rapidly made and lost in the wild boom and its reaction, the feverish activity culminating in a fierce labour dispute which necessitated the calling up of federal troops at the close of 1907; and finally, the consolidation of interests and the systematic ransacking of the ground. It is estimated that the value of the precious metals recovered during the years 1904–7 from this small field was close upon 20,000,000 dollars.

As for its geology, the field is a low dome-like uplift of Tertiary lavas with associated lake-sediments, resting upon a sparingly-exposed foundation of ancient granitic and metamorphic rocks. The ore-bodies, apparently deposited in late-Tertiary times from "acidified" solutions at no great depth, are remarkable alike for their richness and for their irregularity. The structure, origin and mineralogy of the lodes, and the petrology and chemical composition of the rocks are fully discussed, and beautifully illustrated in the plates. In respect to the eruptive sequence, the author finds no proof of the regular order which J. E. Spurr has sought to establish for the lavas of the Great Basin. In criticising this scheme the author remarks:—"To some minds the conformity here shown may appeal as corroborative, but to others, impressed by the scanty representation of the numerous members of the ideal succession in any given locality, the capacity of the scheme for assimilating not only observed sequences, but imaginary ones, raises doubt whether it really represents natural processes" (p. 105). The criticism might be applied to many another ingenious scheme in science.

(3) The San Juan Mountains in south-western Colorado, like most steep mountains of similar structure, have been subject in the past, and are still subject, to extensive landslips. Many examples of these slips, both ancient and modern, are fully described by Mr. E. Howe in the third paper on our list, and are pictured in many fine plates which almost make description superfluous. A massive series of Tertiary volcanic rocks, often carved into huge cliffs, rests on a yielding base of soft Cretaceous shales; and, among the older sedimentary formations, are thick Palæozoic limestones resting on friable shales and sandstones. Attention is particularly directed to the curious "rock-streams" which have their origin in the high cirques; and to the influence of snow-banks on the accumulation of talus at the foot of cliffs. The memoir concludes with a somewhat laboured classification of landslides in which foreign examples and their literature are freely cited.

G. W. L.

MOUNTAINEERING IN THE NORTH-WEST HIMALAYA.[1]

ONE would hardly suppose, after reading this simply-told narrative of physical achievements, that the senior member—and shall we say, with Mrs. Workman's permission, leader—of the party among the peaks and glaciers of the Nun Kun group was compelled some years ago to retire from his medical practice on account of ill-health. Evidently, at great altitudes, where the vitality is lowered by insomnia attending deficient oxygenation, and where mental depression and attacks of irresolution follow a disturbed circulation, the successful explorer depends wholly on having his muscles under the complete control of a resolute mind for that last supreme fight against the irresistible instinct to descend to his natural environment. The Arctic explorer can sleep, can eat, and is the better for work to do; the mountain climber handicaps himself by his load of protective non-conductors; his respiratory difficulties are increased when in the only position of rest left to the biped, and every momentary doze through sheer exhaustion is terminated by frantic efforts to avoid the intolerable feeling of suffocation. Anyone who has experienced these troubles, which beset all climbers—even the lucky few who are proof against mountain sickness—will admire the mental as well as the physical qualities of the altitude record-breaker; for, judging by the recent sordid controversy among Arctic ex-

[1] "Peaks and Glaciers of Nun Kun: a Record of Pioneer-Exploration and Mountaineering in the Punjab Himalaya." By Fanny Bullock Workman and Dr. W. H. Workman. Pp. xv+204. (London: Constable and Co., Ltd., 1909.) Price 18*s*. net.

plorers, "records" have still a market value among geographers.

Although previous achievements of mountain climbers are now eclipsed by the Duke of the Abruzzi's record of 24,853 feet in the Karakorum, the exploration of the Nun Kun group by the authors of this work is likely to remain for long of special interest, on account of the circumstance that Mrs. Workman broke even her own record for women by scaling the Pinnacle Peak of 23,300 feet. The reference to this feat, however, is but a passing incident in the narrative, less drawn-out, in fact, than the accounts of the perky eccentricities of the irrepressible, pugnacious little cock of the poultry-yard—the clown of the party, who, like the indispensable figure among the acrobatic performers of the circus show, "talks all the time," as the Kashmiri *khansamah* remarked.

swadeshi are among those that exemplify new varieties of well-known type difficulties that are invariably "discovered" by non-official travellers in the Indian region; but, in the present instance, the few difficulties faced and overcome are not of the kind which travellers' descriptions often naïvely show to the experienced Anglo-Indian to be due to the travellers' own stupidity and ignorance of local affairs.

The additions to topographical knowledge need not be reviewed; they will be fully appreciated by officers of the Indian Survey Department, who are more conscious than their critics suppose of the shortcomings of their maps in regions which are of little direct concern to their master, the tax-payer, who has as much right to be considered as the sportsman and traveller. The authors made the experiment of taking out six experienced Courmayeur porters under an

View at sources of Hispar Glacier at 17,000 feet. In foreground avalanche-nieve-bed, pinnacles mostly formed from avalanche-blocks. In middle-ground broken, horizontally stratified ice-masses. Behind these ice-wall covered with parallel sub-incidence-*névé*-ridges orienting with slope. In background southern Hispar boundary mountains. Reproduced with the permission of Dr. W. Hunter Workman and Mrs. F. Bullock Workman. From "Peaks and Glaciers of Nun Kun."

The book is not a mere narrative of travellers' experiences in a little-trodden region; it discusses definite and valuable additions to geographical knowledge; important topographical corrections are made on the Survey Atlas quarter-sheet No. 45 S.W.; one-fifth of the text is devoted to the character and origin of the different varieties of ice prominences on the *névé*-surfaces and glaciers, and on the glaciers below the *névé*-line; the principal part of a chapter is devoted to a discussion of the immediate physiological effects of high altitudes; while the extremely high temperatures in sunlight at high levels and the great diurnal variations are all precisely recorded. Incidents of human interest on the journey are not forgotten—the moral weaknesses of the Kargil coolie and the price of the Wazir's devotion to the cause of expert guide, to replace the local coolies for work at high altitudes, where muscle alone is of little service, and this innovation has now been imitated by the Duke of the Abruzzi with successful results. The disturbing uncertainty of the malingering coolie being eliminated from the problem, Dr. Workman was able, with his trustworthy porters, to make satisfactory deductions from observations regarding the altitude limitations of human activity; and he shows that, in addition to the special danger of mountain sickness as a precursor of frost-bite, insomnia and the distressing moral and physical sequelæ of imperfect oxygenation may be sufficient alone to fix the stress-limit of the human organism at something distinctly below the greatest Himalayan heights.

The curious *nieves penitentes* first described by

explorers in the Andes have been recognised by the authors also in the Himalayan region, though their conclusions have not been completely accepted by other travellers. They, however, bring together in this work observations made in the Nun Kun area during 1906, as well as others made before and since in other parts of the north-west Himalaya, and have a right, consequently, to generalise on the phenomena. The prominences grouped under the name *nieve penitente* are often roughly pyramidal in shape, and generally disposed in rows on snow and ice at altitudes at which the night temperature falls below the freezing point; they are due to the unequal melting of the superficial layers of snow and ice. The authors describe in detail eight varieties of *nieves penitentes*, which, judging by the descriptions given, might have been divided into the following two groups:—(i.) Those that are the outward and visible expression of an internal heterogeneity of physical structure induced in the snow and ice by (1) the scoring action of avalanches with a trend parallel to the dip-slope; (2) the shearing effects of slower subsidence along the slopes; (3) the development of pressure waves by the wind; and (4) the more or less regular fracturing on seracs. (ii.) Those that are due to the disposition of various adventitious covers, such as (5) thin patches of earthy material arranged by the wind, and of a kind facilitating the absorption of the sun's heat with consequent melting of the subjacent ice; (6) heavy rock-masses, which compress and protect the ice, giving rise, by melting of the clean ice around, to the well-known glacial tables; (7) thick layers of earthy material, having a protective effect similar to that of the large rock fragments, but giving rise to differently shaped prominences on account of the disintegration and fall of the marginal parts of the covers; (8) water-covers in depressed areas, where silt is deposited unequally on a previously sculptured surface. These phenomena have been discussed in greater detail by Dr. Workman in special papers published in the *Zeitschrift für Gletscherkunde* and in the *Alpine Journal*.

A notice of this book would not be complete without reference to the remarkably fine photographic plates with which it is illustrated, although the illustrations, specially selected to demonstrate the phenomena of *nieve penitente*, and perhaps the best in the book, are taken from other areas, mainly from the Hispar and associated glaciers, further north-west, in the chiefship of Nagar. One of these is here reproduced.

T. H. HOLLAND.

THE EAST AFRICAN NATURAL HISTORY SOCIETY.[1]

THERE has been founded in British East Africa a society for the study of natural history, and the activities of this society naturally extend to the adjoining Uganda Protectorate. This society recently produced the first number of a Journal, which, it is to be hoped, may run to many volumes if conducted on the lines of its first number. Mr. C. W. Hobley, C.M.G., a prominent official of British East Africa, whose service there dates from the earliest days of the British East Africa Chartered Company, has taken a considerable part in the founding of this local natural history society, and is one of the contributors to the first number of the Journal. Mr. Hobley's work in anthropology, in East African languages, in geology, in the exploration of the aquatic fauna of Lake Victoria Nyanza (it will be remembered that he was the first, or one of the first, to discover in that lake organisms akin to the supposed marine fauna of Lake Tanganyika, thereby lessening the acuteness of that problem), has been so remarkable that his association with the Natural History Society should be productive of interesting results.

[1] The Journal of the East Africa and Ugnada Natural History Society. vol. i., No. 1, January, 1910. (London: Longmans, Green and Co., 1910.) Price 5s. net.

This first number contains a very well-executed coloured illustration of a new species of francolin (*Francolinus hubbardi*). This accompanies an article on the francolins of East Africa and Uganda, which to ornithologists is of real value. The scope of this article also includes the allied genus Pternistes. Mr. Battiscombe gives some new and interesting information regarding the flora of British East Africa. There are several small errors in the nomenclature of this article; *Lobelia johnstoni* is given as *Lobelia johnsonii*; *Kniphofia thomsoni* appears as *K. thompsonii*, and *Musa livingstonii* is given as *M. livingstonia*. The generic name Sanseviera is misspelt—a very common fault in books dealing with Africa. But these are trifling defects in an account of East African botany which is of considerable interest.

The Rev. K. St. A. Rogers writes on East African butterflies. There are notes on the haunts and habits of the elephant on the Guas' Ngishu plateau by Mr. Hoey, and Mr. C. W. Hobley contributes two articles, the more important of which, from the point of view of new information, is that dealing with the Karianduss deposits of the Rift Valley—deposits which form beds of a mealy, friable rock, amounting perhaps to millions of tons of diatomite. This is a siliceous deposit, principally of organic origin, mainly composed of the skeletons of minute, lowly plants—diatoms or bacillariæ—mere cells of green or brown protoplasm originally, which enclose themselves in a flinty casing fitting together like a box and a lid. Diatoms are, of course, found in fresh-water ponds and salt seas all over the world. Mr. Hobley considers the Rift Valley to have been the scene of tremendous volcanic activity from Tertiary times onwards, and that at one period in its history this enormously long depression in the surface of East Africa was covered by much larger lakes than at the present day. These beds of diatomite are the result both of the existence of these sheets of water and of the neighbouring eruptive volcanoes.

"Picture Suswa, Longenot, and Eburu all periodically in active eruption, and in addition to lava flows ejecting great clouds of volcanic dust and streams of mud mainly composed of siliceous fragments. This is almost certain to have been thus, as is the case in all volcanoes of this kind: the steam tearing its way through the magma which formed the flows of obsidian and trachytic tuffs would naturally blow large quantities into a state of very fine division, and this would be spread far and wide by the wind and also carried into the lakes by the torrential downpours which always accompany volcanic activity. The soda-laden water would dissolve the silica and place it ready for the diatoms to work upon, and with such rich material to build with one can quite see that this form of life could flourish with great luxuriance."

Mr. Hobley considers this diatomite or kieselguhr may be of some economic value.

H. H. JOHNSTON.

NOTES.

THE Astley Cooper prize for 1910 has been awarded to Prof. E. H. Starling, F.R.S., for an essay upon the physiology of digestion, gastric and intestinal.

THE Mackinnon studentship in physical sciences has been awarded by the Royal Society for a second year to Dr. R. D. Kleeman for the continuation of his researches on radio-activity; and the studentship in biological sciences has been awarded to Mr. T. Goodey for an investigation of the protozoa of the soil.

THE council of the Royal Society of Edinburgh has awarded the following prizes:—(1) The Neill Prize for the biennial period 1907–8, 1908–9, to Mr. F. J. Lewis, for his papers in the society's Transactions "On the Plant Remains in the Scottish Peat Mosses." (2) The Keith Prize for the biennial period 1907–8, 1908–9, to Dr. Wheelton Hind, for a paper published in the Transactions of the society "On the Lamellibranch and Gasteropod Fauna found in the Millstone Grit of Scotland."

THE U.S. Congress has passed a bill granting 10,000*l.* to establish a biological laboratory for the study of diseases of fish, especially those related to cancer. The station is, says *Science*, to be established under the U.S. Fish Commission.

THE committee of the science section of the Japan-British Exhibition has issued invitations to an inspection of the collections at the White City to-morrow, July 22, at 3.30 p.m.

THE Geneva correspondent of the *Times* announces the death, at sixty-four years of age, of Col. Georges Agassiz, nephew of the famous naturalist. After completing his studies at the University of Lausanne, Col. Agassiz spent several years in America with his uncle in scientific work and researches. Recently he presented to the Cantonal Museum at Lausanne his collection of butterflies, numbering 18,000 rare specimens.

IT is stated that a bill is to be introduced into the French Parliament making Greenwich time compulsory instead of Paris time, which differs from it by about nine minutes. If the bill becomes law, France will thus be brought into line with the zone system of referring time to meridians differing by an integral number of hours from the Greenwich meridian. It is thus not so much a question of one country adopting the time standard of another as it is of France accepting an international system of time reckoning. M. Millerand, Minister of Public Works, has been asked by the French Cabinet to support the proposal to substitute Greenwich time for the time of the Paris meridian when the matter is brought before parliament.

IN the House of Commons on Tuesday, a bill "to prohibit the sale or exchange of the plumage and skins of certain wild birds" was brought in and read for the first time. In introducing the bill, Mr. P. Alden said that the object of his bill is to try to prevent the absolute extinction of a few rare birds. The bill that passed the House of Lords in 1905 prohibited the importation of the plumage of almost all birds. Mr. Alden includes in the schedule of the present bill only a few birds that are on the point of extinction, but which may be saved if this bill, or a bill drafted by the Board of Trade, be passed into law within the next year or two. There is a law in Australia to prevent the export of the plumage of certain rare birds, one of which is the emu, yet last year more than one thousand emu skins were catalogued for sale in London—all smuggled out of Australia. A number of species of humming birds are almost extinct. In Trinidad the number of species has been reduced from eighteen to five. The skins of 25,000 humming birds have been catalogued for sale in London during the past year.

