THURSDAY, OCTOBER 17, 1907.

STEREOCHEMISTRY.

Stereochemistry. By Dr. A. W. Stewart. Pp. xx+583. (Text-Books of Physical Chemistry. Edited by Sir William Ramsay, K.C.B., F.R.S.) (London: Longmans, Green, and Co., 1907.) Price 10*s.* 6*d.*

THIS book is practically a complete and in many cases a detailed account of the subject of stereo or space chemistry since the foundations of this exceedingly fruitful branch of chemical science were laid by Pasteur and Wislicenus. It is not an historical summary, but a carefully thought out treatise, and one which chemists who have to lecture or teach the subject will find of the greatest use.

The book commences with a short historical introduction. Part i. deals with optical activity, the first section describing the asymmetry of the carbon atom. The author's idea of explaining the effect of polarisation on light by means of a paper-knife and two books is distinctly good. The next chapter deals with inactive compounds, and from this we are led up to the active compounds and the determination of configuration.

Chapter viii., on "other active elements," is a review of the work done upon nitrogen compounds, and also deals with the isolation of active compounds of sulphur, selenium, and tin by Pope and his co-adjutors. The first part of the chapter is a survey of cases in which nitrogen is known to show isomerism; the second part is a consideration of the various theoretical explanations put forward upon the configuration of nitrogen compounds. This complex part of the subject would perhaps have been more easy to follow if the author had been able to devote a little more space to the consideration of these theories, but as the references are ample and the book is by no means short, even as it is, Dr. Stewart must be left as the best judge of how much space to devote to each portion of the work. As the author himself says in his preface, stereochemistry is much easier to follow if one has a set of models to work with. It is, in fact, very difficult to study the subject from a book alone, and in Appendix B directions for the construction of stereochemical models are given, one of the simplest methods for making tetrahedra being to cut them out of hard yellow soap, needles being used for bonds.

Steric hindrance is a subject which is very much to the fore at the present time, and one rarely visits a meeting of the Chemical Society without hearing it mentioned. For this reason the chapter on steric hindrance in this book is of particular interest. To a certain extent also interest is added because the author, in connection with his work with Baly upon absorption spectra, has come across facts which in the opinion of the authors are a contradiction to the theory of steric hindrance, Stewart and Baly holding that in the case of the carbonyl group the reactivity is not inherent in the group itself, but depends upon the "nascency" of the radical, this "nascency" being governed by the action of the adjacent groups upon the carbonyl radical. Could not some rather more euphonious name be chosen for the activity of the group than "nascency"? One can perhaps hardly talk about the atomic character of a group; would not activity itself do? It is not unusual to speak of hydrogen, at the moment of its liberation, being in the active form, but one never talks of the "nascency" of hydrogen. Or one might borrow an electrochemical term, and speak of the potential of the group. Thus the potential of hydrogen is high or low, depending upon the surface and character of the electrode from which it is liberated, and the tension or potential of the carbonyl group might be high or low, depending upon the character of the adjacent groups.

Appendix A deals with the relations of stereochemistry to physiology. That the configuration of the groups should affect the physiological action is certainly interesting. Thus when given to rabbits in various ways it was found that in the case of the three arabonic acids more of the lævo- than of the dextro-variety was acted upon, and in the case of the mannoses the dextro-variety appears to be best suited for nourishment. The taste, at any rate to some extent, depends upon the stereoisomeric form; thus in the case of glutaminic acid the dextro-form is sweet, but the lævo-form is tasteless. Furthermore, the toxic action in some cases varies considerably with the different isomeric modifications. For example, *l*-hyoscyamine is almost twice as active in its effects upon the pupil nerve-endings as *dl*-hyoscyamine. This branch of the subject is of great interest, and doubtless the gathering together of these facts will serve to stimulate investigation in this valuable practical part of the subject.

The illustrations are good, some of the half-tone reproductions of models being excellent, and the book itself is well got up. It is decidedly one of the most useful of the series, and Dr. Stewart is to be congratulated upon the completion of a very painstaking work.

F. M. P.

ORIENTAL PLAGUE.

Studies in the Bacteriology and Etiology of Oriental Plague. By Dr. E. Klein, F.R.S. Pp. xv+301. (London: Macmillan and Co., Ltd., 1906.) Price 12*s.* net.

THE appearance of this book at the present time is opportune, for plague is ravaging our Indian Empire, some 900,000 deaths having been recorded there from January 1 to May 31 this year. The work is based on Dr. Klein's large experience of the bacteriological examination of cases which clinically and epidemiologically were under suspicion of being plague. Many epizootics among rats on shipboard were also investigated by Dr. Klein, and the results of his examinations are included. The data so obtained, and published in many scattered papers, are thus brought into a convenient form for reference.

In chapter i. a good account is given of the histology of plague lesions and of the distribution of the plague

bacillus in the tissues; in chapter ii. the characters of the plague bacillus are described with great fulness, and many valuable hints on staining, &c., will be found here. Dr. Klein believes to be erroneous the view of Calmette that passage of the plague bacillus through a series of animals of a species, while increasing its virulence for that species, diminishes the virulence for other species. The statement is made at p. 29 and again at p. 47 that Hankin described long filamentous modifications of the plague bacillus when the organism is grown on salted media, an observation for which Dr. Klein claims priority. But surely what Hankin did describe was the occurrence of large spherical, spindle- and pear-shaped involution forms on salted media (see *Centr. für Bakt.* xxii., p. 438). Here and in some other places references are omitted, and authors' names are sometimes wrongly spelt, *e.g.* Tideswell for Tidswell, and Simmonds for Simond (p. 154). Chapter iii. deals with the bacteriological analysis of plague material, many valuable practical hints being incorporated, and chapter v. with microbes simulating the plague bacillus. Notable among these are the *Bacterium bristolense* and the *B. myxoides*. The former was isolated from dead rats found on a ship unloading at Bristol, which had come from a plague-infected port. It caused the death of guinea-pigs with a hæmorrhagic septicæmia and enlarged glands, and the bacilli that were present in the lesions were much like the plague bacillus. As a matter of fact, however, cultures showed that the organism was allied to the *B. coli*. The *B. myxoides* was isolated from a case of acute hæmorrhagic febrile disease, which had been notified as possibly one of septicæmic plague. The organism morphologically and in staining properties presented a certain resemblance to *Bacillus pestis*, but it was not pathogenic by subcutaneous inoculation to guinea-pigs and rats, and culturally differed from the plague bacillus. The case was actually one of hæmorrhagic small-pox with a secondary or a terminal infection with this microbe. These examples illustrate the care necessary to diagnose plague bacteriologically. Plague in the rat and in other rodents is discussed in chapters v. and vi. Dr. Klein considers that there may be a type of *B. pestis* occurring in the rat which is less virulent than the ordinary human type. The transmission of plague from one animal to another (chapter vii.) Dr. Klein would ascribe principally to infection by the digestive tract and not to fleas, lice, and other insects, though it must be pointed out that the careful work of Tidswell (Report on the second outbreak of plague at Sydney) and of the Indian Plague Commission (*Journal of Hygiene*, vi., 1906, No. 4) support strongly the latter theory.

Chapter viii. discusses the agglutination reaction and its application to plague; on the whole the test is difficult to apply in this disease, but under certain conditions may be of value. The important subject of preventive inoculation is dealt with in the last chapter but one. The subject of the supposed danger of inoculation during the incubation period is first alluded to, and Dr. Klein remarks that with a prophylactic he has devised there is no risk of this sort. No reference, however, is made to Bannerman's statistics (*Centr. f. Bakt.*, Abt. i., Bd. xxix., p. 873), which seem completely to remove this objection to the use of the Haffkine prophylactic. As the result of his experiments, Dr. Klein says, "I am prepared emphatically to maintain that 10 c.c. of the Haffkine prophylactic is capable of fully protecting a rat against a subsequent lethal dose of living plague culture." Important testimony this to the protective power of the vaccine when India is decimated with plague and the author of the prophylactic treatment is under a cloud in consequence of an unfortunate accident for which we believe he was in no way responsible! Dr. Klein incidentally confirms much of Haffkine's work on the plague prophylactic.

The most interesting portion of this section is that which deals with the preparation of a new form of vaccine material devised by Dr. Klein which consists of an emulsion of the *dried* organs of a guinea-pig dead of plague. The drying deprives the plague bacilli of their vitality, and it was found that 10–15 milligrams of the dried organ powder sufficed completely to protect a rat against a lethal dose of plague bacilli. The final chapter is devoted to a consideration of the modes for the destruction of the plague bacillus, and much useful information on the action of disinfection and disinfectants on this organism is included.

The book, which lacks an index, is profusely illustrated with a number of excellent plates, and we congratulate Dr. Klein on the amount and importance of the work he has done with reference to plague and the plague bacillus. R. T. HEWLETT.

MEMOIRS ON MARINE ANIMALS.

(1) *Anurida*. By A. D. Imms. Pp. viii+99; 7 plates. 1906. Price 4*s*.

(2) *Ligia*. By C. Gordon Hewitt. Pp. viii+37; 4 plates. 1907. Price 2*s*.

(3) *Antedon*. By Herbert C. Chadwick. Pp. viii+47; 7 plates. 1907. Price 2*s*. 6*d*. (London: Williams and Norgate.)

THESE volumes, which form the thirteenth, fourteenth, and fifteenth of the Liverpool Marine Biological Committee's memoirs, are comprehensive studies, admirably illustrated by lithographic plates, of animals common on our shores and readily accessible to the student. The authors and the editor, Prof. Herdman, are to be congratulated on the production of such excellent aids to the study of types of our British marine animals.