WE learn from *Science* that the University of Southern California, at Los Angeles, has established recently a marine biological station at Venice, Cal. The station is on the nearest beach to the university, some thirteen miles distant. It comprises an aquarium consisting of forty tanks with running sea water, and a series of laboratories for class work and research. The laboratories, which face the north, are provided with sea water and fresh water. The station is designed to afford: (1) facilities for demonstration to classes studying marine life; (2) opportunity for the students of the university to carry on advanced work in marine biology; and (3) a limited number of research laboratories, some of which are available, without cost, to investigators who are prepared to carry on research work in some of the phases of marine biology.

THE programme of papers and of demonstrations drawn up for the International Zoological Congress, to be held at Graz next month, includes a great variety of subjects. Prof. Boveri promises an address on Anton Dohrn; Prof. Delage will give an account of experimental parthenogenesis. Embryology will be treated by Profs. Lee, Julin, and Hubrecht. The geographical distribution of several groups of animals will be discussed, more particularly the cave-fauna of Carinthia. Prof. Gaupp will deal with the affinities of the Mammalia, Dr. Keller with the origins of domesticated races, and there are also many other memoirs promised that will attract workers in protozoology, genetics, and experimental embryology. The Graz meeting should prove a very successful one.

IT is officially announced that a submarine telephone cable of a novel type was recently laid across the Channel from Dover to Cape Grisnez by the British Post Office, in order to improve telephonic communication between this country and France, and also to determine the limits of possible improvement by the use of a new type, with a view to its application to telephonic communication between places which have hitherto been beyond telephonic range. This is the first cable of the kind laid in tidal waters and across the open sea, although a similar cable was previously laid in the Lake of Constance. The new cable will be brought into regular use as soon as the corresponding French land lines are completed, but the tests so far made have given very satisfactory results. The electrical conditions of submarine cables make telephonic communication through them difficult as compared with such communication carried on over land lines, and any improvement in their efficiency will have a marked effect in extending the distance through which telephonic speech is possible, and this more especially when the cable forms a considerable part of the total length of line through which communication has to be effected. In the case of the new cable just laid, the efficiency has been increased more than three times beyond the value which it would have if it had not been specially treated. This improved efficiency is due to the insertion of "loading coils" in the cable at intervals of one nautical mile. The coils reduce the distortion of the current impulses which correspond to the spoken sounds, and so render the speech more distinct.

IN the fourth number of the fifty-sixth volume of the Smithsonian Miscellaneous Collections Captain F. Schmitter, of the Medical Corps, U.S. Army, publishes a set of rough notes on the customs and folk-lore of the natives of the Upper Yukon, Alaska. It is remarkable that they are partly in the age of stone and partly in that of copper. The hammers which they use to break up bones for cooking and for making arrow-heads are rude lumps of stone, and of the same material are the axes which, at any rate up to quite recent times, they employed for cutting down trees; but their hunting-knives are of bone, ground flat, and sharp on both sides, or of copper welded in a similar fashion. Their chief weapon, the spear, is made by binding a hunting-knife of caribou horn to a pole 6 feet long.

IN a paper recently read before the Royal Society of Arts (see p. 58), Captain A. J. N. Tremearne discusses the origin of that remarkable African race, the Fulah or Filani. The view which he finally adopts is that the tribe arose somewhere in the Central Sudan from the union of Berber males with negro women; that with this mixture of race a mixed dialect came into use, combining Berber, Arabic, and Bantu elements. In process of time this mixed race separated from the Berbers and formed various groups, one going east and south, and becoming the Wahuma, another migrating west to Morocco, and a third, moving south, became the Fans. The quasi-Semitic origin of the tribe has produced a spirit of nationality, and some of their legends now connect them with a Jew or Arab progenitor. At present they form the aristocracy of the Hausa States in North British Nigeria and in French territory to the south and west, their head being the Emir of Sokoto. They are a people with great possibilities, and will doubtless take a high place in West Africa when once they frankly accept British and French supremacy.

THE Glastonbury Antiquarian Society has arranged for the publication of a work containing a full description of the excavations at the Glastonbury lake-village, by Mr. Arthur Bulleid and Mr. H. St. George Gray, with an introductory chapter by Dr. R. Munro. The work will also contain reports on the human and animal remains, bird bones, botanical specimens and seeds, and metal, by Prof. W. Boyd Dawkins, F.R.S., Dr. C. W. Andrews, F.R.S., Mr. Clement Reid, F.R.S., and the late Dr. J. H. Gladstone, F.R.S. The Glastonbury lake-village is regarded by archæologists as of primary importance in the history of pre-Roman Britain, giving as it does a vivid picture of native life before the arts of Rome penetrated to the west of England. The village is of the crannog type, the habitable area of about 3½ acres, originally in the middle of a mere, including some eighty dwellings surrounded by a border-palisading. The occupation of this area continued long enough to allow 5 feet of peat to accumulate in some parts during the occupation. The village had its origin in the early Iron age, and has contributed largely to our knowledge of the arts and industries of late Celtic times. The editors hope to be able to publish vol. i. of the work upon the excavations before the close of 1910. Vol. ii. will follow as soon as possible after vol. i., and probably within eighteen months. The work will resemble somewhat in style that of General Pitt-Rivers's "Excavations in Cranborne Chase." Any inquiries regarding the work should be sent (with stamped addressed envelope) to Mr. H. St. George Gray, Taunton Castle, Somerset.

THE Dominion Museum at Wellington has issued a hand-list of New Zealand birds, including stragglers, and the first and second parts of a hand-list of New Zealand Lepidoptera.

WE have received a copy of vol. vi., No. 9, of the University of California Publications in Zoology, containing a preliminary report, by Mr. G. F. McEwen, on the hydrographical work carried on by the Marine Biological Station at San Diego. Work of this nature was the main reason for the foundation of the Marine Biological Association of San Diego, but various causes prevented its being taken up in earnest until the summer of 1908, when the writer of the report before us became a member of the staff of the station, whose duty it should be to take charge for some portion of the year of water-investigations. The work of 1908 consisted of determinations of the temperature and density of the waters of the Bay of La Jolla and the ocean, the area covered lying between 33° 20′ and 32° 30′ N. lat., and extending from the coast to 118° 30′ long. In addition to this, two trips were made to the Cortez Banks, and a third to a point some distance south of Cerros Island. The methods of work and some of the results obtained are recorded in the report.

SOME remarkably fine skeletons of plesiosaurians from the Upper Lias of Holzmaden are described by Dr. E. Fraas, of Stuttgart, in vol. lvii. of the *Palaeontographia*. The author directs attention to the rarity of plesiosaurian remains in the German Lias as contrasting strongly with what obtains in the corresponding English formation. The latter indicates that these saurians were relatively abundant in the Liassic seas, although they did not, in all probability, congregate in such large shoals as the commoner species of ichthyosaurs. The majority of the English specimens come, however, from the Lower Lias of Lyme Regis, Street, and Charmouth, an horizon represented by a different type of strata at Holzmaden. Dr. Fraas refers his specimens to *Plesiosaurus guilelmi-imperatoris*, first named by Prof. Dames in 1895, and to a new species of Thaumatosaurus, which it is proposed to call *T. victor*. So perfect are the remains that they admit of restored figures of the skulls of both species being given. *T. victor* was about 10 feet in length, with a relatively small head, short and thick neck, very plump body, slender and nearly equal-sized paddles, and a very short and powerful tail.

IN the Bulletin of the Johns Hopkins Hospital for June (xxi., No. 231) Dr. Corson contributes an interesting biography of Sir Charles Bell, who did so much to elucidate the structure and functions of the nervous system, and whose "Anatomy of Expression in Painting" has remained a classic. Dr. Walker describes glandular structures hitherto supposed to form part of the prostate gland in rats and guinea-pigs, which, however, differ entirely in structure from the latter, and the secretion of which coagulates the secretion of the seminal vesicles when mixed with it. This coagulation is produced by a very minute quantity of the secretion, 1 part to about 21,000 parts of the secretion of the seminal vesicles being sufficient to produce the reaction. The active principle presumably belongs to the class of ferments.

IT is a pleasure to note the excellent manner in which the natural history of the American State of Connecticut is being worked up, and the results recorded in a series of pamphlets entitled "Bulletins of the State Geological and Natural History Survey of Connecticut." Five geological and five botanical bulletins have been issued, the last (No. 14) being devoted to a catalogue of flowering plants and ferns. A committee of six members of the Connecticut Botanical Society is responsible for the work, which has been compiled with great care. The list enumerates 1481 native and 461 introduced species, besides which 286 varieties and forms are recognised. The Cyperaceæ, Gramineæ, and Compositæ stand out as the largest families. Aster is the largest genus, and also one of the most interesting, as the native species include such useful horticultural types as *laevis, novae-angliae, novi-belgii, ericoides, longifolius,* and the rare *concinnus*; Solidago, another large genus, also provides the original types of some garden plants. The critical genera, Cratægus and Rubus, contribute to the size of the rose family, and the number of Violas is remarkable. Among the ferns, eight species of Isoetes and six of Botrychium are recorded.

THE current number of the Bulletin of the Department of Agriculture, Jamaica (vol. i., No. 3), maintains the high standard set by the two previous issues. Mr. R. Newstead contributes a valuable article on the ticks and other blood-sucking Arthropoda of Jamaica, describing their life-history and the methods adopted in attempts to exterminate them. It appears that ticks are most prevalent during the dry winter months, and that relatively few are found during the rainy season. As a rule the ticks infest cattle, but one much dreaded species, Chrysomyia (Compsamyia), attacks man; a case of myiasis thus produced is mentioned. This tick often passes its larval stages in putrid carcases, and is no doubt kept in check by the scavenger work of the John Crows (*Cathartes aura*), which remove practically all traces of carrion from man's habitations. From an article by the Hon. H. E. Cox, it appears that tea is now being successfully grown on the island; the Cinchona strain is used, and yields a tea of mild character similar to the old China teas and without astringency. There is also a useful history of the economic plants of Jamaica by Mr. Harris.

THE twenty-second annual report of the Agricultural Experiment Station, Lafayette, Indiana, chronicles several important events in the history of the station. The old buildings having proved insufficient, new ones were erected, and were formally opened during the course of the year. Still more important, however, was the provision of further funds, necessitated by the rapidly increasing demand from the farmers of the State for information on the lines of the work already being done. So strong was the demand that the General Assembly amended the Smith Act of 1905, whereby the station annually receives 25,000 dollars, and increased the State subvention to 75,000 dollars annually, to be expended as follows:—10,000 dollars for the general work of the station, 15,000 dollars for the improvement of the crops and soils of the State, 10,000 dollars for the advancement of the dairy interests, 10,000 dollars for the advancement of live-stock interests, 5000 dollars for the investigation of hog cholera and other diseases, 5000 dollars for poultry problems, and 10,000 dollars for extension work; and the Act concludes:—"Whereas an emergency exists for the immediate taking effect of this Act the same shall be in effect from and after its passage." The extension work includes the distribution of copiously illustrated bulletins dealing with important problems, a number of which we have also received; the provision of special trains to carry lecturers through the country, teaching as they go; attendance at shows, and so on. With such liberal support it is not surprising that much good work is done.

MR. ROBERT M. BROWN contributes an interesting series of diagrams to the Bulletin of the American Geographical Society (p. 107) showing the maximum, minimum, and average levels of the waters of the Mississippi system at five stations—Hannibal, on the Mississippi; Hermann, on the Missouri; St. Louis, just below the confluence of the Mississippi and Missouri; Cairo, on the Ohio; and Memphis, Tennessee. The varying influence of the different types of rainfall occurring in different parts of the drainage area is very clearly shown.

MR. H. T. BARNES, Macdonald professor of physics, contributes an interesting paper, with excellent illustrations, to the Proceedings of the Undergraduate Society of Applied Science of McGill University, Montreal, on the problems of winter navigation on the river St. Lawrence. Experience shows that, with Lake St. Peter free of ice, a continuous open channel above that point may be safely predicted, for the river is continually struggling to free itself of its icy burden. Prof. Barnes suggests that it would be quite possible to keep the ice-bridge broken up at the foot of Lake St. Peter and at the Sorel Islands, and that the lake itself could be kept nearly free of ice. One ice-breaker could keep the river clear at the Sorel Islands as well as at Port St. Francis, and this, with one powerful ice-breaker at Quebec, would effectively keep the ship channel open. The ice-problem thus solved, Montreal would inevitably become one of the greatest seaports in the world.

WE have received from the author reprints of two papers by Mr. E. A. Birge, published in the Transactions of the Wisconsin Academy of Sciences, Arts, and Letters. In the first Mr. Birge discusses a hitherto unregarded factor in lake temperatures. The heat of the sun is mostly delivered to the surface strata of a lake, and distributed to the depths by various agencies, chief of which is the wind. The efficiency of the wind as a distributing agent is opposed and limited by thermal resistance to mixture offered by the decreased density of the warmed surface water, and Mr. Birge brings forward evidence to show that the effectiveness of this thermal resistance increases as the temperature of the water departs from the temperature of maximum density, and decreases as it approaches 4° C. The second paper contains a review of the evidence adduced by Wedderburn in favour of the existence of temperature seiches in lakes, which leaves the author unconvinced.

MR. T. S. ELLIS has published a pamphlet on "The Winding Course of the River Wye" (Gloucester: Bellows, price 1s.), in which he expresses his views on the origin of adjacent river-systems. He regards valleys divided by cols at their heads as having originally formed a continuous channel, the two sections becoming separated when main systems tended to develop on either side. He does not seem to appreciate sufficiently the effects of rain, frost, and continual land-slide action in the cutting back of valley-heads, but represents geologists as attributing the removal of cols solely to erosion by the young streams flowing from them. On p. 9 he comes very near to the bold suggestion of Mr. A. W. Rogers, that a winding rock-ravine may record the original meanders of the river in alluvium at a higher level.

THE nature of intermetallic compounds is discussed by Dr. T. Slater Price in vol. iii. of the Proceedings of the Birmingham Metallurgical Society, which has made a somewhat belated appearance. The paper in question was read in January, 1909, and contains a list of 120 of these curious compounds, more of which are described every month. Among the laws of their formation, it is claimed that the metals forming a sub-group of the periodic system do not form compounds with each other, and, further, that any particular metal either enters into combination with all the metals of a sub-group or else it does not form compounds with any of them. Those sub-groups in which there is a change from metalloid to metal, as in the case of As, Sb, Bi, form an exception to the rule. The valencies of the metals in their compounds seldom correspond with the ordinary valencies, only thirty bodies out of the 120 enumerated showing this agreement, and of these, twelve are compounds of antimony, which approaches the metalloids in its characteristics. Among the compounds there are some very remarkable formulæ, for which no explanation is offered. For example, the formulæ $NaZn_{12}$, $NaCd_5$, $FeZn_7$, $NiCd_4$, and $AuSb_2$ have a strange appearance. Among other summaries of the state of knowledge on particular subjects, there are interesting articles by Mr. A. H. Hiorns on copper-nickel alloys, and by Prof. Arnold on the testing of metals.