(1) Mr. Imms's memoir is a well-arranged and detailed account of the interesting Collembolan *Anurida maritima*, which is common on the surface of the quiet shore-pools and in the crevices of the rocks near Port Erin and at other localities on the British coast. In the description of the habits of the animal attention is directed to the covering of hairs, which, when the animal is submerged, retains a supply of air which serves for respiration (there being sufficient to last the insect five days), and also renders the body incapable of being wetted. Chapters follow on the external characters, integument and coloration, mouth parts, digestive, circulatory, nervous, excretory and repro-

ductive systems and embryology. The author has wisely chosen to describe only the general features of the muscular system; a more detailed account would have been beyond the scope of the present memoir. The ventral tube, characteristic of Collembola, present as a papilliform organ on the mid-ventral aspect of the first abdominal segment, is formed, as is shown by development, by the fusion of a pair of appendages. The various functions which have been ascribed to this organ are set forth. The author records his observations in support of the view that its primary function is that of an organ of adhesion, but he also believes that it plays an important part as a respiratory organ, in virtue of the ease with which blood flows into it and distends its two terminal thin-walled vesicles. He confirms on Anurida the observations of Willem and Hoffmann on other Collembola, that the secretions of two pairs of cephalic glands flow into a ventral groove leading from the head to the ventral tube, which they serve to moisten. In the chapters on the general structure, classification and affinities of the Collembola, the author concludes that there are no grounds for regarding these animals as degenerate; they show affinities with the Thysanura (especially in having a pair of mouth appendages—the maxillulæ—intercalated between the mandibles and first maxillæ), and, by reason of certain generalised features, to the lower Arthropoda. The memoir also contains additional remarks on other marine insects, and an extensive bibliography relating to papers on the Collembola published since Lord Avebury's monograph.

(2) In selecting *Ligia oceanica* for description as a type of the Isopoda, Mr. Hewitt has made an excellent choice, for not only is this the largest British Isopod, but it is intermediate between the aquatic and terrestrial forms. Although specimens are usually found just above high-water mark, in deep cervices of rocks or quay-walls, the author found them at St. Kilda on the top of a hill 450 feet above sea-level, to which altitude the sea-spray often reaches. It was remarkable that most of the examples found at this height were females, which do not descend to sea-level to feed, but probably do so when liberating the young from their brood-pouches, for large numbers of young individuals were found under the rocks between tide-marks, but none at the high level. Following the description of the habits are clear and concise accounts of the external characters, the various systems of organs, and the development. The eyes are described in some detail. In each ommatidium there are two cone-cells, each of which secretes a hemispherical, transparent mass. These two masses, with their flat sides apposed, form the cone on the proximal side of which the cone-cells further produce two sub-cylindrical accessory cones, an interesting and exceptional feature of the eye of Ligia.

(3) The present volume on *Antedon bifida* is Mr. Chadwick's second contribution to this series of memoirs, his previous one, on Echinus, having been published in 1900. Detailed and useful descriptions, with excellent figures, are given of the various parts of the skeleton and of the three nervous systems and their functions. The other systems of organs and the development are well treated. The author is inclined, but without giving reasons, to regard the sacculi as excretory structures; he holds that the view that they consist of reserve material for use in the regeneration of lost or injured parts is discounted by the fact that sacculi are not present in the allied genus Actinometra, in which, nevertheless, regeneration proceeds quite as actively as in Antedon. The account of the axial organ contains no discussion of the many functions which have been ascribed to it, but the author has observed that, at the breeding season, the epithelial cells lining the tubules of the organ break away and become amœboid, suggesting that at this period, at any rate, the axial organ is a site of formation of amœbocytes. J. H. A.

A LIFE OF SIR WILLIAM FLOWER.

Sir William Flower. By R. Lydekker, F.R.S. Pp. vii+191. (English Men of Science Series.) (London: J. M. Dent and Co., 1906.) Price 2*s.* 6*d.* net.

IT will be long ere the name of William Henry Flower is forgotten by those in this country who are interested in scientific zoology and in the progress and development of zoological museums; and the sketch of his life and work which Mr. Lydekker has put together in the present volume, a small one indeed, though rich in interesting material, will be much valued by those especially who had the advantage of personal acquaintance with the great museum conservator.

As Mr. Lydekker has indicated in his preface, the present work is more devoted to the scientific than to the personal and social side of Sir William Flower's career. Nevertheless, the opening chapter deals with his birth, parentage, education, marriage, general career, and with his lamented death at the age of sixty-seven, in a manner which is both sympathetic and interesting. The remaining seven chapters are devoted to his work as a scientific worker and as a museum conservator or director, and the value of the work which he performed in both capacities is well brought out by the writer of the memoir.

As all zootomists know, Sir William Flower's original work lay almost entirely in the domain of mammalian anatomy and general classification of mammals, and his name will go down to posterity as the discoverer of many new and important facts, and as the propounder of more satisfactory views on many matters of zoological interest. We need only mention his demolition of Owen's classification of mammalia by their brains; his discovery of the fact that in the marsupial dentition only a single pair of teeth on each side is replaced by vertical succession; or his classification of the carnivorous mammalia according to the characters of the base of the cranium. Everyone knows also that Sir William Flower was a first-class authority on the Cetacea, and that in his later years he devoted much attention to anthropological studies.

In the chapters on Sir William's work as conservator of the museum of the Royal College of Surgeons, as director of the Natural History Museum, and on his

museum and miscellaneous work, Mr. Lydekker gives a very clear account of the principles on which that work was guided and of the results achieved. The main lines along which Sir William's ideas of the purpose of museums and of their arrangement ran must be approved by all interested in the subject, although as to some matters of detail there may be room for individual differences of opinion. There can be no doubt of the soundness of the principle that the specimens exhibited in the galleries should, so far as possible, form a distinct collection adapted specially to its purpose of instructing the general public, that old and bad taxidermy should disappear from the cases, that specimens should not be crowded together, but that each should be exhibited with a purpose, instructively or "descriptively" labelled, and placed so that it can be properly seen. How far, however, the principle of making such a popular series rather a collection of "labels illustrated by specimens" than a collection of specimens explained by labels should be carried out is a question which it would be out of place to discuss in a notice like the present, as is also the question as to how far "pictorial mounting" ought to be adopted in natural history museums.

Sir William Flower was a strenuous opponent of the unnatural divorce between recent biology and palæontology. Everyone agrees with him now—theoretically—but how many zoologists will take the trouble to look up and read an original palæontological memoir? If they want information on a fossil subject, do they not usually take it and quote it from some text-book at second hand?

In compiling this memoir Mr. Lydekker has done his work sympathetically and well, and has produced a little volume which is worthy of a place on the book-shelves of all British naturalists. R. H. T.

OUR BOOK SHELF.

Sfere cosmografiche e loro applicazione alla risoluzione di Problemi di Geographia Matematica. By Prof. Angelo L. Andreini. Pp. xxix+326. (Milano: Ulrico Hoepli, 1907.) Price 3 lire.

THIS little book, as its title implies, shows how a class of simple problems in spherical trigonometry can be solved with approximation by mechanical methods. It is a form of exercise which has fallen into disrepute in this country, but practical computers will admit that there are times when an appeal to the globe is not without its uses. Such cases can occur in the transformation of coordinates, when the conditions of the problem make the choice of a quadrant uncertain. The author, however, is not so much concerned in providing assistance for the expert as in instructing the novice.

After tracing the history of globe construction and showing some forms of orrery which explain the motion of superior and inferior planets, the phases of the moon, &c., the author indicates the principal problems for which mechanical solution is possible. Very considerable ingenuity is exhibited in the choice and variety of problems submitted, and by some simple additional apparatus for measuring angles an approach to accuracy is made. In those problems connected with the diurnal rotation of the earth, the latitude of a place is determined by measurements made on the prime vertical, while in those depending upon the annual revolution about the sun the equation of time and the obliquity of the ecliptic find a place. This will give some idea of the range of subjects for which the author finds application. Indeed, not a little of the interest of the book centres in its completeness. We should imagine that no class of problems to which a globe has ever been applied is entirely unrepresented here. As a matter of fact, there is reference to the tides and the establishment of a port, though it is difficult to see how a globe can give any assistance in such matters. A large number of examples are given to be worked by the student, and in another section the manner of solution is indicated.

Electric Light and Power. By E. E. Brooks and W. H. N. James. Pp. viii+372. (London: Methuen and Co., n.d.) Price 4*s.* 6*d.*

THE best that can be said of this text-book is that it is neither better nor worse than others of its class. The book is apparently intended as a first-year course for students of not very high scholastic attainments; if this is so, we think it covers too much ground. Starting from the very beginning, with experiments with knitting needles, the student is led to the consideration of dynamos, alternators, and motors. Then follow a couple of chapters on lighting circuits and lamps, a chapter on measuring instruments, and finally one on primary cells and accumulators. We doubt if any student can properly master all this material in a preliminary course. In any case, we are strongly of opinion that it is inadvisable that he should try to do so.

Much has been spoken and written on the question of the interconnection between teaching and manufacturing. We cannot forbear quoting one instance from this book, which shows how desirable closer sympathy is. After a very inadequate description of primary batteries, the authors write in reference to the dry cell:—"Economy in first cost is attained in various ways. For instance, a cell recently examined was found to have a solid block of wood nearly three inches thick between the bottom of the cardboard case and the bottom of the zinc cell." It is nothing short of a travesty of teaching to devote even four lines in a text-book, where space is only too valuable, to conveying this sort of information. The authors must have forgotten the excellent definition of an engineer as one who can do for a dollar what any fool can do for five. We pity the young engineer, nourished on this food, who, when asked by his employer to endeavour to reduce first cost, comes forward with a suggestion of this kind. M. S.

L'Hygiène moderne. By Dr. J. Héricourt. Pp. 311. (Paris: Ernest Flammarion, 1907.) Price 3·50 francs.

THIS book surveys, in an interesting, readable, and non-technical manner, modern views on hygiene. It is divided into four sections—hygiene of the individual, which includes predisposition, tuberculosis, diet, clothing, exercise, and infantile mortality; hygiene of the home, which includes the house and domestic life; hygiene of communities, schools, &c.; and public hygiene, including that of public vehicles, streets, domestic animals, &c. One of the earlier chapters on the arthritic diathesis would be better suited, perhaps, to a medical text-book, and the author seems to be one of those who hold extreme views on the evils of uric acid. On the question of alcohol, the author believes that good wine or spirit in moderation does no harm, and in many cases is beneficial. The kissing of children is rightly condemned, and the condition of the public streets, with their dust, dirt, and spitting, is characterised as a "hygienic scandal." R. T. H.

LETTERS TO THE EDITOR.

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

The Advancement of Science.

SOME weeks ago Sir Oliver Lodge directed attention to the congestion of work in Section A of the British Association at Leicester. Last week Dr. Chree remarked upon the comparative neglect on our part of such scientific subjects as terrestrial magnetism and the local variations of gravity, which cannot be pursued adequately within the walls of a laboratory, but depend upon observations "in the field." In the meantime, NATURE has noted Dr. Mill's protest against the scanty opportunity for the discussion of meteorological subjects at Leicester.

My own experience at Leicester supports Dr. Mill's protest. I do not refer to what happened to my own paper. I have no complaint to make against the officers of the section, who, with the rest of us, were victims of an unworkable system. I refer to the proceedings with regard to the papers by Mr. Petavel and his fellow-workers at Manchester on the investigation of the upper air.

Since the meeting, I have learned that the results of the work of the international week at Manchester (the last week in July) were of remarkable interest as showing in an exceptional manner all the characteristic features of the variation of temperature in the atmosphere up to a height of 20 kilometres. The papers were among a large number on the programme for Tuesday, August 6. When I left the section at three o'clock to attend a conference as the delegate of Section A, they had not been reached. When I returned at half-past four I was told that the proceedings of the section for the year had already been concluded, with the usual votes of thanks. Whether the papers had been read in the interval or withdrawn I do not know, nor is it of much consequence. If the only time to be found for a subject of such general interest is after three o'clock on Tuesday afternoon, it is clear that some change is required.

The sectional proceedings on Tuesday opened with a discussion upon new methods of treating observations, an important practical matter for the observational sciences. In the circumstances, it was evidently desirable that the opening paper should be printed *in extenso*; but the recorder pointed out to me, and quite rightly, that such a proposition could not be entertained by the British Association, because the committee of Section A had adjourned for the year on the previous day.

These things do not make for the advancement of science.

I wish, however, to take up the point raised by Dr. Chree, and to emphasise the fact, already too obvious to those who have to do with such things, that subjects like terrestrial magnetism, seismology, atmospheric electricity, and the physics of the globe generally, without any reference to meteorology in particular, suffer very seriously in this country from the congestion of work in Section A.

On the one side, work is done of which the scientific public know little or nothing. Atmospheric electricity is a flourishing study on the Continent; seismology is now the subject of an international organisation with Government support; terrestrial magnetism has called for expenditure on a large scale for an establishment to replace Kew as the normal observatory. It is desirable that the association should know what is going on in such matters.

There are, moreover, a number of departments of Government the work of which has at least its scientific side. Papers of scientific interest could probably be obtained for the asking, from a number of competent workers, by an energetic president or secretary, animated by the meritorious wish to use the meeting of the association to bring the scientific staff of the various departments into touch with the scientific public; but the officials in charge of such work have not the advantage of academic long vacations. The time spent at the British Association must be taken either from short leave or from duty. The matter must, therefore, be treated in a business-like way, which in present circumstances is impossible.

It would be absurd, for example, for a secretary or an organising committee to ask, let us say, the hydrographer of the Navy for a paper on submarine centres of magnetic disturbance, or the Astronomer Royal for a paper on magnetic storms and sun-spots, or any other aspect of the magnetic or meteorological work of the Royal Observatory. There is the paralysing consciousness that the time for reading the papers would have to be looked for in a general scramble between three and half-past four on Tuesday afternoon. What is true with regard to these distinguished public servants is equally true with regard to distinguished foreign workers in science.

There is provision in the constitution of the association for asking competent persons to prepare reports upon recent progress in particular branches of science. The provision is, unfortunately, a dead letter in the subjects mentioned. One reason at least is obvious—there is no time to listen to such reports, however valuable they might be.

It is time that we recognised that the attempt to include in one section with mathematics subjects like laboratory physics, in which workers are many and in constant intercommunication, and subjects like terrestrial magnetism, atmospheric electricity, and other branches of geophysics, in which workers are few and widely scattered, is disastrous for the one class of subjects; and, judging by the way in which a discussion upon so important a subject as the measurement of temperature by radiation was received at Leicester, it is not too successful for the other class.

Some years ago there used to be a subsection for the outdoor subjects, with the not very euphonious title of "Astronomy and Cosmical Physics"—perhaps astronomy and geophysics might be better. It has disappeared—not on account of any want of success while it lasted. It was simply omitted from the South African arrangements. The circumstances which called it into existence have now become more pressing. Laboratory physics has become more radio-active, and the other subjects have extended their operations. The temporary expedient of a special subsection is not now adequate. One special secretary at least is required in the interest of those branches of geophysics which are not covered by astronomy. The occasional treatment of such subjects in a presidential address would be of real advantage to science in this country.

I ask, therefore, the hospitality of the columns of NATURE in order to appeal, in the name of the advancement of science, for the establishment of an independent section of the British Association which shall have sufficient time at its disposal to promote the advancement, not only of meteorology, but also of such subjects as terrestrial magnetism, atmospheric electricity, seismology, and geophysics generally. The briefest consideration of the changes which have taken place since Section A was initiated will show that such an appeal is not unreasonable.

W. N. SHAW.

October 12.

On Correlation and the Methods of Modern Statistics.

I REGRET that the pressure of work associated with the opening of a new session did not permit of my replying to Mr. Hinks last week. His letter (October 3) is so far satisfactory that it gives evidence that one professional astronomer realises the existence of stellar correlation; but Mr. Hinks will have to advance much beyond "scatter diagrams" before he can hope to get much profit out of modern methods. Further, may I suggest that he would be more just to both Miss Gibson and myself if (1) he read her paper carefully, and (2) he did not suppose that, because we approach the subject from a different standpoint from himself, we are of necessity both very ignorant and very foolish?

At the expense of reiteration, I must again refer to one or two facts. There are, in my opinion, three points of much interest in Miss Gibson's memoir:—

(*a*) The correlation of magnitude and parallax is shown to be low; what correlation exists is shown to depend

largely on the sinuosities of the regression curve, and not on a uniform decrease of parallax with magnitude. Miss Gibson's values for the seventy-two Newcomb stars are:—Correlation coefficient, $+0{\cdot}1\pm0{\cdot}1$; Correlation ratio, $0{\cdot}5\pm0{\cdot}1$. For the 173 stars given in the Yale memoir, Dr. Lee has shown that Correlation ratio $=0{\cdot}28\pm0{\cdot}06$.

Now let us see how Mr. Hinks faces such results. In the report of the British Association discussion, published with his approval in the Royal Statistical Society's Journal, he refers, in the *first place*, to the theoretical question, namely, he speaks of the theoretical possibility that the relation between luminosity and distance is controlled by a logarithmic curve, and makes the suggestion that this curve (although referred to several times in Miss Gibson's memoir) had been overlooked by us, and that accordingly she ought not to have used the correlation coefficient, which might screen under such a value as 0·3 the really perfect correlation which would flow from the logarithmic relation. What was the meaning of Mr. Hinks's appeal to the logarithmic curve if he did not at the British Association suppose Miss Gibson's value of the relationship of magnitude and parallax to be an underestimation? If that appeal was made to show that she ought to have used the correlation ratio, then he had clearly not studied her paper before criticising it. The charge made at the British Association is indirectly repeated in the last words of his letter in NATURE, where he talks about the propriety of calculating the correlation ratio, as if it had not actually been given on p. 452 of the memoir. The divergence between the correlation coefficient and the correlation ratio shows the trained statistician that the sinuosities of the parallax-magnitude curve are not solely humps due to random sampling.

Well, let us come to our one point of agreement at present: "Astronomers do not believe that magnitude is closely related to parallax." I am glad Mr. Hinks accepts this view, and I will refrain from quoting the work of some great astronomers to show that it has not always been their opinion. Mr. Hinks states in his letter that I asked for details of the reason for the switchback character of Miss Gibson's diagram of parallax and magnitude. If he will read my letter carefully, he will find I asked for no such thing. I asked for details of *his* reasoning at the British Association that the dips and humps were produced by selection of proper motions, which is an entirely different point.

He said at Leicester:—"The second peak belongs to stars of the fourth and fifth magnitude; they were not representative of the average star of that magnitude, but had been chosen *because of their exceptionally large proper motion.*" I very pertinently asked him why this selection had not also been applied to stars of the second to third and to stars of the sixth magnitudes, and further to demonstrate that if it had been thus applied it could possibly have produced the desired effect. To produce an effect on the correlation of A and B by selecting C, a third character, A and B must both be fairly highly correlated with C, and, further, to produce humps we must show that the selection was concentrated at certain points of the range. Mr. Hinks, to give a logical reply, must therefore show:—(1) that parallax and proper motion are highly correlated; (2) that proper motion and magnitude are highly correlated; (3) that the selection of astronomers has been discontinuous along the magnitude range. Instead of proving (3), Mr. Hinks has pointed out that the "humps" in the curve are due to the presence of individual stars of low or high parallax in the special groups, or rather that *some* of them are. Quite so; any statistician knows that with a population of seventy-two the averages of eleven subclasses will be largely influenced by individuals; but the statistician calls this a result of *random sampling*, and does not suggest discontinuous selection by a third variable with a relatively low correlation to at least one of the two characters. Did Miss Gibson, however, lay any special stress on these humps? On the contrary, she says:—"It is possible that a curve of a somewhat complex character—a quartic curve, for instance—might fit the observations." But she concludes:—"Examining Fig. 1, we see that on the present data nothing better than a horizontal straight line at the mean parallax, or a zero correlation coefficient is likely to be found to fit the observations." I think this will show that we laid no special weight on the humps. On the other hand, the high value of the correlation ratio compared with the value of the correlation coefficient does suffice to suggest that astronomers should be cautious about assuming even a moderately low, but continuously descending relationship between luminosity and distance. The rise in parallax of the faintest stars in Miss Gibson's diagram is again manifest in the Yale results, and is probably not due to mere random sampling. The thirty-six stars of magnitude eight to nine in the Yale data have a parallax nearly three times as great as those of magnitude six to seven, which number thirty-one. Will Mr. Hinks assert here again that the former group have been selected by proper motion and the latter have not?