THE problem of determining the vertical motion of the air during a balloon ascent is complicated by the fact that the balloon itself is in motion. Measurement of the variation of the barometric pressure at the balloon has, however, proved a trustworthy means of determining the vertical motion of the balloon, and the further problem of recording the relative vertical motion of the air with respect to the balloon appears to have been satisfactorily solved by an instrument described by Mr. P. Ludevig in the *Physikalische Zeitschrift* for June 15. It consists of light anemometer vanes which can rotate about a vertical axis. The spindle carries a thin, hollow brass cylinder through which six holes are punched, each pair at opposite extremities of a diameter, two near the top, two near the middle, and two near the bottom of the cylinder. The diameters are inclined at 60° to each other. Light can pass through, say, the central pair of holes when they happen to be in the direct line between a source and a moving strip of photographic paper, and a spot is registered. According to the direction of rotation of the cylinder, the spot next registered may be the upper or lower, and the speed of rotation determines the distance between the spots. An examination of the strip allows the speed of the air with respect to the balloon at any instant to be calculated if the speed of the strip is known.

THE Ontario Government announces that the system organised for the distribution of power from the Niagara Falls will be in operation for the supply of Toronto, London, and St. Thomas by the end of the year. The most distant of these places is about 100 miles from the Falls, and the transmission will be at 100,000 volts. The electrical energy will be bought from the existing Canadian generating stations by the various municipalities, which will effect the distribution by new transmission lines, extending over a wide area. By this means cheap power will be available for manufacturing and agricultural purposes, and it is hoped that a network of new tramways will be constructed which will not only improve travelling facilities, but also act as a means of bringing agricultural produce to the towns. A system of distribution of this kind should be of particular value in Canada, seeing that the supply of coal is deficient. The municipalities will not themselves own the tramways, lighting and power companies, but private companies will be formed to effect the final distribution of the power, and the control of the price charged to the consumer will rest with the municipalities in virtue of their ownership of the transmission lines. The cost of carrying out the above scheme will be defrayed by an issue by the Provincial Legislature of bonds redeemable at the end of forty years.

MESSRS. TOWNSON AND MERCER have submitted for our inspection a technical thermometer based on a novel principle. This consists of a metallic bulb containing liquid, and connected by narrow copper tubing with a pressure gauge. The gauge index responds to the variations in pressure of the contained vapour, and this depends upon the temperature of the bulb. The dial of the gauge can therefore be graduated in degrees instead of pressures, and is thus made into a direct-reading thermometer. The indications may, of course, be automatically recorded, as in the case of an ordinary aneroid barometer. The indications depend only upon the temperature of the bulb; they are independent of the temperature of the gauge, *which may be any distance away*, the air in the capillary tubing forming the connecting link which transmits the pressure of the vapour in the bulb. Damage to the bulb or capillary tube does not interfere with the accuracy of the indications; the bulb and tube may, in fact, be twisted or bent in any way which leaves them intact and does not prevent free communication of the vapour pressure. It will be seen at once that the thermometer possesses qualities which no other thermometer of the same simplicity can claim, and the result is that it is rapidly being adopted in works of all kinds where long-distance thermometry is advantageous. For example, in a single cabin of a ship may be dials indicating the temperature in any part of the hold, in powder magazines, coal-bunkers, refrigerating chambers, &c. Humidity is indicated by employing a pair, wet and dry, in the ordinary way. Its use in indicating the temperature of superheated steam has caused it to be adopted by all railways in France and by many other railways on the Continent. These thermometers are made of very various ranges, from −25° C. to +25° C., up to 450° C. to 700° C. This system of temperature indication is known as the "Fournier" system.

THE Journal of the Franklin Institute for June contains an article by E. E. Free on the phenomena of flocculation and deflocculation, a discussion of the mechanics of suspension, a subject of importance in the treatment of sewage, in ore separation, and many other commercial problems. The physical production of light forms the subject of a paper by E. P. Hyde, and is dealt with from the points of view of the laws of radiation and of physiological optics. There are also articles on Brennan's monorail car, the colloid nature of complex inorganic acids, and the Lumière process of colour photography.

THE *Bulletin de la Société d'Encouragement pour l'Industrie nationale* for May contains a paper by J. H. Ricard on the pine forests of the Landes. Full details are given, with numerous photographic illustrations, of the methods now employed for the extraction of the resin (*gemme*), and the extraction of essence of turpentine and rosin from the latter. Figures are given showing the yield of pine wood per hectare, and the proportions of the wood suitable for various uses. The financial aspect of the industry is dealt with fully, and the great advantages of the cultivation of the pine in these sandy districts pointed out.

THE electrolytic conductivity of non-aqueous solutions at low temperatures is the subject of a paper by P. Walden in the current number of the *Zeitschrift für physikalische Chemie* (June 17). Twelve organic solvents were used, tetraethylammonium iodide and tetrapropylammonium iodide being used for the "normal electrolytes," the observations in each case being carried down to the freezing of the solvent. The general result of the work shows that, as with aqueous solutions, the conductivity curve does not cut the temperature axis with a measurable angle; in other words, there is no definite temperature of conductivity.

THE 22,000-ton floating dock for the Brazilian Government is illustrated in the *Engineer* for July 8. This dock has been built by Messrs. Vickers, Sons and Maxim, Barrow-in-Furness, at a cost of 182,700*l.*, and is the largest dock of the kind built as yet in this country. The contract time for delivery at Rio Janeiro was eleven months. The contract was placed on October 4 last, and the dock sections were launched on June 7, 8, and 9. The designs were prepared by Messrs. Clark and Standfield, of London, who have already been responsible for sixty-seven floating docks having an aggregate lifting capacity of 486,691 tons. The present dock is surpassed by the 35,500-ton dock built last year by Blohm and Voss at Hamburg. Its lifting capacity will also be exceeded by two box-type docks now

building at Portsmouth and Sheerness for the British Admiralty, which are expected to be ready for service during the autumn of next year.

THE aërial-propeller testing plant at Vickers' Works, Barrow-in-Furness, is illustrated in *Engineering* for July 8. The apparatus consists of a double cantilever, 166 feet in length, the longer arm, at the end of which the propeller under test is mounted, being 110 feet in length. The cantilever is carried on ball-bearings on a cast-iron column, and the propeller is driven from a 100 horse-power electric motor situated in a test house which is arranged on the cantilever near the supporting column. The power is conveyed to the propeller by means of a long shaft passing along the cantilever, and bevel gear. The cantilever may revolve at any speed up to 70 miles per hour at the point of attachment of the propeller. The structure is balanced by a weight on the shorter arm of the cantilever. There is a method of compensating the circular motion of the propeller so that the conditions are similar to those of a ship running in a straight line through the air. The propeller may be run at speeds from 500 to 1000 revolutions per minute, and its speed through the air can be regulated by means of resistance screens. Measurements of thrust, efficiency, &c., are recorded in the observation station. Provision has been made for attaching a gondola to the platform ahead of the propeller, so as to obtain similar conditions to those on an air-ship having the propeller astern of the gondola. With characteristic solicitude for the advancement of science generally, Messrs. Vickers will place the apparatus at the disposal of investigators, so that any type of propellers may be tested.

METEOROLOGISTS, teachers of practical geography, and others will all find Messrs. Aitchison and Co.'s catalogue, Section iv., useful and interesting. It is concerned chiefly with barometers, thermometers, rain gauges, compasses, and pedometers; and the excellent illustrations and clearly arranged letterpress make reference easy and pleasant.

A THIRD edition of Prof. Ch. Moureu's "Notions fondamentales de Chimie organique" has been published by M. Gauthier-Villars, of Paris. The first edition of the work was reviewed in our issue of January 22, 1903 (vol. lxvii., p. 269), and it is only necessary to state that the present volume has been revised and brought up to date.

"AFRICAN MIMETIC BUTTERFLIES" is the title of a monograph by Mr. H. Eltringham which the Oxford University Press is about to publish. Descriptions and illustrations are given of the principal known instances of mimetic resemblances in the Rhopalocera of the Ethiopian region, together with an explanation of the Müllerian and Batesian theories of mimicry.

A VALUABLE supplement of seventy pages, dealing with Japan in all its aspects, was published with Tuesday's *Times* (July 19). Among the numerous important articles we notice in particular those on education, seismology, and volcanoes, by Baron Kikuchi, Prof. F. Omori, and Mr. E. Bruce-Mitford respectively. The publication, as part of a daily newspaper, of such a vast amount of detail and description relating to Japan as is given in the articles and tables is a remarkable enterprise. The supplement contains more information upon the position and progress of Japan than can be found in many books.

A SECOND edition of Prof. Armstrong's book of essays, "The Teaching of Scientific Method and other Papers on Education," has been published by Messrs. Macmillan and Co., Ltd. The first edition was reviewed at length in our issue of January 28, 1904 (vol. lxix., p. 289), and it will be sufficient to direct attention to the additions made in the present volume. Prof. Armstrong has introduced a prefatory essay entitled "Twenty-five Years Later," in which he considers the changes that have taken place in the teaching of science in schools during the period to which his essays relate. He has added two contributions; one, "The Correlation of Mathematical Teaching with other Work in Schools," was part of a report presented to the British Association at its York meeting, and the other, "A Criticism of School Method, with Suggestions for its Improvement," was delivered as an address to the Portsmouth Secondary Education League.

THE following volumes of the "Fauna of British India" series are nearing completion:—Mr. G. J. Arrow's volume on the Cetoniinæ and Dynastinæ is practically ready for publication. Mr. W. L. Distant's volume, an appendix to the Rhynchota, and Canon W. W. Fowler's work on the Cicindelidæ and Paussidæ, with a general introduction to the Coleoptera, are in the press. The remaining volumes which the editor, Mr. A. E. Shipley, with the assistance of Mr. Guy A. K. Marshall, and with the sanction of the Secretary of State for India, has arranged for in this series are:—Volumes on the Orthoptera (Acridiidæ and Locustidæ), Mr. W. F. Kirby; Butterflies (Lycænidæ and Hesperidæ), Mr. H. H. Druce; the Curculionidæ, Mr. G. A. K. Marshall; the Ichneumonidæ, Mr. Claude Morley; the Longicorn Beetles, Mr. C. J. Gahan; the Blattidæ, Mr. R. Shelford; the Helicidæ, Lieut.-Colonel H. H. Godwin-Austen; the Ixodidæ and Argasidæ, Mr. C. Warburton; Leeches, Mr. W. A. Harding; Fresh-water Sponges and Polyzoa and Hydrida, Dr. N. Annandale; the Meloïdæ, Mr. Creighton Wellman; the Brachyurous Crustacea, Lieut.-Colonel A. Alcock; and the Nemocera (excluding the Chironomidæ and the Culicidæ), Mr. E. Brunetti.

THE annual report of the Board of Scientific Advice for India for 1908–9 has been received. The attention of the Board has been directed to the fact that the rapid increase in the number of scientific institutions throughout the world is rendering it more difficult to obtain back numbers of the more important scientific periodicals, and that unless efforts are made now to secure complete sets of some of these for India it will be impossible at a later date to establish efficient libraries for the requirements of scientific research in India. The Board, on the advice of a sub-committee appointed to deal with the question, has recommended the Government to maintain "first-class" general reference libraries in Bengal, Bombay, Burma, Madras, the Punjab, and the United Provinces, and "second-class" libraries in large towns like Cawnpore, Mandalay, Nagpur, Simla, and so on. Lists of scientific periodicals which should be maintained in all "first-class" libraries and in "second-class" libraries accompanied the recommendations. The programmes of the various scientific departments of Government for the ensuing year were, after some revision, approved by the Board. In connection with the work of the Meteorological Department, it is proposed to make a series of balloon flights next December, the month chosen by the International Commission in Europe and America for simultaneous experiments on the conditions of the upper air. It is hoped, too, that the publication of the sixty years' records in connection with terrestrial magnetism at Colaba will be completed during the current year. The Department of Agricultural Bacteriology hopes to attack, among other problems, the determination of the chief bacteria characteristic of Indian soils, particularly those taking part in the fixation of nitrogen, the rotting

of organic material, and nitrification. In other departments interesting research work is being pursued actively. Very complete reports of the work done during the year 1908–9 in each of the scientific departments is included in the volume; to name a few, that dealing with astronomy and meteorology is by Dr. G. T. Walker, F.R.S.; that in geology by Sir Thomas Holland, F.R.S.; and in geodosy and geography by Colonel S. G. Burrard, R.E., F.R.S. An appendix on the economic investigations conducted at the Imperial Institute, by Dr. W. R. Dunstan, F.R.S., completes the volume.

OUR ASTRONOMICAL COLUMN.

PHOTOGRAPHS OF AURORÆ.—As an abstract from the *Comptes rendus*, we have received from the author, M. Carl Störmer, an interesting note on a photographic method of determining the altitudes of auroræ. The difficulty in obtaining such photographs is, of course, the extreme feebleness and the motion of the light, but, by using a cinematograph lens of 25 mm. dianeter and 50 mm. focal length, in conjunction with Lumière's "violet" plates, M. Störmer succeeded in obtaining measurable images, some of which are reproduced in his note. By choosing two stations 4·3 km. apart and arranging for simultaneous exposures, data for determining the altitudes were secured. The four sets of photographs reproduced represent different forms of auroræ seen during March, and also show recognisable stars, so that the parallax of definite points is easily calculated. The heights determined are 166 km., between 50 and 60 km., 190 km., and 120 km. respectively.

DISPLACEMENT OF SPECTRAL LINES AT THE SUN'S LIMB.—In spectroscopic determinations of the radial velocities of the various solar layers, a difficulty arises from the fact that various perturbations alter the wave-lengths of the lines considered, independently of the rotation. These subsidiary displacements have been ascribed to two causes, first, the effect of ascending currents in the solar atmosphere, and, secondly, to pressure effects. In order to decide which of these is the disturbing agent, M. A. Perot performed some delicate interferometer experiments which he describes in No. 1 (July 4) of the *Comptes rendus*. In order to determine definitely the exact point of the solar image under observation, M. Perot projected a 36 mm. image on to a copper plate ruled in millimetre squares, and having a circular hole, or a slit, 0·1 mm. broad at the centre; thus only the radiations passing through this definite aperture reached his interferometer and spectroscope. As a result of the experiments, M. Perot deduces, from the form of the curves of relative variation of wave-length obtained, that this relative variation is an effect of pressure, or density, and not of ascending currents.