Let me further remind him that the correlation between magnitude and proper motion has not even been mentioned by him in his argument, and yet this vital relationship, for which I have further determinations, is lower than 0·2. Accordingly, it would need a very high relationship between parallax and proper motion to reduce by a proper motion selection the magnitude-parallax relationship to a small value.

(*b*) The second point in Miss Gibson's memoir was involved in the statement that the correlation between parallax and proper motion was "quite significant and important, but not half-way up the scale of correlation" (p. 449). Mr. Hinks says that I am misled by Miss Gibson's results, and asserts that his scatter diagram shows "considerable correlation." Mr. Hinks is an astronomer, and therefore knows the value of exact numerical work. Miss Gibson obtained in her memoir the value 0·4 for the proper motion components. Does he really suppose that his scatter diagram can demonstrate that the value of the whole proper motion correlation is greater or less than this?[1] My estimate, however, was based, unfortunately for Mr. Hinks, not on Miss Gibson's results, but on determinations of the correlations of proper motion and parallax, which involve not only component, but total proper motion. Actually the Newcomb stars exaggerate the result, and the relation between the two characters is sensibly under Miss Gibson's value. Thus for the Yale stars, when we deal with the *whole* proper motion, it is only 0·36. Mr. Hinks says that Miss Gibson "has naturally obtained a smaller result than if she had used the whole proper motion in seconds of the arc on a great circle as is usually done." If Mr. Hinks had studied the subject of correlation a little more fully, he would have known that one correlation is related to the others, and if he had actually worked out the theoretical relationship between them he would not have attributed the lowness of our estimate of the parallax and proper motion correlation to dealing with component instead of total proper motions. The multiplying factor is, I think, $\sqrt{2}/(1+r)$, where r is the mutual correlation of the components $=0{\cdot}3$.

Mr. Hinks would support his view of high relationship between parallax and proper motion by *selecting* seventeen stars by magnitude, and leaving the reader to form a mental impression of their correlation. He asserted that our results on seventy-two stars were vitiated by selecting by proper motion, yet he does not hesitate himself to select, not seventy-two, but seventeen stars by magnitude. And what is the result even of this selection? Why, that 40 per cent. of the value he reaches for correlation depends upon the fact that he has not sufficiently counteracted the overwhelming influence due to his inclusion of α Centauri in the seventeen! If he leaves this star out (or reduces its influence by introducing another seventeen stars) the value of the correlation differs from Miss Gibson's value by less than the probable error of the difference.

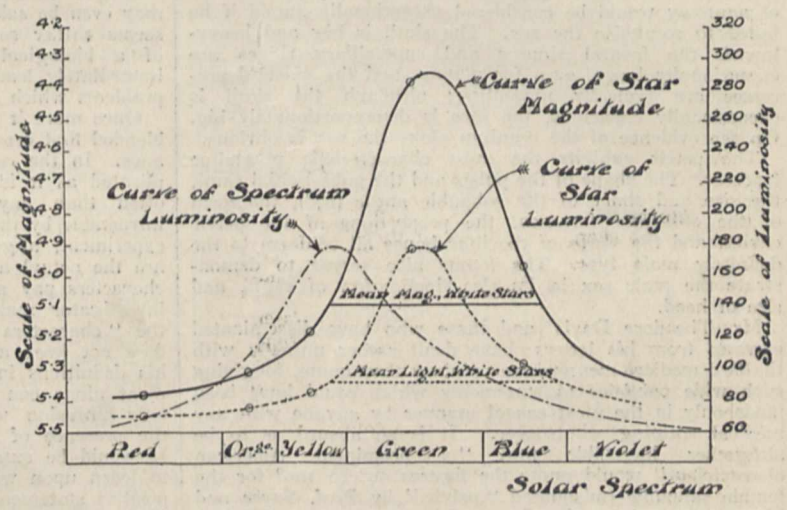
I must now state the conclusion to which I feel myself driven, namely, that astronomers in the near future will not suppose a *very* close, but a "quite significant and important" relationship between proper motion and parallax. The relationship is more intense than that of parallax and magnitude, but, as shown by the Yale data, it is probably less than the value originally fixed by Miss Gibson, and I

[1] For the total proper motion the Newcomb stars give $0{\cdot}58\pm0{\cdot}05$.

hold that this relatively low value is the second point her paper has indicated for the first time. Meanwhile, I leave Mr. Hinks to consider whether the proven correlations of both proper motion and magnitude with parallax (under 0·4) have or have not any significant bearing upon the differential method of determining parallax, and upon the fact that more than 20 per cent. of negative parallaxes can be found.

(*c*) The third point in Miss Gibson's paper was the statement that colours (and probably spectral classes) were more highly correlated with magnitude than distance. Mr. Hinks takes this point as one which will fully justify his criticisms at Leicester. I am of opinion that it is peculiarly a case in which he would have done well to have tempered his judgment by previously asking whether there was no method in our madness. He charges us with three grievous offences:—(1) using a highly selected material; (2) omitting to take into consideration the "white stars"; and (3) deducing from such material sweeping conclusions about the stars in general. He further charges me, *on the basis of this investigation*, with asserting "that colour and magnitude are related at least as closely as parallax or proper motion and magnitude."

In my letter, when making my statement, I made no reference to Miss Gibson's published work, but the fact that I cited the value of the correlation of magnitude and spectral class which is *not* given in the published paper might have warned Mr. Hinks that we held other reductions in our hands. Mr. Hinks asserts that our results would have been modified had we included the "white" stars. Using the 2834 stars of the Harvard Catalogue, of which roughly one-quarter are white ("Annals," vol. xiv.), Miss Gibson worked out more than a year ago the contingency of colour and magnitude; the value was 0·27 (±0·01), as compared with the 0·30 (±0·05) of the list in the Cape Observatory "Annals" previously given by her. Omitting the white stars from the Harvard data, the value is 0·297, agreeing absolutely with the result obtained from the Cape data. Thus we see that Mr. Hinks's suggestion that the Cape Catalogue is worthless, owing to selection of special stars, has no validity at all when we turn to the relationship of colour and magnitude, and, further, the inclusion of white stars produces, as we had logically anticipated, no sensible effect.



But I will go a step further, and reveal another conclusion, which I should naturally have preserved for the present, as the research is as yet incomplete. The mean magnitude of the white stars is almost identical with the mean magnitude of all the remaining truly "coloured" stars; the white star has not a preponderance of any special part of the colour spectrum, and if we wish to investigate the relationship between luminosity and colour we must logically leave out the white stars. The accompanying diagram gives the Harvard stars classed according to colour, with (*a*) the mean magnitudes of each colour group, and (*b*) the corresponding luminosity on the assumption that the light of a tenth-magnitude star is unity. It will be seen that the stellar luminosities form a curve very similar to the light-intensity curve of the solar spectrum, but shifted towards the violet end of that spectrum, possibly owing to the fact that the average star is hotter than our sun. On this scale there is clearly no place for the white stars, and the essential feature is that stellar magnitude takes its place in a continuous and definite relation to stellar colour.

I had no intention of anticipating work not yet completed, but Mr. Hinks's contemptuous reference to our omission of the white stars needed to be dealt with. Their inclusion or exclusion makes no difference from the standpoint of the statistical constant; their exclusion is, however, justified by the physical considerations which I have here suggested.

I should wish to say one word, albeit I am afraid it must be a strong one, about Mr. Hinks's further treatment of Miss Gibson and myself. In the paper, to use its own words, a suggestion, "even if it be only of the *vaguest* kind," is made that the bulk of the lucid stars *may* belong to a differentiated system. Mr. Hinks asserts that the basis for "this far-reaching suggestion" is one in which the white stars had no frequency in the record. Will the reader believe that this suggestion, which the writer herself describes as of the "vaguest kind," is not based on the colour correlation at all? Can Mr. Hinks really have criticised the memoir and supposed that even this vague suggestion was based on the 159 Cape stars? The suggestion, such as it is, is based on counts of *all* stars, and results from showing that a continuous curve can be found which describes with remarkable closeness the counts up to the sixth and seventh magnitude, but that beyond this magnitude any formula hitherto proposed fails even approximately to describe the frequency. This result, reached by other investigators, is confirmed by Miss Gibson, and in association with changes in other stellar characters, which occur about the same magnitude, does suggest, I venture to think, that in the vaguest kind of way some differentiation of the stellar system may possibly exist beyond the bulk of the lucid stars. I think Mr. Hinks owes us an explanation of what his statement, that a far-reaching suggestion has been based on stellar statistics from which all white stars have been excluded, really is intended to convey.

In conclusion, may I say that I have learnt from my experience with biologists, craniologists, meteorologists, and medical men (who now occasionally visit the biometricians by night!) that the first introduction of modern statistical methods into an old science by the layman is met with characteristic scorn; but I have lived to see many of them tacitly adopting the very processes they began by contemning. Mr. Hinks is at present in the first stage; but may I remind him that even astronomy owes something to the layman, and express my hope that he may quickly reach a more understanding and sympathetic frame of mind? KARL PEARSON.

Biometric Laboratory, University College, London.

The Body of Queen Tii.

JUDGING from the letter addressed to NATURE of September 26 (p. 545), Mr. Hall (like Prof. Sayce in the *Times* of September 17) has been thrown into a state of doubt in regard to the real sex (? and age) of the mummy supposed to be "Queen Tii" by a letter from Mr. Theodore Davis, calling in question the accuracy of my statement that the mummy supposed to be an old lady of at least fifty years is the skeleton of a young man of about half that age.

Let me give a concise account of what I know in regard to this matter. At the end of June of this year Mr. Weigall, the Government inspector in the Service des Antiquités at Luxor, acting on the instructions of M. Maspero, the director-general of that department, sent me a skeleton to be examined and reported on. The skeleton was practically complete, for, although the face, certain ribs, and part of the pelvis were broken, most of the fragments were sent. Mr. Weigall told me that the bones were found in their coffin in a tomb opened by Mr. Theodore Davis in January last, and that they were supposed to be the remains of Queen Tii. Moreover, he has assured me that no possible mistake could have been made, because he himself and Mr. Ayrton had packed the bones, and they were received and unpacked by me in the anatomical department of the Cairo School of Medicine. The fact that the bones were soaked with paraffin wax, and that no other skeleton is known to have been so treated in Luxor, puts their identity beyond all doubt.