THE PRESSURE OF LIGHT ON GASES.—In No. 5, vol. xxxi., of the *Astrophysical Journal*, Dr. Lebedew describes a series of very ingenious and delicate experiments by which he has been able to observe the effect of the pressure exerted by a beam of light on various gases. The apparatus is too complex to describe here, but, in effect, it consists of a small chamber in which the gas under examination is contained, and through which a beam of light can be projected in either direction. The pressure exerted by the light produces an excess of pressure in the gas at the farther end of the chamber, and this acts on a very delicate valve which is suspended on one arm of a torsion balance. From a large number of experiments, in which other variable effects were eliminated, Dr. Lebedew succeeded in establishing experimentally the existence of the translatory force exerted by light upon gases, and also in showing that these forces are directly proportional to the quantity of incident energy and to the absorption coefficients of the gas masses. As these experiments were made with gases at atmospheric pressure, the numerical values determined cannot be applied directly to such excessively tenuous masses as are involved in the case of comets' tails, but they provide a satisfactory basis on which further experimental work in this direction may be founded.

THE DETERMINATION OF STELLAR RADIAL VELOCITIES.—In No. 5, vol. xxxi., of the *Astrophysical Journal*, Prof. Frost publishes a table of corrections to be applied to the previously published list of radial velocities of certain stars of the Orion type. The corrections are necessitated by the re-determination of the wave-lengths of the three silicon lines at λλ 4553, 4568, and 4575, for which Exner and Haschek's values were previously adopted. Prof. Frost's new measures give 4552·636, 4567·897, and 4574·791 as the correct wave-lengths, and this involves positive corrections of 7·51 km., 3·48 km., and 7·14 km., respectively, to plates reduced with Exner and Haschek's values.

As Prof. Frost points out, finality in radial-velocity measures is hardly to be obtained; the values must be amended as a greater accuracy in the determination of stellar wave-lengths is attained. Further, in the case of blended lines, such as the double helium line at λ 4472, a variation in the relative intensities of the two lines will considerably modify the results. This is especially effective when the adopted blend is uncertain, as in the case of the blending of lines of different elements which may vary considerably from one stellar type to another. Prof. Frost also publishes the data establishing the variable radial-velocity of Rigel, showing a variation from +1 to +26 km., and states that on one plate a faint component to the line at λ 4472 was measured which gave a velocity of −108 km.; faint components were suspected in other instances.

The same journal also contains some further notes by Prof. R. W. Wood on the determination of radial-velocities with objective prisms. After trying several other media for producing fiducial lines, he tried peroxide of chlorine, which, contained in a suitable cell, appears to answer very well. It gives absorption bands which are very well defined on the red edge, and in his 21-foot grating photographs can be measured to within 0·02 Å.U.; with such bands, he suggests, radial velocities, of suitable stars, could be determined to within 2 or 3 kms. Unfortunately, the absorption bands cover most of the hydrogen lines, so that this absorbent could not well be used for first-type stars, although it is possible that λ 4863 and λ 3837 would appear; for other types a peroxide of chlorine screen apparently answers perfectly.

HALLEY'S COMET.—A number of observations are recorded in *Astronomische Nachrichten*, No. 4425, but, in general, they do little more than confirm others previously noted.

Herr G. Müller gives an outline of the observations made, at great altitudes, in Teneriffe, and Herr W. Münch describes the general observations at Potsdam. The spectrographic observations made on May 19, from 4h. 55m. to 5h. 10m. and from 5h. 28m. to 5h. 30m. (M.E.T.), are described by Herr v. d. Pahlen, but no modification of the normal solar spectrum was discovered. The slit covered 3½′ of arc, and two series of six exposures on the predicted positions of the comet on the sun's disc were made, so that a large area of the solar surface was covered without revealing any trace of the comet.

An observation by Dr. Ristenpart, at Santiago de Chile, on July 1 showed the comet as a nebulous mass 1′ in diameter, with no condensation, and with a tail 2° long.

HARVARD COLLEGE OBSERVATORY.—In his report for the year ending September 30, 1909, Prof. E. C. Pickering deplores the diminution of 5000 dollars in the income of the Harvard College Observatory, and points out that a disproportionate decrease will have to be expected in the amount of work accomplished. As in previous years, a great number of negatives of stellar regions and stellar spectra were added to the magnificent collection now stored at Harvard, and a number of important discoveries were made from the Draper memorial photographs. Seven meteor trails were found on chart plates, and at Arequipa the spectrum of a very bright meteor was secured. At this southern station the work was sadly upset by unusually bad weather, but, among other things, the spectra of more than 400 stars of magnitudes 5–6 were secured with the 13-inch Boyden telescope.

COLOUR OF THE SEA.

APROPOS of the report (NATURE, March 10) of Lord Rayleigh's lecture dealing with the parts played by reflection and transmission of light in the production of the integral impression of colour on the eye of an observer looking at the sea from the deck of a ship, I should like to be permitted to make some observations on the proper colour of the water of the ocean, as it is a subject which has occupied my attention, off and on, during the last forty years.

During the voyage of the *Challenger* I began to log the colour of the water in February, 1874, when she was working in the neighbourhood of the Antarctic circle. My attention was there directed to it by the frequent and abrupt passage of the ship from water of the clear indigo colour of the ocean of temperate latitudes to the deep olive-green water which is a distinctive feature of these icy regions.

The colour is due to the abundance of diatoms. These are so plentiful and so preponderant that, besides putting their stamp on the surface, they furnish a distinct type of oceanic deposit, the *diatom-ooze*. The green colour of the water is due, not only to the living diatoms, but also, and perhaps to a greater extent, to the excretions of the animals for the subsistence of which the diatoms furnish the ultimate food supply. The crowds of penguins and other birds to be met with in these seas stain all the ice green where they have rested. The water, inhabited by diatoms and affected by diatomaceous débris, has a deep olive-green colour which is characteristic, and this I accepted as one colour-type of the water of the ocean. It is seen best in the water the transparency of which is not interfered with by too great a crowd of the diatoms themselves. Water belonging to this type of colour is not confined to polar latitudes; it is met with in a certain class of homologous districts of the warmer ocean, in tropical and even in equatorial latitudes.

When we quit the edge of the polar ice and steer equatorwards, the surface water assumes a pronounced indigo colour, and this persists until we pass the fortieth parallel. If we start from the equator and sail polewards, the colour of the surface water persists as a pure and brilliant ultramarine until the thirtieth parallel is passed. The passage from the ultramarine to the indigo, and *vice versa*, is usually very rapid, and the area of mixture is restricted. No one who has once sailed in the ultramarine waters of the intratropical ocean and has observed, as well as seen, its colour, can ever mistake any other colour for it. If he has doubt as to whether the water through which he is passing is ultramarine or not, he may be sure that it is not. The ultramarine and the indigo are the two great colour-types to which the mass of the surface water of the deep sea belongs, and, with the olive-green, they make the three fundamental colour-types which are required, and are sufficient for the adequate logging of the colour of the surface water of the ocean.

The water of the Mediterranean belongs to the ultramarine type, but it always appears to me to have a harder tone than the soft and brilliant ultramarine of the intratropical ocean.

With regard to the method of judging the colour of the water, much unnecessary difficulty is made. The first precaution to be observed is to take up a position where the greatest amount of light can reach the eye after passing through the water, and the smallest amount after being reflected from its surface. There is generally little difficulty in accomplishing this on one side or the other of the ship and by looking as nearly as possible vertically into the water.

The *Challenger*, like other men-of-war of her date, was fully rigged, and built for sailing as well as for steaming. When under sail the propeller causes a certain amount of retardation, and to remedy this she was fitted with a "screw-well" into which the propeller could be hoisted out of the water. This proved to be a perfect observation tube for determining the proper colour of the water. Its diameter was about 6 feet; it passed from the upper deck through the captain's cabin on the main deck and the ward-room on the lower deck into the water. Looked into from the deck, the sea water appeared to be enclosed in it as the water is in a well, but with this difference, that the water, by day, was brilliantly illuminated from below. There being no clearance between the surface of the water in the well and the structure of the ship, no light could enter except through the water. No direct sky-light could reach it down the well, because the poop awning, which was practically always spread during the day, completely excluded it. The screw-well was, in effect, an artificial and perfected *Grotto di Capri*, which was carried round the world. It was perfected, inasmuch as there is a passage for boats to penetrate into the grotto from the outside, while the screw-well is entirely shut off. During the whole of the voyage the colour of the water was under observation in this very perfect apparatus.

The statement that the blue colour of the sea is nothing but the reflection of the blue of the sky was at first frequently made, even on days when the sky was completely overcast; a visit to the screw-well, especially on overcast days, never failed to convince the doubter that the water contained in its own mass sufficient colour to account for all that was perceived. When the ship was in green water the view was never advanced that its colour was due to reflection from the sky.

As ships with screw-wells long ago disappeared from the sea, it may not be superfluous to point out that what could be observed in the screw-well was altogether different from what can be seen in the wake of the screw of a modern steamer. While the screw-well was a perfect instrument for gauging the colour of the water, the determination of its transparency was more conveniently made from a boat. Thus in mid-Pacific, with the aid of a "water-glass" to eliminate the disturbing action of ripples, a metal plate measuring only 4 by 4 inches, painted white and not masked by the suspending line, was distinctly seen at a depth of 25 fathoms (45 metres). Beyond this depth it became indistinct, and became invisible at about 27 fathoms, but this was due mainly to its smallness and to its want of steadiness, being attached to the boat, which rose and fell with the swell. At 25 fathoms the plate had a pale ultramarine colour, and its edges were sharply defined. These separated the column of water, into which I looked through the water-glass, into a central column of rectangular section having a depth of 25 fathoms, and into a column, surrounding and contiguous with it, which had a depth many times greater. These columns, being juxtaposed, were placed in the way most favourable for the comparison of their colours. The colour of the central column, 25 fathoms in length, was a pure but pale ultramarine; that of the external and uninterrupted column through which the whole unabsorbed and undissipated part of the sunlight which had penetrated into the water returned to the surface was of the same tone, but of many times greater intensity. Assuming the intensity of the colour to be proportional to the length of the column of water traversed by the light, it is to be concluded that the length of the uninterrupted column which transmitted the more intense colour was many times greater than 25 fathoms. It must be noted that the glass plate forming the bottom of the small tub, which is called a "water-glass," was during the observation completely protected from direct sky-light by my head and the brim of the panama hat which, at that time, I always wore when exposed to the sun.

It has already been said that water of as pure a green as that of the Antarctic occurs in other and warmer districts of the ocean. My attention was first directed to this during the cruise of the *Dacia*, which, although it occupied no more than three weeks, marks an epoch in deep-sea research. A short account of it is given in a paper by me—"On Oceanic Shoals discovered in SS. *Dacia* in October, 1883"—and published in the Proceedings of the Royal Society of Edinburgh, 1885, xiii., p. 748. Perhaps the most remarkable of these shoals was the one which was named the "Coral Patch," in lat. 34° 57′ N., long. 11° 57′ W., the exploration of which, along with that of the tidal currents in the open ocean (Proc. Roy. Soc., 1888, xliii., p. 356), supplied the evidence which definitively established the fact that coral islands are a product of elevation and not of subsidence.

When the survey of this shoal had been completed, in so far as the time at the disposal of a steamer engaged on a commercial mission permitted, a line of soundings was

run from the "Patch" to the African coast at Mogador. Independently of the high land which is visible from the sea at a distance of many miles, the approach to the coast is indicated by a fall in the temperature of the water of the sea surface, and a remarkable change in its colour. Outside, the temperature of the surface water was 21° C., and its colour was ultramarine. After sighting the land its temperature fell, at first slowly, then rapidly, and, when at a distance of two miles from Mogador, it was only 16° C. The colour at the same time had become a pure olive-green, which maintained its transparency until close to the shore, where it became masked by the solid matter kept continually in suspension by the mechanical energy of the breaking waves.

The pure green colour of the water and its temperature, so much lower than that which could persist at the surface of the sea in the latitude of Mogador, made me for a moment think that it might be in reality Antarctic water which had found its way, at or near the bottom, into the northern hemisphere, having been diverted first to the west while in the South Atlantic, then to the east after crossing the line. But this idea could persist only for a moment, because the temperature and the density of the bottom water were found to be those characteristic of the bottom water of the eastern basin of the North Atlantic, as shown by the *Challenger* observations, and these are much higher than those of any other ocean.

The low temperature of the water showed that it could not come on the surface from the north or south or west of it, and the only source from which it could come was from below the surface. Deep water comes close to the coast, and the water at 2000 fathoms was found to have a temperature of 2·5° C., so that the supply of cold from this source was adequate, and it was available with a very small expenditure of energy. Arrived at the surface and following the south-westerly drift of the surface water, exposure to the sun raised the temperature of the water and discharged its colour *pari passu*. It was evident that there was here a case of the rising of deep water at the weather coast of an ocean, away from which the prevailing wind was continually driving the surface water.

From Mogador the *Dacia* proceeded to the "Seine Bank," in lat. 33° 47′ N., long. 14° 1′ W., and explored it thoroughly. Among the specimens brought up on the grapnel were masses of dead coral and shells, all having the same green colour. Some of these fragments were preserved in spirit, which quickly assumed the green colour, leaving the shells and coral practically decolourised. I sent the bottle, with the specimens and spirit, to my friend Prof. W. N. Hartley, in Dublin, who was good enough to subject them to spectroscopic examination. He wrote to me on February 15, 1884:—"I have made a spectroscopic examination of the colouring matter you sent me and have no doubt that it is altered chlorophyll. I have got identical wave-length measurements for the absorption band with your liquid and a specimen of very pure chlorophyll dissolved in ether"; and he adds, "there is very little real substance in even a dark green solution."

As the year 1884 belongs now to the remote past, I recalled the matter to Prof. Hartley, and, confirming his previous information, he added:—"I believe my impression at the time was that the chlorophyll was the colouring matter in a living micro-organism, and that these settled upon the shells, but when not deposited they were floating in the sea water." I am obliged to Prof. Hartley for kindly permitting me to use these private communications. Further information will be found in his paper on chlorophyll from the deep sea (Proc. Roy. Soc. Edin., 1885, xiii., 130).

Prof. Hartley's report furnished a remarkable confirmation of my first impression in so far as it showed that the green water of the Mogador coast owed its colour to the same substance as did the diatom-crowded water of the Antarctic, namely, chlorophyll.

In April and May of 1885 I made a coasting voyage from Valparaiso to San Francisco. Excepting the equatorial part, stretching from Cape Blanco to Panama and round the coast of Central America to near Mazatlan, the west coast of the American continent between the fortieth parallels is the weather shore of the Pacific Ocean. All along it cold and green water is met with, in the same way as we have seen to be the case on the Atlantic coast of Morocco. On the South American coast the green water was found to extend, with few interruptions, from Valparaiso, lat. 33° S., to Cape Blanco, lat. 4° 27′ S. As on the Morocco coast, the green colour and the low temperature of the water are found only close to the shore. At a distance of ten miles outside the colour is blue, and the temperature normal for the latitude. There can be little doubt that, as the localities where the green water occurs are geographically homologous, so the substance which produces the colour is generically the same, namely, chlorophyll.