The skeleton is undoubtedly that of a young man of about twenty-five years of age.

It does sometimes happen that a skeleton presents features of such an indefinite character that even the most experienced anatomist hesitates before expressing an opinion as to sex; but these bones do not fall into such a category. All of them, and especially the skull, pelvis, and leg-bones, present the male characteristics in such a pronounced or even exaggerated form that a junior student of anatomy would be considered exceptionally stupid if he failed to recognise the sex. The skull is big and heavy-jawed, the frontal sinuses and superciliary ridges are exceptionally large, even for a man, and the mastoid processes are typically masculine; although the skull is exceptionally capacious, the face is disproportionately big. On the evidence of the cranium alone the sex is obvious.

The pelvis exhibits the most characteristic masculine features. The shape of the pubes and the pubo-ischial rami, the size and shape of the subpubic angle (67°), the form of the obturator foramen, the proportions of the pelvic cavity, and the shape of the iliac bones all conform to the definitely male type. The femur also serves to demonstrate the male sex in its size, inclination of shaft, and size of head.

Mr. Theodore Davis and those who have disseminated extracts from his letters have dealt rather unfairly with the two medical men, whose opinions they quote, in giving such wide publicity to statements which could have been made only in the most casual manner by anyone with any medical training whatsoever. It is so absurd as to be altogether incredible that "a prominent American obstetrician" would quote the figures 90° to 100° for the female subpubic (misquoted "pelvic" by Prof. Sayce and Mr. Hall) angle, and 70° to 75° as the average for this angle in the male, with the object of demonstrating the *female* sex of a pelvis *the subpubic angle of which is only* 67°!

But, quite apart from the very obvious male characters of the skeleton, there are even more obtrusive features equally fatal to the possibility of it being Tii's, which could hardly have escaped the observation of a medical man, however casual.

The teeth are practically unworn; three of the "wisdom" teeth had just been "cut," and the fourth was only just emerging from the jaw at the time of death; and a large number of epiphyses on ribs, vertebræ, clavicles, sternum, and pelvis were either separate or in process of joining. In other words, the bones are clearly those of a person of about half the age Queen Tii is known to have reached.

The archæological and historical remarks in Mr. Hall's letter do not concern me.

In a short time I shall publish a full account of this skeleton, with photographs exhibiting the evidences of sex and age, and the points of similarity and dissimilarity to the mummies of Amenhotep III., Yuaa, Thua, Thothmes IV., and perhaps some other royal mummies of the eighteenth dynasty.

G. ELLIOT SMITH.

Anatomical Department, The School of Medicine, Cairo, October 4.

The Interpretation of Mendelian Phenomena.

ALTHOUGH it is impossible within the limits of a short letter to attempt an answer to the question of the bearing of "Mendelism" upon biological problems in general, there are one or two points in Dr. Archdall Reid's letter in NATURE of October 3 which seem to require discussion.

Dr. Archdall Reid begins with the following statements:—"Mendelian phenomena are possible only when reproduction is bi-parental. They cannot occur, of course, when it is parthenogenetic." In the first of these statements the expression "bi-parental" should not be taken too literally, since in the majority of cases of Mendelian inheritance investigated hitherto the method of so-called self-fertilisation has been employed. I hope I may be pardoned for the assertion that the second statement is a little premature. For my own part I shall certainly await the result of experimental evidence upon the point before accepting it as conclusive.

In the absence of Dr. Archdall Reid's definition of what he means by "the problem of sex," I am not sure that I entirely understand the remainder of his first paragraph; but the suggestion may be made that "the function of sex," "the causation of variation," "retrogression of characters," and "mode of development" are less immediately to the purpose in the present condition of biology than the problems of the actual method of transmission of existing characters. Upon the problem of the "alleged transmission of acquirements" Mendel's facts may even be said to throw some light; but in any case it seems rather severe treatment to belittle the importance of a biological discovery merely because it does not immediately lead to the solution of all the most difficult problems which biology affords.

Once more it must be repeated that the appearance of a blended first cross is no criterion of non-Mendelian inheritance. In the case of a problem like that of man, complicated as it is by the fact that he has "crossed more often than any other animal," and further rendered intractable by the circumstance that he is not amenable to experiment, a great difficulty arises in discovering which are the actual allelomorphs concerned. For these natural characters pay no heed to our definitions; so that if an investigator makes the mistake of first rigidly defining the "characters" with which he proposes to deal, and does not keep a perfectly open mind, prepared to revise his definitions in the light of the evidence which experiment alone can afford, he runs a great risk of finding only confusion where a proper analysis would have shown the presence of perfectly definite methods of inheritance. It would be extremely interesting to students of genetics to learn upon what evidence Dr. Archdall Reid bases his positive statement that there is no segregation in the case of the mulatto.

There is certainly occasion for surprise in finding it maintained that "nature selects only mutations"; but that natural conditions lead to the obliteration of a host of mutations is as fair a deduction from the fact that such mutations appear under cultivation as the current deduction that the conditions of cultivation actually cause the occurrence of this kind of variation. We have the testimony of de Vries and others that the former process actually takes place. That the latter process does so is an assumption which still lacks the support of facts.

R. H. LOCK.

Botany School, Cambridge, October 7.

The Colour of Dye Solutions.

IT is generally accepted that the colour of dye solutions depends upon the chemical structure of the dye, and colour changes are usually attributed to some change in constitution; but certain recent investigations on colloidal solutions show that this argument must be accepted with caution. It is well known that colloidal solutions of the metals are highly coloured. Further, it is recognised that many dyes exist in solution in what, for lack of a better term, must be called the colloidal state. Some observations of my own point to the following statement as being true for certain dyes:—

The absorption spectrum of the dye in solution may be

either (*a*) a characteristic absorption, consisting of one or more narrow bands and depending on the chemical structure of the dye molecule, or (*b*) a "resonance" spectrum due to colloidal particles, and much more remotely connected with chemical constitution. This spectrum is ill-defined.

The detailed experiments which have led to these conclusions will be communicated in a paper shortly to be published. A word or two is desirable in explanation of the term "resonance" spectrum. By this is denoted the type of absorption exhibited by colloidal metal solutions, glasses, and certain photographically prepared films (F. Kirschner, *Drude's Annalen*, 1904, xiii., 239; Kirschner and R. Zsigmondy, *ibid.*, 1904, xv., 573; K. Schaum and E. Schloemann, *Zeit. wiss. Phot.*, 1907, v., 109). It is probable that all absorption is due to resonance, no doubt, and hence the narrow-band type (*a*), but in this case the resonators would be the molecules or the contained electrons, whereas in case (*b*) the resonance of larger aggregates is the cause of the absorption.

The investigation is to be continued, but a striking case was found in one of the pinacyanols, a class of dyes recently introduced as photographic sensitisers. This dye gives in aqueous solution a flattish, ill-defined absorption, the solution showing all the characteristics of a colloidal solution. In alcohol and organic solvents the absorption was of a narrow-band type, entirely different, and *this spectrum was also obtained by heating the aqueous solution to boiling point.* The behaviour was quite analogous to that of starch, which gives crystalloid solutions at the boiling point.

S. E. SHEPPARD.

Phys. Institute, Marburg a. L.

The Convection Explanation of Electrolysis.

AT p. 12 of a recent text-book entitled "Electrochemistry," by Prof. R. A. Lehfeldt, the author mentions the convection explanation of electrolysis, and states that "Faraday was sufficiently impressed with it to form the hypothesis of *ions*, *i.e.* of charged particles in the liquid travelling under the action of the electric force."

So far from being impressed favourably by this "explanation," Faraday considered it might have a "dangerous influence" and "do great injury to science by contracting and limiting the views of those engaged in pursuing it." He therefore constructed his terminology of electrolysis specially to get clear away from this "explanation."

Again, Faraday did not form a "hypothesis of ions as particles." The word ion refers to the nature of the substance evolved at the electrode, not its dimensions. The ion of Faraday might weigh an ounce or a ton.

The opinions which the modesty of the great observer permitted him to express may be found in the seventh series of his "Experimental Researches." To attribute to him, for any purpose, other opinions absolutely alien to these is, I submit, either scientifically reprehensible or grossly careless.

J. BROWN.

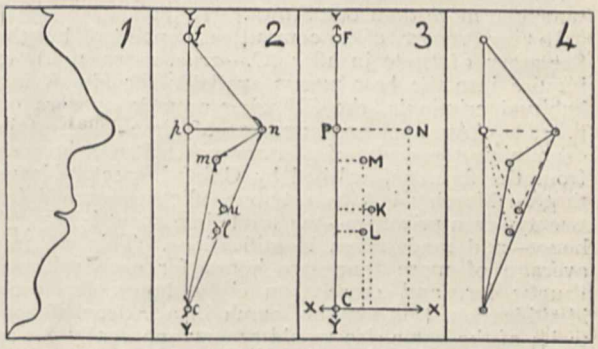
Belfast, August 18.

CLASSIFICATION OF PORTRAITS.

EXPERIMENTS of various kinds that I have made to define the facial peculiarities of persons, families, and races by means of measurement led to the following results that seem worthy of publication. The most elementary form of portrait will alone be considered here, namely, the outline of the face from brow to chin, as in a shadow or in a silhouette. It contains no sharply defined points whence measurements may be taken, but artificial ones can be determined with fair precision at the intersections of tangents to specified curves. It will be shown that it is easy to "lexiconise" portraits by arranging the measurements between a few pairs of these points in numerical order, on the same principle that words are lexiconised in dictionaries in alphabetical order, and to define facial peculiarities with greater exactness than might have been expected.

The individuality of a portrait lies more in the relative positions of six cardinal features (see the figures below) than in the shapes of the lines that connect them, so long as the general character of the connecting lines is roughly indicated. A few standard types, perhaps ten in all (though I prefer to use more), represent as many concave, convex, and sinuous varieties of outline, between each specified pair of the six cardinal points, as need to be noted. I may recur to this in a future letter.

This will be apparent to the reader's satisfaction if he compares portraits under unfavourable conditions, as through a blurring medium, or out of focus; or, again, if he substitutes connecting links that differ somewhat from the true ones. Consequently my first endeavour was to define accurately six points that should severally be good representatives of the six cardinal features in the outline. Those features the limits of which are vague are expressed by *italic* letters in Fig. 2, and their representative points by the same letters in *capitals* in Fig. 3. The features are these:—*c*, the tip of the chin; *l*, the lower, and *u*, the upper lip; *m*, the hollow between the upper lip and the nose; *n*, the tip of the nose; *f*, the hollow between the nose and the brow. In order to find their respective representative points, proceed as shown in Fig. 2, by drawing (upon tracing paper) a tangent, YY, to both *c* and *f*. Then draw a short tangent to *n* parallel to YY (accidentally omitted in the Fig.). A tangent to



both *c* and *n* intersects the first of these lines at C and the second at N, and determines them. A line drawn from N tangential to *f* determines F. Thus the fundamental triangle CNF is obtained, in which YCFY is used as the axis of Y, and the length of CF (divided into 100 equal parts, here called "cents") determines the scale of measurement. In the life-sized portrait of an adult, 1 cent may be regarded as roughly equivalent to 1¼ mm. or to 1/20th of an inch. M, and consequently the triangle CMN, is determined by the intersection of one line drawn from C with another from N, both tangent to *m*. U and L lie at the intersections of tangents drawn in either case, parallel to X and CN respectively. They require less attention than the preceding letters, because *u* and *l* are usually small.

The positions of the six cardinal points may be expressed in either of two ways—(1) as in Fig. 3, by rectangular coordinates, YCY being the axis in Y, and XCX perpendicular to it, the axis in X. Or (2) as in Fig. 4, by triangulation. Here an additional line, NP, drawn perpendicularly from N to YCY, is convenient. I have compared both of these methods, and found each to have its advantages and disadvantages, depending on many variable causes, of which the scale of the portrait is one and the available in-

strument is another, and am inclined on the whole to prefer the method of coordinates.[1]

In my experiments I have chiefly used the side-view portraits by George Vance, R.A., of his distinguished contemporaries, published in 1809 (2 vols., folio, Longmans), which yielded sixty-eight pure profiles of about one-third the natural size. I lexiconised these in respect to the measures (entered to the nearest cent) of the two coordinates of N and M respectively (4 measures in all), and found, first, that no two of the numerical formulæ were the same, and, secondly, that in two-thirds of them the *smallest* difference between the most nearly resembling pairs was 3 cents in one or more of the four measures. This conspicuous difference, equivalent to between 1/6th and 1/7th of an inch in a portrait of the natural size, could never be due to the inherent imperfection of the art of measurement, but to some gross blunder. It follows that the collection of sixty-eight portraits was lexiconised with remarkable precision. The data were insufficient to enable me to speak with much assurance of the gain that would accrue from taking L and U into additional account, but their correlations with C, M, N, and F, seeming to be very small, the gain ought to be great. I am content to underrate this gain considerably, and to allow only fifteen-fold for it. On that basis a collection of 1000 profiles from brow to chin could be lexiconised and searched with great ease. In 667 cases each portrait would have a clearly distinctive formula; in the remaining 333 there would be doubtful duplicates, and even triplicates, just as in any list of the names of 1000 British persons there would be more than one Smith.

In the report of a committee appointed by the Secretary of State in 1894 (C.—7263, price 10*d*.) to inquire into the best means available for identifying habitual criminals, the following remark appears on p. 18:—"An enormous amount of time is spent in examining the books of photographs. It will be seen from the figures furnished by Chief Inspector Neave that on March 1 last twenty-one officers searched for twenty-seven prisoners—the total time spent being 57½ hours—and made seven identifications. This was an average of more than two hours for each prisoner sought for, and more than eight hours for each identification." A similar search in a lexicon of portraits of the same size would occupy apparently fewer minutes than the above occupied hours.

I will go no further now into the results of my experiments than to say that I have applied the above method to portraits of persons of very different races, and have thus far found it efficient in all of them.

FRANCIS GALTON.

WEIGHTS AND MEASURES REGULATIONS.

THE new regulations, which came into force on October 1, apply only to weights, measures, and weighing instruments used for the purposes of trade. They are in some respects rather less stringent than the preliminary draft issued by the Board of Trade in August, 1906, a review of which appeared in these columns last year.

There are but few points of scientific interest in the regulations. Specific instructions as to temperature are now given for the first time to inspectors of weights and measures. Measures of length are to be verified by comparison with a local standard at or near the normal temperature, which is 62° F. for imperial measures. For imperial measures of capacity the standard temperature of their water contents is also 62° F.; for metric measures of capacity it is 4° C.; but metric measures graduated at 15° C. or 60° F. may also be verified for chemical or pharmaceutical purposes, or for volumetric estimations. Measures marked with the temperature at which they are graduated must be tested against measures standardised at the same temperature. An apothecaries' measure, marked with equivalents in weight, is permitted, provided that the words "of water" are marked on it in addition to the denomination.

Certain restrictions are placed upon the weighing instruments to be used by dealers in precious metals or precious stones, retail chemists or druggists, and silk merchants. These traders are permitted to use three kinds of weighing instruments, the first kind being chemical and assay balances provided with means for relieving all the bearings and knife edges, the second being beam scales of a lower order of sensitiveness and accuracy, which must be marked "Class B," and the third being instruments other than beam scales which satisfy the requirements for Class B. The first and third of these types of instruments are not to be marked with a "class."

The requirements of Nos. 69 and 78 of the regulations, prohibiting adjusting contrivances which are not permanently fixed to the weighing instrument, will render some kinds of analytical and assay balances ineligible for official stamping in the future. Traders who use such balances should be careful not to keep them upon their trade premises if unstamped, otherwise they may be liable to forfeiture if they come under the notice of an inspector of weights and measures.

Counter weighing machines of the "accelerating" type are prohibited by the regulations. It is often difficult to distinguish between a vibrating and an accelerating instrument, especially when these are sluggish or have been in use for some time. The requirement prescribed in No. 68 of the regulations that the machine shall balance when unloaded will, however, be sufficient in general to determine this point. When the machine is unloaded, if either of the pans be pressed down and then released, the beam will be set in oscillation about its horizontal balancing position, if the instrument is of the vibrating type; but if the instrument is accelerating, it will be found that one or other of the pans when pressed down will remain down, and the beam, failing to oscillate, will rest out of balance.

Spring balances are somewhat rigorously dealt with, but, on the whole, the Board of Trade has taken a fairly lenient view with respect to these instruments in permitting them to be used for ordinary trade, rather than restricting their use to such purposes as the weighing of postal parcels and passengers' luggage, as is the case on the Continent.

Weights, measures, and instruments at present stamped and in use, but which do not comply with the new regulations, may be continued in use for certain prescribed periods, and, with the exception of a particular type of spring balance, may be re-stamped from time to time.

Appendix 2 contains a useful list of all the denominations of weights and measures which are at present legal in this country. It will be seen from this list that weights of ¼ grain, which are frequently employed by chemists in compounding drugs, are not legal for use in trade.

[1] In some cases brevity is very desirable, and may be obtained by regarding only the limits within which the variability of each link most commonly occurs and by dividing the interval between those limits into 8 equal parts. Then 0 would signify all measures below the lower limit, and 9 all above the upper one. The range of the rectangular coordinates to N and M within the limits above explained varies between 12 and 20 cents, so the value of each of the eight equal parts will vary from 1½ to 2½ cents according to the coordinate in question. These "parts" are more suitable for classification than cents, which are too small to be quite trustworthy. But I will not go further here into this question than to add that the 8 rectangular coordinates of M, N, L and U can be described in this way by only 8 figures, and the connecting outlines CL, LU, UM, MN, NF by 5 (or say 10) more, so that a portrait can be expressed (say be telegraphed) in a rude but recognisable form by only 13 (or 18) figures.

ANCIENT KHOTAN.[1]

DR. M. A. STEIN'S promised scientific publication of the material gathered by him during the course of his first expedition to Chinese Turkestan has now appeared, and has been awarded the distinction of being published by the Clarendon Press, and so under the auspices of the University of Oxford; and worthily: for the importance of Dr. Stein's archæological discoveries is great. The significance of his finds will be found fully explained in two articles which appeared in NATURE on the occasions of the publication of Dr. Stein's first "Preliminary Report" (1901) and of his popular book, "Sand-buried Ruins of Khotan" (1903), which gave so good a general account of his work. It is therefore unnecessary to go over the same ground again now, and we can confine ourselves to a consideration of the fine volumes before us.

The Clarendon Press has produced the book in sumptuous style. The form of the broad page and the size of the type are both good and pleasant to read. The title-page is quite a work of art; as a specimen of a modern title-page with good type, well sized and well spaced, it is worth seeing. The only fault we can find in the general get-up of the book is that the photographs in the first volume are printed on paper that is somewhat too thin and flimsy, with the result that the half-tone blocks have a somewhat cheap appearance which does not agree well with the fine appearance of the rest of the book.