The following particulars are taken from my unpublished journal. The only ports or anchorages where the water was blue were Huasco, lat. 28° 27′ S., temperature of the surface water 14·7° C., and Carizal, lat. 28° 5′ S., temperature 15·1° C. The occurrence in this latitude of blue water with so low a temperature is very remarkable.

At Antafogasta, lat. 23° 39′ S., the water was greenish-blue, and its temperature was 18·0° C. Between this port and Iquique the ship's course took her to a distance of nearly twenty miles from the coast, and there the colour of the water was ultramarine and its temperature 21·2° C. At Iquique the water was quite green, and its temperature 17° C. Between this port and Arica the water was quite green, even at a distance of five miles from the coast, where the temperature was 19·5° C., but on anchoring at Pisagua, lat. 19° 36′ S., the temperature of the water was only 15·2° C. At Arica, lat. 18° 28′ S., the water was equally green, but its temperature was 19·5° C. Arica lies in the angle where the trend of the coast changes from north to about north-west. From Arica the ship made a longer run to Chala, lat. 15° 49′ S., keeping at a distance of fifteen to twenty miles from the coast. Here ultramarine water was met with, its temperature rising to 23·2° C., but even at fifteen miles from this coast some green water was met with having a temperature of 18·8° C. I attributed this to the foggy state of the atmosphere which prevailed. This obscured the sun, and retarded both the heating and the bleaching of the water. In lat. 14° 8′ S., when six miles off shore, the water was quite green, and its temperature 15·1° C. Outside of Callao, lat. 12° 0′ S., the water was green, and its temperature 16·3° C.; in the harbour its temperature was 17·5° C., and its colour a dirty green, turbid and milky with sulphur, smelling strongly of sulphuretted hydrogen, and full of dead fish. Continuing northwards, off Ferrol Islands, lat. 9° 11′ S., the temperature of the water was 16·0° C., and its colour olive-green. At Payta, lat. 5° 5′ S., the temperature of the water was 17·1° C., and its colour a chalky green.

The green and cold shore water ceased abruptly at Cape Blanco, lat. 4° 27′ S., and during the passage round this cape from Payta to the entrance of the Guayaquil River, lat. 3° 9′ S., the temperature of the water rose from 17·1° to 25·2° C. From this locality a pretty straight line was followed across the equatorial current near its source to Panama, lat. 9° 0′ N. During the passage the temperature of the water varied between 25° and 27° C., and it maintained a blue colour throughout. At Panama, however, with a temperature of 27° C., the water was quite green.

A similar occurrence of cold and green water near the shore was observed on the North American coast from Cape San Lucas, at the extremity of the Californian peninsula, to San Francisco. In the equatorial waters which wash the coast from Cape Blanco, lat. 4° 27′ S., to Panama, and thence to Cape Corrientes, lat. 20° 25′ N., long. 105° 43′ W., green water is prevalent along the shore, but its temperature is very high, 28° or 29° C. Further information on this subject will be found in a paper by me on similarities in the physical geography of the great oceans (Proceedings of the Royal Geographical Society, 1886, viii., p. 753).

I will here refer to only one other locality, and that a well-known one, where the weather shore of an ocean is associated with green water of abnormally low temperature, namely, the east coast of North America from Florida to Nova Scotia. The cold and green water which is found on this coast, and lying between it and the western edge of the Gulf Stream, is usually attributed to the Labrador current, which is charged with the duty of

bringing cold water from Baffin's Bay as a surface current round Newfoundland and down the coast to Cape Hatteras and even beyond it. The principle was the same as that which moved Humboldt to attribute the cold water, which we have described in connection with the Pacific coast of tropical South America, to a surface current from the Antarctic Ocean. In the paper on similarities, &c., above referred to, I showed that Humboldt's explanation postulated an impossibility. The deeper layers of the water on the coast itself are capable of supplying, as and when required, much more cold than is wanted, and that with the least expenditure of energy. The same is the case with the "cold wall." Besides the south-westerly winds of the North Atlantic, and perhaps independently of them, the Gulf Stream itself, pouring its waters in a stream of great momentum past the American coast and out into the open ocean, performs the function of a colossal jet-pump, carrying water away from the surface and leaving its place to be taken by the other water which can get there most easily. This is the cold water of the deeper layers *in situ*. It is this hydraulic cold-water service which tempers the climate of the eastern States. The labours of the U.S. Coast Survey during the last seventy years have shown that fluctuations, both regular and irregular, occur in the flow of the Gulf Stream. These necessarily react on the supply of cold water drawn from the deep and spread over the continental shelf. Such variations are probably the source of the accidents which occasionally occur and cause the extinction of life over large tracts of shoal water on that coast.

J. Y. BUCHANAN.

REMNANTS OF THE PAST.

MUCH interest attaches to a paper by Mr. R. S. Lull, published in the "Proceedings of the Seventh International Zoological Congress, Boston, 1907" (issued 1910), on the evolution of the horned dinosaurs, or Ceratopsia. Although early ancestral forms are at present unknown, it is probable that the group took origin from an iguanodont stock. The earliest known types are Monoclonius and Ceratops of the Judith River beds, the single representative of the former being the more primitive, and probably ancestral to all the rest. In Monoclonius the orbital horns are much smaller than the nasal one, but in one species of Ceratops the two have become subequal; both genera show large vacuities in the cervical flange of the skull, which was probably internal. Between the Judith River and Laramie formations occur certain marine formations yielding no dinosaurian remains, but in the basal Laramie occur Agathaumas, of which the skull is unknown. Higher up this is succeeded by Triceratops, in which the vacuities in the cervical flange are obliterated, while in the various species may be traced a gradual increase in the size of the orbital at the expense of the nasal horn, the latter becoming almost obsolete in *T. elatus*, while it has disappeared in Diceratops, which forms a side-branch by itself. The remarkable genus Torosaurus of the Upper Laramie, although having developed large orbital horns at the expense of the nasal one, retains the long, straight skull, with a large vacuity in the cervical flange, of the Judith River *Ceratops monatus*, from which it may be directly descended. Physical changes in their environment seem, in the author's opinion, the most probable cause of the extinction of these marvellous reptiles.

In the April number of the *American Journal of Science* Mr. F. Loomis describes the complete skeleton of a new species of the camel-like genus Stenomylus from the Harrison beds of Nebraska. The genus differs from other Tertiary types by the hypsodont character of the dentition. This is considered by Mr. Loomis as an indication that Stenomylus differed from its relatives in habits. The early tylopods of the Protomeryx type probably fed on a mixed diet, while the members of the long-limbed Oxydactylus group may have subsisted on leaves and shoots, both retaining the original brachyodont dentition. Stenomylus, on the other hand, seems to represent a separate branch derived from the ancestral Poëbrotherium, which developed a hypsodont dentition, and took to feeding on hard-stemmed grasses growing on open, arid plains.

Dr. A. E. Ortmann contributes to the April number of the *American Naturalist* an article on the theory that a connection between Africa and South America persisted into the Tertiary. According to the Archelenis theory, as originally proposed by Dr. von Ihering, an ancient connection between the above-named continents was the last remnant of the much greater equatorial land-mass known as Gondwanaland, an area which was broken up at various dates, and remnants of which are represented by Australia, India, Africa, and Brazil. The separation of Brazil from Africa was the final stage in the dismemberment of the old continent, and it is generally considered that this took place towards the close of the Mesozoic epoch. A study of the Tertiary flora of Patagonia has, however, induced Dr. von Ihering to believe that Archelenis persisted into the Tertiary. It is argued, however, that the facts cited by von Ihering really lead to just the opposite conclusion, while the existence of marine Eocene deposits in many parts of West Africa is likewise an indication that the connection between the two continents had ceased. Accordingly, the evidence for a Tertiary Archelenis is considered valueless.

Vol. vii., No. 2, of the University of Colorado Studies is devoted to an account, by several authors, of the results of a scientific expedition to north-western Colorado. In a paper on plant-remains from the Cretaceous of Mesa Verde, Prof. T. D. A. Cockerell describes and figures a fragment of a branch bearing a remarkable resemblance to the Palæozoic lycopods of the Ulodendron type. It really belongs to an araucarian conifer (*Geinitzia reichenbachi*), but its resemblance to lycopods of an earlier period is highly significant in view of the probability of a real relationship between the two groups.

NON-FERROUS METALS.

IN many respects the second volume of the journal of the Institute of Metals marks a decided advance on the first volume—an advance which serves as a healthy sign of the continued growth of the institute. Perhaps the best sign of this advance is the inclusion, in the second volume, of a series of abstracts of scientific and technical literature bearing upon the subjects which come within the scope of the institute. These abstracts fill what has hitherto been a decided gap in metallurgical literature; they are obviously modelled on the very excellent abstracts of the literature of iron and steel which appeared in the Journal of the Iron and Steel Institute while that journal was under the editorship of the late Mr. Bennett Brough. Perhaps the most serious criticism to be offered on these abstracts is that they are of too indiscriminate a character, mere descriptive papers of small permanent interest being accorded equal space with papers of real importance.

The original papers, which, with the discussions, occupy the greater part of the second volume, have already been referred to in these pages on the occasion of the meeting at which they were read. It is satisfactory to find that the discussions show signs of free and vigorous criticism, and that such criticism seems to be accepted by the authors in a kindly spirit, even though at times the criticisms are practically destructive. Thus the first paper (Edwards and Andrew on aluminium-copper-tin alloys) is criticised on the ground that the data published do not afford sufficient insight into the facts upon which the authors base their conclusions. The paper of Prof. Turner and Mr. Murray, on the volume-changes of the copper-zinc alloys, is also challenged as regards the validity of its conclusions on the ground—apparently justified—that the mere measurement of the longitudinal contraction of a casting can give no true insight into the volume-changes which accompany the passage of the metal from the liquid to the solid state. More than eighty pages of the volume are devoted to the paper of Mr. A. C. M. Smith on the elastic breakdown of non-ferrous metals, and although the subject presents certain points of interest, it appears to occupy a good deal more than its fair share of space in a journal not specially devoted to such questions as the best means of measuring elastic constants. The paper, however, shows clearly the narrow limits within which Hooke's law is applicable to such metals as copper and aluminium; the latter appears to be particularly unsatis-

[1] The Journal of the Institute of Metals, vol. ii. Pp. 341. Vol. iii. Pp. xi + 360. Edited by G. Shaw-Scott, Secretary.

factory in this respect, and to carry this property with it into some of its alloys.

The third volume of the same Journal more than maintains the character of the earlier volume; this applies particularly to such papers as those of Bengough and Hill on copper-arsenic alloys, and of Hudson and Law on the phosphor-bronzes, together with the discussions on these papers. Such work must prove of great importance to the advancement of the technology of whole classes of important alloys.

Taken as a whole, the young Institute of Metals may well be proud of the present volumes, although we may hope that greater experience on the part of the editor and of the publication committee will lead to a more satisfactory apportionment of space. The illustrations throughout have been reproduced in a very satisfactory manner, and this applies also to the frontispiece, an excellent likeness of the first president, Sir William H. White, although the portrait of the second president (Sir G. Muntz) is not nearly so satisfactory.

THE ASSOCIATION OF TECHNICAL INSTITUTIONS.

Examinations for Evening Students.

THE summer meeting of the Association of Technical Institutions was held in Manchester last week. The question of examinations for evening students formed the basis of the discussion at the morning meeting on July 15, when Sir William Mather took the chair. At the present time examinations are held by the Board of Education in science subjects by the City and Guilds in technological subjects, and the Society of Arts in literary and commercial subjects. The London Chamber of Commerce also holds examinations which overlap both those of the Board of Education and the Society of Arts—especially the latter—and there are many other smaller examining bodies.

The Board of Education has for many years held examinations in mathematics, engineering, and building subjects, and in most of the sciences. Each examination is conducted by examiners appointed directly by the Board, and the examinations in each subject are independent, or nearly independent, of those in any other subject. The examiners have no official connection (and in most cases no connection of any kind) with those responsible for instruction in the subjects; and even those on the staff of the Board who come into contact with the teachers and the students—namely, the inspectors—are not systematically consulted, if they are consulted at all. Thus, although the examinations in any given subject may be excellent, and have been valuable in developing a higher standard of work throughout the country, it was the unanimous opinion of those present at the meeting that they are capable of great improvement.

Of late years most technical institutions have endeavoured to develop organised courses of instruction in connection with the important industries, engineering, textiles, building, chemical, &c. For these courses it is desirable that the syllabus in the individual subjects shall be modified to suit the particular course.

So far are the Board of Education examinations in many directions out of sympathy with the work that some speakers at the conference were doubtful whether the Board of Education was the best authority for conducting the examinations; but the meeting as a whole considered it desirable that the advanced work should be controlled by some national examining board in order that there should be a uniformity of standard, and thus the certificates obtained should have a common value; but it was felt that the examinations must be brought more closely into touch with the teaching, and it was resolved:—

"That it be represented to the controlling authorities of the examinations taken by evening students in technical institutions that it is desirable, for the encouragement of systematic courses of instruction and to bring the examinations into closer correlation with technical teaching, that the examining authorities should constitute advisory boards upon which representatives of teaching institutions (including teachers) and of technical and commercial interests should sit.

"That it be the function of such advisory boards to receive and consider the views of persons directly concerned in technical and commercial education, as to examination subjects, syllabuses, and methods of conducting examinations; and to advise the respective examination authorities thereon."

An examination has a two-fold object—to test knowledge and to grant a certificate—and the two are to some extent antagonistic; the first, enabling the student and his teacher to judge of his progress, is probably best attained if the teacher himself conducts the examination. A certificate, however, granted on the examination of an individual teacher, can have no public value, and can only become valuable to the extent to which it attains uniformity. In the earlier stages of instruction the former object is of the greater importance, and therefore in the earlier stages it is probably desirable that the examinations shall be conducted by the teachers. In the latter stages it is more important that the certificates shall have a uniform value, and therefore in these stages it is desirable that the examinations shall be conducted by a national body. Also, in the higher stages, the number of candidates who would be sitting for the examination in any given centre would be comparatively small, and the cost of a separate examination for individual schools in these subjects would be prohibitive except in the very large centres; so that, even if it were desirable that the examinations for the higher work should be conducted by the teachers, the financial burden would be too great in most cases. Thus the following resolutions were adopted:—

"That this association is of opinion that, in the interests of technical education, it is essential that the Board of Education or other national authority shall continue to conduct examinations above Stage 1 Board of Education, and Preliminary Grade City and Guilds."