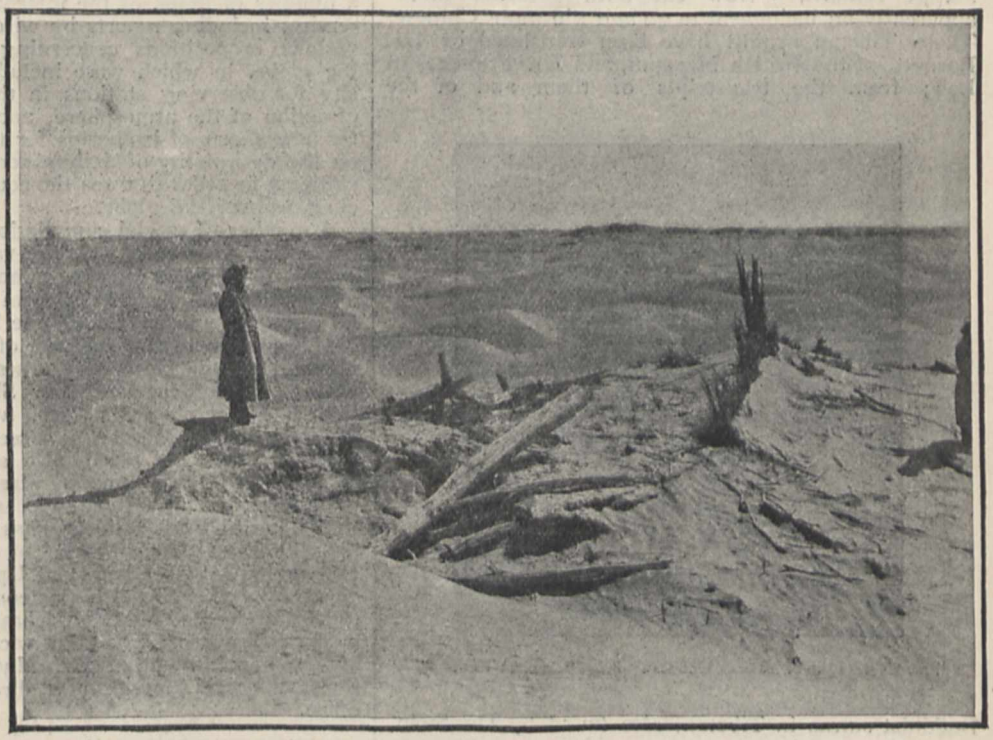


FIG. 1.—Remains of dwelling completely eroded; Niya site. From "Ancient Khotan."

The same may be said of the first eighteen plates of the second volume, which contains the great body of the illustrations. In one of these also (plate iii.) the upper picture has been printed upside down, which is a pity. But to the rest of the plates nothing but unqualified praise can be given; the coloured ones are very good, especially those reproducing textiles.

From these plates the remarkable character of the art of Niya, Yotkan, and Dandan-Uiliq, having the chief "find-spots" in their chronological order, can easily be grasped. Especially interesting are the wooden remains from Niya, and the pottery and little clay *genre* figures from Yotkan. The strength of the classical tradition which came from Greece to India, and thence to Chinese Turkestan, is very evident to us as we turn over these pictures. Plate lxx., too, shows wooden chair-legs in the shape of the foreparts of sphinxes, with a headdress that reminds us of the triple horn above the heads of Assyrian bulls. Why not? Niya's art came from Gandhāra, and Gandhāra's from Seleucia on the Tigris. The analogy of these excavations to those of Egypt is well shown in such a plate as No. lxxiii., which presents to us antiquities in the shape of musical instruments, carding combs, brooms, hoes, &c., of the same kind as those that may be found on an Egyptian site. In both countries the dryness of the soil preserves objects that elsewhere would long since have perished.

The Kharoshthi letters on wooden boards, and the Chinese written slips found with them, also have a very Egyptian look, and we have a strange note of connection in the Judæo-Persian document written on paper, which was found at Dandan-Uiliq, but which, so far as its language and appearance are concerned, might just as well have been found at Oxyrrhynchus! After all, Tabaristan, where it was written, is not so much farther from the banks of the Nile than from those of the Tārīm. And in the reign of Trajan, long before this document was written, the great Chinese general, Pan-ch'ao, advancing ever westwards from Ch'angan (Si-ngan-fu, then the capital of China), had reached the Caspian, and tried to open up relations with the Romans. So that many a merchant may even in the first century A.D. have known the banks of the Nile, Tigris, Oxus, and Tārīm equally well, and we can well comprehend how classical art influenced that of China by way of the civilisation of which Dr. Stein has discovered the remains in Turkestan.

Dr. Stein's letterpress is very copious, since he includes in his work long dissertations on Chinese and other literary evidence as to the identification and history of the ancient places which he has found. When we say that his success, and that of his co-adjutors, in this interesting work has been striking, we do not err; and, on the other hand, several of

[1] "Ancient Khotan; Detailed Report of Archæological Explorations in Chinese Turkestan, carried out and described under the Orders of H.M. Indian Government." By M. Aurel Stein. Two vols.; text and plates. Pp. xxiv+621; pp. vii+119. (Oxford: Clarendon Press, 1907.) Price 5*l.* 5*s.* net.

Dr. Stein's finds have amply confirmed the statements of the Chinese official records, especially with regard to the period of the isolation of the "Four Garrisons" of Turkestan after the Tibetans had driven a wedge northwards into the dominions of the T'ang, in the eighth century A.D. To this period belong the ruins of Dandan-Uiliq, while those of Niya, which show the most marked classical characteristics, are five hundred years older. It is at Niya that we find a document sealed with a Chinese and a Greek seal side by side!

The Tibetan evidence contained in graffiti (which Dr. Stein for some reason insists on calling "sgraffiti": "sgraffito-work" is something quite different) at Dandan-Uiliq and Endere is curious. We have apparent references to defeats of the Chinese: "At Pyagpag in the province of Glom-lom this army fought, and a tiger's meal was obtained (*i.e.* many were killed)"; followed by the savage remark, "Now eat until you are fat!" apparently an incitement to go and kill more Chinese. These Tibetan graffiti have been translated by Dr. Barnett, of the British Museum, and Dr. Francke, of Leh; from the transcripts of them and of the

FIG. 2.—Intaglio of a Greek Goddess. From "Ancient Khotan."

Buddhist sutras in Tibetan, also found by Dr. Stein, the curious reader can gain an idea of the sounds of the extraordinarily hideous Tibetan language, which would seem to have served as the model for Swift's Glumdalclitch, Brobdingnag, the Struldbrugs, and the rest of the names in "Gulliver's Travels," not excepting "Houynhnhnm."

The Chinese graffiti are translated by the great French Sinologist, Dr. Chavannes; and Prof. E. J. Rapson, of Cambridge, has begun the translation of the Kharoshthi letters of the Indian maharajas who ruled Khotan in the third century B.C., and of their officials and dependants. Chinese rule seems to have been maintained contemporaneously with that of the maharajas; but what powers were specially reserved to the latter we cannot quite see from this correspondence. Dr. Stein's new discovery (1907), that the Indian kingdom stretched away east to beyond Cherchen and Charkhalik to the Lop-nor, is of great historical importance.

For the details of Dr. Stein's exhaustive description of his discoveries we must refer the reader to the book. The congratulations of all archæologists to all concerned in its making go without saying. And not least congratulatory should be modern Chinese and Japanese literati, to whom the Chinese documents and antiquities of the Former Han and the Great T'ang dynasties should prove of the greatest interest.

H. R. HALL.

INTERNATIONAL METEOROLOGICAL COMMITTEE.

A MEETING of the International Meteorological Committee was held at Paris on September 10 and following days.

The committee consists of seventeen members, appointed at the conference at Innsbruck in 1905. Ten members were present, including the director of the Japanese service. Two places were vacant by death. The principal subjects discussed were the scheme of organisation of international meetings for meteorological purposes; marine charts and weather signals; a number of items of the international daily weather service, including reports by wireless telegraphy; and various propositions concerning the meteorology of the globe, in which were included one on the necessity for observing stations in the regions of centres of action of the atmosphere, another on the necessity for new charts of isotherms for the globe, and a third on the desirability of daily observations from selected stations, in order to trace the course of meteorological changes over the globe.

A number of special commissions were appointed to report upon, or carry out, the various proposals. M. Mascart, president of the committee, was unfortunately prevented by illness from attending the meetings with the exception of one held at his house for the discussion of the question of international organisation. At the close of the session he resigned the office of president, and Dr. Shaw, director of the British Meteorological Office, was elected president. M. Angot, M. Mascart's successor at the Bureau Central, takes his place also as a member of the committee. Dr. Hellmann, director of the Prussian Meteorological Institute, was elected secretary, in succession to Prof. Hildebrandsson, who retires upon his withdrawal from the post of director of the Royal Meteorological Observatory at Upsala. Dr. Hamberg, director of the Swedish Meteorological Office, was elected to succeed Prof. Hildebrandsson as a member of the committee. The other vacant places were filled by the appointment of Dr. Maurer, director of the Swiss office, and Mr. Stupart, director of the Canadian office.

NOTES.

WE notice with regret the announcement made in a Reuter telegram from Paris that M. Loewy, director of the Paris Observatory, and a member of the Academy of Sciences, died there on Tuesday, October 15.

AT 1.17 a.m. on October 11 the Cunard liner *Lusitania* arrived at Sandy Hook, having crossed the Atlantic in 4 days 19 hours 52 minutes. The total distance travelled was 2780 nautical miles, and the average speed was 24·002 knots. The highest day's run was 617 nautical miles.

REUTER'S correspondent at Mombasa reports that Dr. Koch, who has been examining the causes of sleeping sickness, left for Germany on October 15. His investigation camps in Uganda have been taken over by the colonial authorities. It is understood that Dr. Koch's investigations have not led to any fresh discoveries.

THE Peking correspondent of the *Times* reports that an Imperial Edict issued on October 9 orders the Board of Revenue and Commerce forthwith to introduce a uniform

system of weights and measures throughout the Chinese Empire, the standards to be fixed within six months.

A REMARKABLE long non-stop railway run was achieved by the Great Western Railway on September 16. A special excursion train, carrying only third-class passengers, the total load weighing approximately 148 tons, was run from Paddington to Fishguard, a distance of 263½ miles, without a stop, at an average speed of 53 miles an hour.

ON October 12 the Clifton (Bristol) Scientific Club celebrated its twenty-first anniversary by entertaining Sir William Ramsay and other past members, when Sir William, who was one of the founders of the club, delivered an address on the recent history of chemical science and on the nature of matter. On the previous evening he visited Clifton College, where he gave an account of the experiments by which argon and other gases of the atmosphere were discovered.

WE learn from the *Pioneer Mail* that a large meeting was held at Rangoon on September 19 to consider the establishment of a Pasteur Institute in Burma. It was resolved that the institute should be established at Maymyo. A committee was formed with powers to undertake measures preliminary to the formation of the institute. The subscriptions already amount to 80,000 rupees, which secures the success of the movement. Other subscriptions have been promised, which will be sufficient to enable the institute to start on a wide basis.

THE announcement that bison are about to be taken from the Zoological Park in New York to Kansas reminds one of the carrying of coal to Newcastle. In the great plains of the Middle West, however, the encroachment of population has practically made these animals extinct. The zoological collections in the east are now to be drawn upon to re-establish, in the Wichita reservation, herds of sufficient size to ensure their permanency.