"That examinations of an elementary character (*e.g.* Stage 1 Board of Education, Preliminary Grade City and Guilds, Elementary Stage Society of Arts) should, in the main, be conducted by provincial boards, local education authorities, or the governing bodies of the institutions; but that, pending the re-modelling of the examination system, the present examining boards should continue to hold these examinations."

Even with the establishment of advisory boards there would still remain the evils arising from the overlapping and duplication of the examinations. At the present time the examinations of evening students begin in April and last well into July, thus destroying the value of the last part of the session for teaching purposes. So long as examining bodies endeavour to arrange that any student may take any subject, it is obvious that the examinations will have to spread over a large period of time. With the establishment of the course system, it will be possible to a large extent to determine beforehand those subjects which a given student will require to be examined in, and thus to concentrate the examinations upon a much smaller number of evenings. So strongly was it felt that the whole system requires a very drastic reform that it was unanimously resolved to ask the Board of Education to appoint a committee to inquire into the working of the present examination systems, including science, technology, and commerce.

Trade Schools and Trade Preparatory Schools.

At the afternoon meeting, a report prepared by the council of the association on the above subject was discussed. The report includes accounts furnished by the organisers of many of the schools which have recently been established in various parts of the country.

It is pointed out that there are two very distinct types of school with entirely different aims; one, which in the report is termed, for want of better title, *Trade Preparatory School*, may be considered a form of secondary school in which the ordinary education is continued, but with a very distinct bias on the technical side. It is assumed that the majority of the boys, though not all necessarily, attending such a school will afterwards be engaged in some trade. The schools differ from the ordinary secondary schools in the large amount of time devoted to various forms of manual instruction. As a rule the curriculum includes English, mathematics, one language, drawing—both free-hand and model—science, and workshop practice in wood

or metal, or both. The course is, as a rule, intended to last three years for boys from twelve to fifteen years of age.

As so many of the technical institutes throughout the country are only used at present in the evenings, and have their rooms and equipment idle in the daytime, and the staffs of the technical schools are particularly suitable for the type of instruction required, these schools, which have proved exceedingly successful where they have so far been established, may be considerably increased in number in the near future.

Attention was directed to the very strong expressions of approval by employers, the Chamber of Commerce, and trades unions in the case of the trade preparatory school, which is now in its third session at Halifax; and as the boys from these schools pass into employment as apprentices or as improvers, the value of this kind of school is becoming more and more appreciated.

One speaker pointed out the great value of manual instruction to boys and girls right through their school course, and remarked—his remark being applauded by the meeting—that he hoped the board would do its best to encourage this work in every kind of school.

Another speaker said that there are a great many boys to whom the literary subjects of the ordinary school course do not appeal, and to whom the more technical subjects introduced in the trade preparatory schools do appeal very strongly. Thus it is educationally of real advantage to the community that schools should be provided in which boys with a turn for mechanical subjects, but no liking for literary subjects, may have a chance to learn that they have some ability, and may not leave school with the feeling that they are inferior to their fellows because they are unable to distinguish themselves at literary work.

Other speakers referred to the very small grant it is possible to obtain under the board's regulations for this type of school, which is necessarily an expensive one to run owing to the large amount of practical work in the time table. It was felt that the grant should be at least as great as that given by the board to an ordinary secondary school.

Quite distinct in aim from the Trade Preparatory School is the *Day Trade School*, only a few of which are at present in existence. In London there are day trade schools for girls which have proved most successful; a good account of these is included in the report referred to. There are two special trade schools for bakery and confectionery; there are one or two part-time trade schools for boys who are already employed in the trade, the boys being allowed to attend two or three afternoons a week by arrangement with the employers. The best example of such a school is, perhaps, that for jewellers and silversmiths at Birmingham, which is already proving of real value to the trade.

Opinions were somewhat divided as to whether local authorities could be expected to establish schools of this kind, which take the burden of preparation of apprentices off the employers, without substantial financial aid from the employers themselves. It was pointed out that, although none of these schools could decrease the unemployment, they would give boys the chance of entering a useful occupation, and would thereby tend to reduce the number of those who take up so-called "blind-alley occupations."

THE POSITION OF UNIVERSITY EDUCATION IN GREAT BRITAIN.

A BLUE-BOOK has just been published (Cd. 5246, price 2*s.* 6*d.*) containing the reports from the universities and university colleges which participated, in the year 1908–9, in the annual grant, now amounting to 100,000*l.*, made by Parliament for "University Colleges in Great Britain," and from the three colleges in Wales which received a grant of 4000*l.* each.

This is the sixteenth volume of the reports, and it is by far the most useful on account of the analysis it contains of the position of university education in Great Britain. For several years we have urged in these columns that the Board of Education should bring together the statistical and other information given in the separate reports of universities and university colleges, so that a comparison could be made of the position and progress of the various institutions, and of university education in Great Britain, with that in other countries. Merely to print the reports without any attempt to sum up the particulars they contain, as was done in all volumes previous to the present one, has always seemed to us as unscientific as it would be to record a long series of observations without endeavouring to arrive at conclusions from them. This unpardonable omission has now been remedied, and we have available, for the first time, an instructive abstract of the financial resources and students under instruction of institutions which participate in the Parliamentary grant for universities and university colleges. We give below some extracts from the introductory memorandum signed by Mr. W. Runciman, President of the Board of Education, and abridgements of the tables appended to it.

In the last ten years no fewer than five new universities have been founded in England, but the progress of institutions of older date has been no less marked. In July, 1909, King Edward VII. laid the foundation stone of important new laboratories for the Imperial College of Science and Technology, a college for the highest studies in pure and applied science, which was inaugurated by Royal Charter in July, 1907, and was formed by the union under a single governing body of the Royal College of Science, the Royal School of Mines, and the City and Guilds' Central Technical College. In the following October the new buildings of the University College of South Wales and Monmouthshire were opened at Cardiff, and on that occasion the present King, as Chancellor of the University of Wales, wrote words which apply equally to all the universities of England and Wales when he said, "We must look ahead and endeavour to be ready to meet all the requirements of scientific and intellectual progress. The imperative necessity for higher education and research is becoming more and more recognised."

This encouragement to further effort has been tangibly supported by the Government. Acting upon the report of a special committee of inquiry, under the chairmanship of Sir Thomas Raleigh, K.C.S.I., the treasury, by a minute dated December 18, 1909, made an increased annual grant of 15,000*l.* to the University of Wales and its constituent colleges. Of this sum 1500*l.* has been specially allocated to the Medical School of Cardiff, and another 1500*l.* a year has been assigned to the university itself for the foundation of research fellowships.

The treasury has also made a capital grant of 20,000*l.* towards the cost of the new buildings for the University College of North Wales, Bangor.

State-aid to university teaching would, however, be of doubtful advantage if it did not stimulate private effort and induce benefactors to contribute in the present day as they did in the olden times, to give of their wealth for the support of that higher learning upon which now, more than ever, "the prosperity, even the very safety and existence, of our country depend."

The Board is glad to find that there is no evidence of the springs of private beneficence failing, but rather that the growing national sense of the vital need of universities has impressed many of those, whether individuals or corporations, who are in the position to help. The following are some of the more important gifts made during the last twelve months:—

Sir Alfred Jones, the well-known ship-owner, who died in 1909, and who during his life had founded the School of Tropical Medicine in connection with the University of Liverpool, left to his trustees the sum of more than 500,000*l.* upon trust for such charitable purposes and objects in England (or any British possession on the west coast of Africa) as they may in their absolute discretion think fit. For the guidance of his trustees, however, he made suggestions as to the purposes to which the money might be applied, and amongst them were—the advancement, benefit, or support of education or science, and original research of all kinds in the cause of disease on the west coast of Africa.

Mr. Otto Beit, in December, 1909, gave 215,000*l.* for the endowment of thirty medical research fellowships of 250*l.* a year, each tenable for three years. The fund is to be entirely devoted to the furthering of medical research work, which is to be conducted, with a few exceptions, in institu-

tions allied to London University. The fellowships are open to any man or woman of European descent who is a graduate of any approved university within the British Empire.

The late Dr. Charles Graham, who died in November, 1909, and had been since 1889 emeritus professor of chemical technology at University College, London, bequeathed his residuary estate to London University, to be applied to the promotion of research at University College itinerary regulated and prescribed by the trustees, will be elected by the trustees on the nomination of the Vice-Chancellor or other executive head of each of the universities in the United Kingdom, the President of the Royal Society, and the president of the British Academy. M. Kahn has provided funds sufficient for a period of three years, and is prepared at the expiry of that time to endow the fellowships in perpetuity if they should prove to fulfil the objects which he desires.

TABLE I.—UNIVERSITIES AND UNIVERSITY COLLEGES IN ENGLAND AND WALES

Returns of Income, 1908–9

(Figures to the nearest £)

	(1) Fees		(2) Endowments		(3) Donations and Subscriptions		(4) Grants from Local Authorities		(5) Grants from Exchequer		(6) Other Income		(7) Total
Name of University or College	Total of all Fees	Percentage to whole Income	Total Amount of Endowments	Percentage of total Income	Total Amount	Percentage of total Income	Total Amount. [Fees remitted, as a condition of grants, are shown in brackets]	Percentage of total Income	Total from Exchequer	Percentage of total Income	Total Amount	Percentage of total Income	Total Income. [Including Amount represented by Fees remitted.]
England	£		£		£		£		£		£		£
1. Birmingham...	17,176	31·6	8,462	15·5	1,344	2·5	7,081	13·0	15,070	27·7	5,229	9·6	54,362
2. Bristol	6,636	44·3	411	2·7	1,419	9·5	770 (195)	5·2	4,918	33·0	792	5·3	14,946
3. Leeds	14,641	25·9	7,183	12·7	2,285	4·0	15,522 (1,923)	27·5	15,167	26·8	1,765	3·1	56,563
4. Liverpool ...	19,721	27·1	16,198	22·3	4,863	6·7	14,350 (623)	19·7	16,132	22·2	1,334	1·8	72,599
5. Manchester ...	25,141	31·4	24,938	31·1	2,900	3·6	5,250	6·4	19,034	23·7	2,861	3·6	80,124
6. Sheffield ...	6,722	16·4	3,770	9·2	1,522	3·7	16,112 (1,063)	39·3	11,505	28·1	1,379	3·3	41,010
7. London: University Coll.	23,686	42·4	11,066	19·8	3,421	6·1	1,960 (1,781)	3·5	11,250	20·1	4,485	8·0	55,867
8. King's College	26,387	53·4	1,582	3·2	4,473	9·1	4,171 (2,318)	8·4	9,704	19·6	3,077	6·2	49,394
9. Bedford Coll.	8,002	46·8	892	5·2	516	3·0	1,924 (1,672)	11·3	4,944	28·9	819	4·8	17,097
10. School of Economics...	3,741	29·0	115	0·9	2,031	15·7	3,845 (283)	29·8	3,080	23·9	81	0·6	12,893
11. Newcastle: Armstrong College ...	8,172	28·5	2,084	7·2	2,689	9·4	3,020 (608)	10·5	11,996	41·8	719	2·5	28,680
12. Nottingham...	3,287	15·8	572	2·7	252	1·2	7,954	38·3	8,328	40·1	386	1·8	20,779
13. Reading ...	6,602	32·4	2,107	10·3	2,281	11·2	1,875 (273)	9·2	7,112	35·0	402	1·9	20,379
14. Southampton: Hartley Coll.	2,790	22·9	525	4·3	130	1·0	3,869 (564)	31·8	4,765	39·2	71	0·6	12,150
15. Totals—England	172,704	32·2	79,905	14·9	30 126	5·6	87,703	16·3	143,005	26·6	23,400	4·3	536,843
Wales													
16. Aberystwyth	5,937	38·5	484	3·1	1,682	10·9	598	3·8	6,598	42·8	114	0·8	15,414
17. Bangor	3,616	24·7	2,897	19·7	627	4·3	709	4·8	6,672	45·5	136	0·9	14,658
18. Cardiff	7,111	34·6	535	2·6	561	2·7	2,804 (750)	13·6	6,678	32·5	2,865	13·9	20,554
19. Totals—Wales	16,664	32·9	3,916	7·7	2,870	5·7	4,111	8·1	19,948	39·4	3,115	6·1	50,626

Hospital Medical School "for the prevention, cure, or alleviation of human disease or suffering." The legacy was estimated at 35,000*l*.

Still more recently, M. Albert Kahn, a well-known French philanthropist, has handed over to a board of six trustees a sum of 414o*l*. to provide for the annual award of two travelling fellowships, each of the value of 66o*l*. It is expressly desired by him that the trust shall be permanently associated with the University of London. The fellows, who must travel for at least twelve months, according to an

Mr. Alexander Elder gave, in 1909, a sum of 20,000*l*. as endowment for a chair of naval architecture in the University of Liverpool, and Mr. W. H. Lever, of the firm of Lever Brothers, Port Sunlight, in March, 1910, made a gift of 91,000*l*. to the same university for the erection of a building in which the School of House and Town Planning could be accommodated, and also the School of Architecture, and for assistance to the School of Tropical Medicine and the School of Russian Studies.

City companies and corporate bodies have also made new

contributions to the support of university education during the last year. The Goldsmiths' Company, who had already been generous benefactors of university education in London, made a gift in May, 1909, of 50,000*l.* towards the cost of the new engineering buildings of the Imperial College of Science and Technology referred to above. The Drapers' Company made a further grant of 10,000*l.* to the building fund of the new college at Bangor, to be applied towards the library and museum of the college. The same company make an annual grant of 7000*l.* to the East London College, which has been admitted for the first time this year to share, subject to the fulfilment of certain conditions, in the annual treasury grant made to university colleges. The company also grants scholarships in connection with this college to the annual value of 1555*l.*

The universities have recently shown in other directions that they are conscious of a joint responsibility in their direction of equalising the standards required by the several examining bodies; but there is a general agreement as to the end desired, and the difficulties are chiefly those of means, in both senses of the word. The whole question of examinations in secondary schools is at present under consideration by the consultative committee of the board, and the board hopes that the report of the committee, when presented, will point the way to further progress.

But the national life and the national needs in higher education cannot be confined within the limits of these islands. The growth of important universities in the British dominions beyond the seas, and in the Empire of India, and the rapid improvements in the means of communication, have brought new opportunities and new responsibilities to those who are entrusted with the provision of university education. The necessity for a regular interchange of views, and for the better organisation of

TABLE II.—UNIVERSITIES AND UNIVERSITY COLLEGES IN ENGLAND AND WALES

Returns of Expenditure, 1908–9

(Figures to the nearest £)

Name of University or College	Administration (1)	Percentage of total Expenditure (2)	Maintenance of Buildings, &c. (3)	Percentage of total Expenditure (4)	Remuneration of Teachers Departmental Expenditure (5)	Percentage of total Expenditure (6)	Superannuation (7)	Percentage of total Expenditure (8)	Scholarships (9)	Percentage of total Expenditure (10)	Other Expenses (11)	Percentage of total Expenditure (12)	Total (13)
England	£	%	£	%	£	%	£	%	£	%	£	%	£
Birmingham ...	6,611	10·8	6,105	10·0	37,362	61·3	820	1·4	1,896	3·1	8,128	13·3	60,921
Bristol	1,915	11·6	1,410	8·5	11,570	70·1	967	5·8	271	1·6	363	2·2	16,495
Leeds	4,803	8·8	6,411	11·8	37,701	69·3	1,153	2·1	1,620	3·0	2,674	4·9	54,362
Liverpool	6,996	10·0	7,541	10·8	45,403	65·0	955	1·3	5,986	8·6	2,988	4·3	69,870
Manchester	7,079	8·9	8,858	11·2	49,970	63·2	2,457	3·1	5,014	6·3	5,725	7·2	79,103
Sheffield	4,281	10·5	4,006	9·7	27,858	68·6	586	1·4	1,311	3·2	2,538	6·2	40,580
London: University College ...	3,862	7·4	7,919	15·2	36,007	69·3	500	1·0	1,497	2·9	2,153	4·1	51,938
King's College ...	3,851	7·9	5,793	12·0	33,179	68·8	800	1·6	1,569	3·2	2,965	6·1	48,157
Bedford College ...	1,476	9·7	3,508	23·0	9,002	59·0	223	1·5	548	3·6	497	3·2	15,255
School of Economics	2,225	21·2	909	8·6	6,858	65·0	—	—	407	3·8	53	0·5	10,454
Newcastle: Armstrong College (Durham Univ.)	3,412	11·7	2,677	9·2	20,537	70·5	—	—	950	3·2	1,559	5·4	29,136
Nottingham ...	1,182	5·3	2,216	9·8	16,791	74·6	250	1·1	978	4·4	1,088	4·8	22,505
Reading	2,924	14·3	2,470	12·0	13,516	65·9	200	0·9	797	3·9	609	3·0	20,515
Southampton: Hartley College	1,151	10·5	1,555	14·1	7,391	67·3	10	0·09	86	0·8	783	7·1	10,976
Totals—England	51,768	9·8	61,378	11·6	353,145	66·6	8,921	1·7	22,930	4·3	32,123	6·0	530,267
Wales													
Aberystwyth ...	1,819	10·9	1,510	9·1	10,783	64·9	—	—	1,415	8·5	1,085	6·5	16,612
Bangor	1,987	12·9	842	5·5	10,404	67·6	—	—	1,700	11·0	451	2·9	15,384
Cardiff	3,218	15·9	1,995	9·9	13,078	64·6	—	—	657	3·2	1,277	6·3	20,225
Totals—Wales	7,024	13·4	4,347	8·3	34,265	65·6	—	—	3,772	7·2	2,813	5·4	52,221

relations to the national life. They realise that the tests they severally impose upon students applying for admission to their courses in preparation for degrees must have a profound influence upon the curricula of secondary schools, and that, if a common policy cannot be reached, evil results must ensue to the schools, and so, indirectly, to themselves, from the confusion caused by the multiplicity of tests for which school pupils must be prepared. Important and far-reaching steps have already been taken towards the mutual recognition of their various matriculation examinations, and the northern universities of Manchester, Liverpool, Leeds, and Sheffield have, under their charters, established a Joint Matriculation Board, which conducts a single examination of all candidates for admission to any one of the four universities. Much still remains to be done in the direction of substituting a school-leaving examination based upon the school course for an external test, and in the facilities for advanced study throughout the Empire, has led the Universities of Oxford, Cambridge, and London to issue invitations to the universities of the Empire to a conference to be held in the metropolis in 1912. There can be no doubt that this is the first step towards a closer union and sympathy, which cannot but have the most far-reaching and beneficial effects.

The present volume of reports deals only with those universities and university colleges which, during the session 1908–9, were in receipt of grants from the treasury, but these grants affect, directly or indirectly, every university in England and Wales, except the two ancient foundations of Oxford and Cambridge.

It has been possible this year, thanks to the hearty cooperation of the universities and university colleges themselves, to prepare the reports upon much more uniform lines than hitherto, and to supplement the audited accounts in

each case by an abstract which enables a comparison to be made for the first time of the various sources of income and the main heads of expenditure in the various institutions.

The returns under the different heads of income and expenditure are summarised in an appendix, and this is the first time that a comparative statement has been possible of the sources from which the several English universities and university colleges and the Welsh university colleges draw their income, and of the main headings of their expenditure.

From Table I. it will be seen that the actual total annual income of the English universities and university colleges under review exceeds half a million, some 26 per cent. of 33 per cent. is derived from the fees of students and less than 8 per cent. from endowments.

Table II. shows how the income is expended upon administration, upkeep, and teaching. It will be seen that two-thirds of the whole expenditure is devoted to the remuneration of the teaching staff and the accessories of teaching, while 20 per cent. is expended on administration and in the maintenance of buildings; but this figure is unsatisfactory, because there is no means under the present form of the return by which expenditure upon the provision of buildings and equipment can be separated from maintenance. When this separation can be made, a comparison will be possible of the expenditure of the various institutions upon the main heads of teaching, administration,

TABLE III.—ANALYSIS OF RETURNS OF STUDENTS UNDER INSTRUCTION, 1908–9

Name of University or College	Students preparing for Matriculation	Students preparing for Degree Courses [Over 300 hours]	Degree Courses of less than 300 hours [Law Students in Brackets]	Research or Post-graduate Students	Students in Training to be Teachers	Whole-time Students, *i.e. over* 300 Hours	Part-time Students, *i.e. under* 300 Hours [Evening Students in brackets]	Total Number		Other Students taking Special Courses of Lectures, *e.g.* Teachers, &c.
								Day	Evening	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
England										
Birmingham	19	455	18	72	245	756	228	984	—	—
Bristol	21	125	—	19	241	442	413 (287)	568	287	501
Leeds	10	370	55 (12)	54	134	657	508 (233)	932	233	64
Liverpool	—	617	—	112	230	997	147	1,144	—	—
Manchester	48	794	165 (38)	175	252	1,167	618 (199)	1,586	199	400
Sheffield	21	133	18 (6)	31	59	255	1,634 (1,390)	499	1,390	297
London: University College	—	519	—	308	80	1,225	250 (27)	1,448	27	2,500 +372
King's College	—	520	—	126	108	1,040	732 (381)	1,391	381	800 +705
Bedford College	19	172	—	28	53	229	128	357	—	—
School of Economics	—	175	—	96	—	274(?)	1,003(?)	274	1,003	—
Newcastle: Armstrong College	—	248	—	9	204	407	999 (781)	625	781	—
Nottingham	18	211	14	5	150	377	1,986 (1,737)	626	1,737	—
Reading	1	90	8	13	113	345	888 (625)	608	625	—
Southampton: Hartley College	10	73	15	4	148	210	498 (484)	224	484	—
Totals—England	167	4,502	293	1,052	2,017	8,381	10,032	11,266	7,147	5,639
Wales										
Aberystwyth	20	439	—	13	144	481	92	573	—	128
Bangor	—	273	—	7	110	293	37	330	—	—
Cardiff	—	463	—	25	191	543	66	609	—	398
Totals—Wales	20	1,175	—	45	445	1,317	195	1,512	—	526

which comes from the exchequer, and some 16 per cent. from local education authorities, while 32 per cent. is in the nature of fees of students, and nearly 15 per cent. arises from endowments.

In the case of the Welsh colleges, the total annual income exceeds fifty thousand pounds. Of this total above 39 per cent. comes from the exchequer, and next year, when the additional grant of 13,500*l.*[1] voted for the session 1909–10 comes into account, this percentage will be considerably increased. The local education authorities in Wales contribute about 8 per cent. of the total income, while some

[1] An additional sum of 1,500*l.* a year is payable to the University of Wales as distinct from its Colleges "for an extension of the existing schemes of Fellowships in Arts and Science."

provision and maintenance of buildings, and equipment; and of each with the expenditure of all. The returns show that each English university and university college, with two exceptions, has a superannuation scheme towards which funds are allocated, and of these two exceptions, one (Armstrong College, Newcastle) has since the date of the return established a satisfactory scheme. The Welsh colleges have at present no superannuation scheme.

Table III. presents an analysis of the returns of students under instruction in England during the session 1908–9, the figures contained in the tables under the various headings being obtained from the information supplied by the authorities of the universities and university colleges concerned. It is certain that this return is not in all respects

TABLE IV.—ENGLAND AND WALES

Annual Grants to University Colleges and to Colleges forming Constituent Parts of Universities, and Grants in aid of Universities for the year ended March 31, 1910

Name of Institution	Board of Education			Board of Agriculture and Fisheries	Treasury			Total Exchequer Grants
	Grants for Training of Teachers	Grants under Regulations for Technical Schools	Total		Grants in aid of University Colleges	Grants in aid of Universities	Total	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
England	£	£	£	£	£	£	£	£
Birmingham University	5,863 (188)	978 (978)	6,841	—	9,000 + 900	2,000	11,900	18,741
Bristol University	5,613	121	5,734	—	4,000 + 700	—	4,700	10,434
Leeds University	3,550 (200)	1,662 (1,317)	5,212	1,000	8,000 + 900	2,000	10,900	17,112
Liverpool University	5,139	915 (915)	6,039	200	10,000 + 950	2,000	12,950	19,204
London University	—	—	—	—	—	8,000	8,000	8,000
,, University College	—	—	—	—	10,000 + 950	—	10,950	10,950
,, Bedford College	200 (200)	—	200	—	4,000 + 700	—	4,700	4,900
,, King's College	1,498	299	1,797	—	7,800 + 800	—	8,600	10,397
,, School of Economics	—	—	—	—	500 + 650	—	1,150	1,150
,, Imperial College of Science and Technology	—	—	24,970	—	—	—	—	24,970
,, East London College	—	1,708 (748)	1,708	—	500	—	500	2,208
Manchester, the Victoria University	7,754	622	8,376	—	12,000 + 2,000	2,000	16,000	24,376
Newcastle-on-Tyne, Armstrong Coll., in the University of Durham	4,574 (75)	1,802 (622)	6,376	1,350	6,000 + 700	—	6,700	14,426
Nottingham University College	2,650	1,156 (710)	3,806	—	5,000 + 700	—	5,700	9,506
Reading University College	3,165	713 (337)	3,878	1,000	3,400 + 500	—	3,900	8,778
Sheffield University	1,942	3,328 (901)	5,270	—	5,000 + 700	2,000	7,700	12,970
Southampton, Hartley University College	3,404	544 (123)	3,948	—	2,250	—	2,250	6,198
Total	45,352 (663)	13,848 (6,651)	84,170 (76,856)	3,550	86,950 + 11,650 = 98,600	18,000	116,600	204,320
Constituent parts of Universities								
Bristol, Merchant Venturers' College	—	1,848 (575)	1,848	—	—	—	—	1,848
London, Goldsmiths' College	6,847	1,868	8,715	—	—	—	—	8,715
,, Day Training College (Holborn)	3,867 (75)	—	3,867	—	—	—	—	3,867
,, St. Mary's Hospital Medical School	—	1,037 (1,037)	1,037	—	—	—	—	1,037
Wye, S.E. Agricultural College	—	63	63	1,000	—	—	—	1,063
Manchester Municipal School of Technology	—	10,635 (2,605)	10,635	—	—	—	—	10,635
Total—England	56,066 (738)	29,299 (10,868)	110,335 (98,729)	4,550	98,600	18,000	116,600	231,485
Wales								
Wales, University of	—	—	—	—	—	4,000 + 1,500	5,500	5,500
Aberystwyth University College of Wales	3,542	—	3,542	1,000	4,000 + 4,000	—	8,000	12,542
Bangor University College of N. Wales	2,865	—	2,865	1,250	4,000 + 4,000	—	8,000	12,115
Cardiff University College of S. Wales and Monmouthshire	4,553	396 (315)	4,949	—	4,000 + 5,500	—	9,500	14,449
Total—Wales	10,960	396 (315)	11,356	2,250	12,000 + 13,500 = 25,500	4,000 + 1,500 = 5,500	31,000	44,606
Total—England and Wales	67,026	29,695	121,691	6,800	124,100	23,500	147,600	276,091

complete. It is encouraging to note that the total number of whole-time students is increasing, and that students are more and more taking advantage of the facilities now provided for research and for work of a post-graduate type.

It will be seen that the total number of day and evening students in attendance at the universities and university colleges in England (excluding Wales) in receipt of treasury grant exceeds 18,000, but that the number of whole-time students is only some 8,300, and the number of whole-time matriculated students preparing for degrees slightly more than 4500, of whom 1230, or 27 per cent., are students in training under the regulations of the Board of Education for the training of teachers for elementary schools. If to these 4500 are added the 1052 post-graduate and research students, we have a rough measure of the amount of university education, in the strict sense of the term, which is being given by the universities and university colleges under review.

The percentage of students in training under the regulations of the Board of Education for the training of teachers for elementary schools to the number of whole-time students in the case of three of the institutions concerned exceeds 50 per cent., while there are three other institutions in which it exceeds 30 per cent.

Table III. shows that the total number of whole-time students in the Welsh colleges exceeds 1300, of whom no fewer than 1175 are whole-time matriculated students preparing for degrees. Of these, 437, or about 38 per cent., are students in training under the regulations of the Board of Education for the training of teachers for elementary schools. There are also 45 post-graduate and research students.

Further appendices are added with the view of setting out the amount of financial assistance given to university education from the exchequer. Table IV. shows the annual grants to universities and university colleges and to the colleges which form constituent parts of universities, whether from the treasury, from the Board of Education or from other Government departments.

Table V. shows the amount of the grants in aid for "University Colleges in Great Britain," given by the treasury for several years since funds were first appropriated to this purpose by the vote of 15,000*l.* set down in the Civil Service estimates for the year 1889–90.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

A BILL "to require that in public elementary schools instruction shall be given in hygiene, and to girls in the care and feeding of infants," was introduced in the House of Commons on Tuesday, and read for a first time.

THE council of the Junior Institution of Engineers, in conjunction with the council of the Society of Engineers, has arranged for a course of six fortnightly lectures on "The Law relating to Engineering," to be delivered by Mr. L. W. J. Costello. The first lecture will be given on October 10.

THE annual meeting of the Midland Agricultural and Dairy College will be held on Monday, July 25, when the report on the year's work will be presented. The Right Hon. Earl Carrington, K.G., president of the Board of Agriculture and Fisheries, will address the meeting, and present the diplomas and certificates gained during last session.

TABLE V.—GRANTS IN AID FOR "UNIVERSITY COLLEGES IN GREAT BRITAIN"

—	Treasury Minute of July 1, 1889	Treasury Minute of June 2, 1897, sanctioning Grants for 1897–1902	1904–5		1905–7		1909–10	
			Treasury Minute of Dec. 28, 1904	Treasury Minute of Mar. 8, 1905	Treasury Minute of July 18, 1905	Treasury Minute of Mar. 23, 1906	Treasury Minute of July 9, 1907	Treasury Minute of Mar. 23, 1910
	£	£	£	£	£	£	£	£
Birmingham	1,400	2,700	4,500	700	9,000	850	9,000	900
Bristol	1,200	1,200	2,000	700	4,000	850	4,000	700
Leeds	1,400	2,200	4,000	700	8,000	850	8,000	900
Liverpool	1,500	3,000	5,000	700	10,000	850	10,000	950
Manchester	1,800	3,500	6,000	700	12,000	850	12,000	2,000
Sheffield	1,200	1,300	2,300	700	4,600	850	5,000	700
London: University College	1,700	3,000	5,000	700	10,000	850	10,000	950
,, King's ,,	1,700	2,200	3,900	700	7,800	850	7,800	800
,, Bedford ,,	—	1,200	2,000	700	4,000	850	4,000	700
,, School of Economics	—	—	—	—	—	—	500	650
Newcastle-on-Tyne: Armstrong College	1,200	2,200	3,000	700	6,000	850	6,000	700
Nottingham	1,400	1,500	2,900	700	5,800	850	5,000	700
Reading	—	—	1,700	650	3,400	825	3,400	500
Southampton: Hartley Institute	—	—	1,700	650	3,400	825	2,250	—
Dundee	500	1,000	1,000	—	1,000	—	1,000	—
	15,000	25,000	45,000	9,000	89,000	11,000	87,950	11,150
			54,000		100,000		99,100	

IT is announced in *Science* that Cornell University has been made residuary legatee of the estate of the late Dr. Goldwin Smith. It is reported that the value of the bequest will exceed 200,000*l.* From the same source we learn that by the will of Mr. Frank W. Collendar, Tulane University will receive 13,000*l.* for the Sophie Newcomb College, and that Mrs. Ida A. Richardson, who during her lifetime gave generously to various departments of the university, has left 5000*l.* to the Medical School.

AT the summer graduation ceremony at Aberdeen University on July 13, Principal Smith announced that the Chancellor of the University, Lord Strathcona, has just given to the university a sum of 10,000*l.* towards the endowment of a chair of agriculture. The interest on this money, along with the annual revenue of the Fordyce lectureship on agriculture and rural economy, and the 450*l.* a year in the charge of the governors of the college for the same purpose, will enable the university to secure the services of a thoroughly competent authority on the subject.

THE suggestion has been made that a scholarship should be established at the Imperial College of Science and Technology as a memorial to the late Mr. C. S. Rolls. It is proposed that the scholarship should be devoted especially

to the engineering side of aëronautics. It would be difficult to find a more fitting memorial than such a scholarship, which would enable properly trained young men to engage in aëronautical research, to perpetuate the memory of an engineer who devoted his life to the development of various branches of applied science.

A SHORT vacation course on oceanography (hydrography and planktology) will be held at Port Erin Biological Station, Isle of Man, in the first half of next month. We understand that there is still room for about four more persons in the laboratory. Applications for admission should be sent to Mr. H. C. Chadwick, Curator, Biological Station, Port Erin, Isle of Man. Prof. Herdman will give an opening lecture on the history and present position of oceanographic investigation; he will also deal in one or two following lectures with quantitative plankton methods, the distribution of the plankton, and its bearing on fishery questions. Prof. Herdman will also conduct some demonstrations of methods of investigation at sea, and will discuss some of the problems and results of plankton investigation. Dr. W. J. Dakin will give lectures and demonstrations dealing with the following matters:—History of quantitative methods; hydrographical apparatus as used at sea, and general work in the laboratory; the periodicity of the plankton; the most important plankton species—phyto- and zoo-plankton—of the Irish and North Seas, and the sea as a nutrient fluid. Dr. H. E. Roaf will deal with the following:—Respiration of marine animals; metabolic processes in animals; carbon-dioxide determination; and oxygen determination.

IN the course of an address at the Holborn Restaurant, London, on Monday, Mr. Haldane remarked that the Royal Commission on University Education in London, of which he is chairman, will consider the subject with reference to the Empire. There are vast possibilities of the various parts of the Empire, with their different industries, their different methods for training people for the great battle of life, coordinating their systems of university training in such a fashion that we in the metropolis may accomplish our part, and they may do their specialised parts, so that we may have an educational system in which the student may proceed from place to place, and in which we may have the sense of a unity in the great conceptions of the mind as well as in more material things. Germany has vast organising capacity, a splendid educational system, and a genius for organisation which Mr. Haldane wishes we possessed at home. If we were the equals of Germany in the kind of education which bears so closely upon commerce, and if organisation with us were developed on the same plane to which it is developed in Germany, we need not have much fear for the future. But there need not be much fear for the future, because these very things—organisation and education—are being advanced among ourselves with strides which were wholly unfamiliar a short time ago. We have added nine universities in the last twelve or thirteen years to those which we had before; we have developed our school system enormously; our technical system has gone on; and there is a life and an energy in the people which, with the individual capacity of the members of the race, gives us every prospect of holding our own.

ONE of the best results of the Education Act of 1902 was to place the administration of education in all its grades in the hands of one committee for each area. That this course has led to the prevention of much overlapping, the encouragement of coordination, and economical management is to be gleaned from a study of the annual report of the Education Committee of the city of Manchester for the year 1908–9. The report runs to nearly 350 pages, and constitutes a splendid record of what public spirit and persistent endeavour can accomplish in the provision of educational facilities in a great manufacturing town. It is possible to refer only to one or two of the many points of interest in the report. We notice with pleasure an increase of 110 individual students attending the day departments of the Municipal School of Technology, bringing the total, including manual training students, up to 823. The work of the principal evening departments of the school is now organised in group courses of instruction ranging over five years, and leading to the diploma of the school, with the title of associate. The work of the special day course for engineering apprentices has now entered upon its seventh year. It is designed to give instruction to selected apprentices employed in engineering works, and candidates for the course are nominated by their respective firms, and they are required to give evidence of a satisfactory knowledge of mathematics and mechanical drawing. The students attend for eight hours on one day a week for forty weeks, and it is found that they are able to obtain a more extended and satisfactory course than the evening classes are able to afford, and the evenings are left free for the preparation of home work and for necessary reading. A similar course is held for apprentice plumbers. Numerous tests have been carried out in the school during the year for manufacturing firms in the city and surrounding neighbourhood, and the staff has been able to accomplish a large amount of research work.

SOCIETIES AND ACADEMIES.

EDINBURGH.

Royal Society, June 20.—Prof. Cossar Ewart, F.R.S., vice-president, in the chair.—A. D. **Ross** and R. C. **Gray**: The magnetism of the copper-manganese-tin alloys under varying thermal treatment. The alloys prepared contained 14, 16, 18, 30, 38, and 48 per cent. of tin, the remainder, copper and manganese, being in the ratio of 7 to 3. At 15° C. these alloys gave in field 100 intensities, which were equal, respectively, to 55, 77, 82, 0·4, 96, and 1. Thus the 38 per cent. alloy forms a group by itself, marked off from the group of lower percentages by the 30 per cent. alloy, which has very small susceptibility. The critical temperatures varied from 225° C. to 275° C. In the case of the 38 per cent. alloy, the critical temperature was 225°, on cooling from which the alloy regained its magnetic quality, but when heated to 330° C. it did not regain its magnetism on cooling. Many other results were detailed in connection with thermal treatment of various kinds.

July 4.—Sir William Turner, K.C.B., president, in the chair.—Sir William **Turner**: Morphology of the manus in *Platanista gangetica*, the dolphin of the Ganges. Ten specimens of the manus in this species had been examined and compared with the corresponding organ in Hyperoodon and Mesoplaton. On account of fusion, the five carpal bones typically represented in Hyperoodon were reduced to four in Platanista, the fourth and fifth corresponding to the ring and little finger being united. In some cases the radial was found fused with the first carpal bone. The paper gave a full, detailed account of the morphological similarities and dissimilarities among these related forms.—Prof. Alex. **Smith** and A. W. C. **Menzies**: A static method for determining the vapour pressures of solids and liquids, and the vapour pressures of mercury. In the former paper the authors described a modified form of their "isoteniscope," in which, by adjusting the pressure under a fixed temperature, they were able to measure vapour pressures with great accuracy. Previous determinations of the vapour pressures of mercury at different temperatures showed considerable discrepancies. They had accordingly carried out a series of measurements of the pressure of this vapour between the temperatures of 255° C. and 450° C.—J. W. **M'David**: Specific volumes of solutions of tetrapropylammonium chloride. Dilute solutions had a density less than that of water, passing through a minimum as the solution became stronger. The position of this minimum depended on the temperature, occurring, for example, with a 5 per cent. solution at 0° C., and with a 20 per cent. solution at 56° C.—Dr. A. Louise **M'Ilroy**: The development of the germ cells in the mammalian ovary, with special reference to the early phase of maturation. The research was carried out with the view of determining the maturation processes which take place in the germ cells, and also to obtain evidence of the origin of the stratum granulorum. It was found that the cells matured inwards from the periphery. The capsular epithelium on the surface of the ovary was derived from the oogonia, and was differentiated at a very early stage. It had no function other than protective. Mitosis occurred among the oogonia, and also among the primary oocytes of the reticular stage. The growth of

the stroma and germ cells was mutually correlated throughout the development of the ovary. The follicle cells were derived from the oogonia, and not from the stroma, cells, the latter being only supporting and vascular. The paper contained many other important details, partly supporting, partly correcting, the conclusions of other workers.—Dr. Thomas **Muir**: The theory of wronskians, recurrents, and all other less common special forms of determinants up to 1860.

PARIS.

Academy of Sciences, July 11.—M. Émile Picard in the chair.—A. **Lacroix**: General consequences to be drawn from the study of the petrographic constitution of Tahiti. The author shows the presence of granitoid rocks in this island to be of some importance, since no analogous rock has yet been found in Polynesia.—Sir William **Ramsay** and Robert Whytlaw **Gray**: The density of the radium emanation. After two years' efforts, the authors have constructed a balance sensible to a half-millionth of a milligram, and by means of this have arrived at 220 as the mean value of the atomic weight.—Édouard **Heckel**: The action of cold and anæsthetics upon the leaves of *Angraecum fragrans* and the green husks of Vanilla. As a practical deduction from these observations, it would appear useful, in order to diminish the time necessary for the industrial extraction of vanilla, to submit it first to the vapour of sulphuric ether for 5 or 8 hours, afterwards drying by the usual processes.—P. **Puiseux**: The origin of the "cirques" and angular outline of the lunar crevasses.—G. **Millochau** and H. **Godard**: Observations on Halley's comet from the Pic du Midi Observatory.—E. **Study**: The "Géométrie des feuillets" of MM. R. de Saussure and R. Bricard.—Arnaud **Denjoy**: The continuous and the discontinuous.—L. **Amaduzzi**: The variation of the appearance of a discharge with the variation of the distance of explosion.—Ettore **Cardoso** and Georges **Baumes**: Critical constants of acetylene and cyanogen. The authors find the mean values to be: acetylene, $t_c = 35{\cdot}5°$ (308·5 abs.), $p_c = 61{\cdot}5$ atmospheres; cyanogen, $t_c = 128{\cdot}3$ (401·3 abs.), $p_c = 59{\cdot}6$ atmospheres.—A. **Lafay**: The average pressures supported by a body maintained in a current of air of irregular velocity.—P. **Carré**: Researches on the fixation of trioxymethylene by magnesium derivatives of homologues of benzyl bromide.—M. **Vandernotte**: The brookite of an albitic syenite from the neighbourhood of Ernée.—E. **Gourdon**: Two deposits of zeolites in the Antarctic.—Leclerc Du **Sablon**: The ascent of sap. It is shown that the mechanism of the ascent is independent of the height of the trunk, and that water has no more difficulty in rising to the top of a tree of 300 metres than a plant of some decimetres.—M. **Radais** and M. **Sartory**: Rendering a rabbit immune from the poison of mushrooms.—A. **Magnan**: A certain law of variation of the liver and the pancreas among birds.—Marcus **Hartog**: A new force: mitokinetism.—A. **Perrier**: The combustion of acetaldehyde by lower vegetable organisms.—J. **Winter**: The quantity of secretion contained in a given gastric liquid.—M. **Doyen**: The use of thermo-electric baths without alteration of normal tissue. The author describes successful experiments based on the fact that cancerous poison cannot resist a temperature of 55° C., while normal tissue supports a temperature of 58°–60°.—M. **D'Arsonval**: Remarks on the previous paper.—A. **Briquet**: The succession of cycles of erosion in the Franco-Belgian district.—Henri **Mémery**: Remarkable coincidences between the variations of sun-spots, and the temperature variations at Paris, Bordeaux, and Pau during the winter and spring of 1910.

CAPE TOWN.

Royal Society of South Africa, March 18.—Mr. S. S. Hough, F.R.S., president, in the chair.—Dr. R. **Marloth**: Some further observations on the biology of Roridula. *Roridula dentata*, commonly called the fly-bush, is a shrub 1 to 4 feet high, growing on the mountains near Tulbagh and on the Cedar mountains. As the leaves are provided with many stalked glands, which secrete a very viscid fluid, numerous insects adhere to the leaves and perish there, hence the shrublet is universally considered to be an insectivorous plant. Experiments, however, have shown that the fluid secreted by the glands does not possess any digestive properties, and that it is quite different from the fluid secreted by droseraceous plants. The fluid is a kind of balsam, and probably affords protection to the plant against the attacks of creeping animals, such as snails, caterpillars, earwigs, &c., and the capturing of other insects is merely accidental, and of no advantage to the plant. *Roridula dentata* and *R. Gorgonias*, the only two species of this genus, are consequently to be excluded from the list of insectivorous plants.—Dr. T. **Moir**: The absorption spectrum of oxygen and a new law of spectra. The AB and *a* lines of the solar spectrum, which are due to absorption by terrestrial oxygen, have each a complicated rhythmic structure. The author has discovered an algebraical formula whereby each line can be calculated from a fundamental, the differences being directly proportional to the squares of the first fifteen or sixteen integers. The agreement is practically in all cases within the observational error. The oxygen molecule is shown to be very slightly unsymmetrical.—Dr. L. **Péringuey**: Notes on some bushmen. The small, elf-like bushman was legendary, with all the concomitants of the legend. If careful comparison of the description of the old authors such as Sparrman, Barrow, and Burchell with the remnants of that so-called bush race was made, it would be found that such physical peculiarities in male or female of which the authors spoke were most accurately described. Yet the skull of the brother of one of the females exhibited came within the measurements assigned to Hottentots. This was another proof of the conclusion arrived at by Shrubsall that the Hottentots and the so-called bush people are closely allied, whereas the akin race, "Strand Looper," show more differentiation.

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