AN exhibition has just been held in Boston, U.S.A., to illustrate the precautions that should be taken against tuberculosis. It included a representation, side by side, of two sleeping-rooms, with arrangements favourable and unfavourable respectively to the growth of the disease. There were also exhibits of tents for open-air treatment. A lecture on hygiene was given during the exhibition.

AN exhibition promoted by Lady Aberdeen, as president of the Women's National Health Association of Ireland, with the object of educating the people on the great danger of tuberculosis, was opened at Dublin by the Lord Lieutenant on October 12. The exhibition is intended to be an object-lesson to teach people certain facts contained in Blue-books and the Registrar-General's reports. Its primary object is to reach the women of the country, and to bring these facts home to them as guardians of the home. In opening the exhibition, the Lord Lieutenant read the following message from the King :—"I am commanded by the King to express his good wishes for the success of the Tuberculosis Exhibition, the first of the kind ever held in Great Britain and Ireland, on the occasion of its being opened by you to-day. His Majesty is greatly interested in the problem of checking the progress of this disease, and he trusts that the exhibition may be the means of attracting the attention of the public to the terrible ravages caused by this scourge and to the efforts which are now being made to arrest its progress.—KNOLLYS." After the exhibition has closed at Dublin it will be taken to various parts of Ireland, where lectures will be delivered upon it.

IN connection with the indication by the London County Council of houses in London which have been the residences of distinguished individuals, a memorial tablet was, on October 7, erected on 88 Mile End Road, E., where Captain Cook, the circumnavigator, resided at one time. It is probable that his removal to this house took place in 1764, and his wife continued to reside there for some time after his death in Hawaii in 1779. The house does not appear to have been re-built since Captain Cook's tenancy, but it has been converted from a private dwelling-house into business premises by the erection of a shop on the forecourt. The tablet is of encaustic ware, terra-cotta in colour, and bears the following inscription :—"Capt. Cook, 1728–1779, Circumnavigator, Lived Here."

REFERENCE has previously been made in these columns to the progress effected by the Congo authorities in the task of domesticating the African elephant. A recent visitor to the State establishment at Api writes as follows :—"Owing to an unfavourable season no attempt has been made to increase the number of elephants under training. The number in the colony at the present time is twenty-five, of which nineteen are employed in different kinds of work. During the four months of the wet season the elephants are not merely not worked, but are even allowed to rejoin those in a wild state—that is to say, they are turned out into the forest, but they seem to keep apart. They, however, attract some of the wild elephants to the vicinity of the establishment, but these are generally too old and intractable to provide useful recruits. On resuming the regular routine they manifest no indisposition to work, and submit themselves freely to the discipline of the establishment. The African elephant is of short stature, the young elephants at Api averaging from 4 feet 4 inches to 5 feet 7 inches at the shoulder."

THE report of the Departmental Committee appointed to inquire and report as to the nature and extent of the benefit accruing to British arts and industries from the participation of this country in great international exhibitions, which has just been issued as a parliamentary paper (Cd. 3772, price 7*d*.), is a document of great interest. The committee found that the evidence it received went to show that international exhibitions are of little use to the textile and other great staple industries of the country. The committee is, however, in favour of the continued participation of this country in all really important exhibitions, owing to the indirect advantages resulting. One aspect of exhibitions to which it is considered that considerable importance should be attached is the effect which they have in encouraging national emulation and in stimulating individual exhibitors to improve their productions. Interesting examples of the effects which particular exhibitions have had on the development of different industries will be found in the evidence of Sir William Preece, K.C.B., Mr. Bennett Brough, and other witnesses. Sir William Preece attributes to the Paris Exhibition of 1881 many of the most important developments of the electrical industry. The exhibition at Paris of certain high-speed tool steels by an American firm is said by Mr. Bennett Brough to have contributed in a large degree to the development of what has become a British industry of great magnitude; and an exhibit by the Courrières Colliery Company, at the mines of which the death-rate from falls of roof was abnormally low, has since led to considerable improvement in the methods of timbering employed and a consequent decrease in the death-rate. The report concludes with important recommendations for securing in future continuity of organisation from exhibition to

exhibition, and more effective representation of this country at any exhibition in which the Government may decide to take part.

In the September issue of the *Annals and Magazine of Natural History*, Mr. G. E. Mason describes the remains of a supposed new fruit-bat from Round Island, near Mauritius. The remains, which occur in a guano-deposit, appear to be very recent, and in the October issue of the same journal they are referred by Dr. K. Andersen to an existing species.

Articles on spermatogenesis in the water-beetle (*Dytiscus marginalis*), with remarks on the nucleolus, by Mr. W. D. Henderson, Carnegie research fellow at Aberdeen, and on the embryonic development of *Taenia serrata*, by C. von Janicki, of Basle, appear in *Zeitschrift für wissenschaftliche Zoologie*, vol. lxxxvii., part iv.

Nos. 1558, 1559, and 1561 of the Proceedings of the U.S. National Museum are devoted to new echinoderms from the North Pacific, Mr. C. L. Edwards describing holothurians in the first of these issues, while free crinoids are discussed by Mr. H. H. Clark in the second and third. Attention is directed to the brilliant and varied colouring of the feather-stars of the multicolour group of Antedon, which exceeds that of all other crinoids. For classificatory purposes this colouring is, however, useless.

The colouring of the interior of the mouths of nestling perching-birds offers, according to Mr. W. P. Pycraft in *British Birds*, No. 5, an almost unknown field of investigation. It is suggested that the bright-coloured membranous margins of the gape are intended as a guide to the parents in feeding their offspring. In addition to this, the interior of the mouth in most nestlings is bright yellow, occasionally marked with black (hedge-sparrow) or white (bearded titmouse) spots on the tongue and palate, and it seems that this bright colouring attains its highest development in nestlings reared in deep shade. If this be confirmed, it seems obviously connected with the feeding process.

The greater part of vol. viii., No. 1, of the Journal of the Marine Biological Association is taken up with descriptions of various organisms collected in August, 1906, by the *Huxley* during a cruise on the north side of the Bay of Biscay. Among these, the most interesting is a second specimen of *Corallium maderense*, this genus of alcyonarians being previously unknown from the area in question. The axis, or "coral," is white, hard, and semi-translucent; and, although not likely to command a high price, in the opinion of Prof. Hickson, this coral might prove, if found in sufficient quantities, to have a marketable value.

In an article on the harm caused to the vision of school children by their studies, published in the *Popular Science Monthly* for July, Prof. W. D. Scott remarks that "the human eye which had been evolved for distant vision is being forced to perform a new part, one for which it had not been evolved, and for which it is poorly developed. The difficulty is being daily augmented. The invention of printing presses has been followed by an increasing number of books, magazines, and daily papers. . . . All things seem to be conspiring to make us use our eyes more and more for the very thing for which they are the most poorly adapted. It requires no prophet to foresee that such perversion in the use of an organ will surely result in a great sacrifice of energy, if not of health and of general efficiency." Certain mitigations of the evil are suggested in the case of young school children.

To the October number of the *Century Magazine* Prof. H. F. Osborn contributes an illustrated article on his experiences in the Fayum district of Egypt while in search of fossil vertebrate remains, with remarks on the nature and origin of the fauna and its bearing on the geographical distribution of mammals. Among the illustrations, special reference may be made to Mr. C. B. Knight's restorations of Arsinoitherium, Hyænodon, and Zeuglodon. In Eocene times the Fayum, in the author's opinion, was a savanna country, partly open, partly covered with scrub, and partly with forest, the temperature being much the same as at the present day. That Africa (when much less extended to the north than at present) was the home of the ancestral proboscideans, sea-cows, hyraxes, and probably hyænodonts, Prof. Osborn is fully convinced; but the absence in the Eocene deposits of remains of ancestral hippopotamuses, ruminants, horses, and rhinoceroses leads to the inference that "none of these quadrupeds had as yet reached Africa; that they were evolving elsewhere, either in Europe, Asia, or North America, and preparing for the great interchange of life which would occur when Africa should again be connected with the other continents." In referring on p. 824 to the *emus* of New Zealand, the author doubtless intended to write *moas*.

In vol. xx., part i., of the Proceedings of the Royal Society of Victoria, Prof. R. J. A. Berry reproduces a photograph of an aged half-caste Tasmanian woman now living on Kangaroo Island, South Australia. She is the daughter of a pure-bred Tasmanian woman by a European husband, and was born on the island about seventy-five years ago. In colour, as well as in her wide nostrils and mouth, weak chin, and dark eyes, she retains strong evidence of her Tasmanian ancestry, but her hair, although distinctly woolly, has departed somewhat from the aboriginal type. The latter is, however, better displayed in one of her daughters, who is, of course, a quarter-caste. The author believes "Mrs. S." to be the oldest surviving half-caste Tasmanian. Prof. Berry accepts the view that the Tasmanians were a branch of the Papuans, and that they reached Tasmania at an early period across Australia, when the continent had a direct land connection with Tasmania. Various cases have been known along the coasts of southern Australia of hybrids between Australian and Tasmanian aborigines, doubtless due to Tasmanians having been carried across Bass Strait by the sealers. The same number of the Proceedings contains a paper by Messrs. Chapman and Pritchard on fossil fish remains from the Australian Tertiaries; it describes seven new species, which are referred to genera which range in time from the Jurassic to the present. There is also the sixth of Prof. Ewart's contributions to the flora of Australia, and a paper by the same author on the movement of the soluble constituents in fine alluvial soils.

The theoretical articles in the fourth part of vol. v. of *Biometrika*, issued in September, include a note by Mr. Francis Galton on "grades and deviates," with a table giving the deviations in the normal curve corresponding to assigned percentiles; this table is due to Mr. W. F. Sheppard, who also contributes a memoir on the calculation of moments. Mr. A. P. di Cesnola gives an account of an investigation as to the action of natural selection in *Helix arbustorum*, by the method of the late Prof. Weldon, shells being ground so as to expose a longitudinal section of the spiral on which measurements can be made, and the frequency distributions compared for the earlier whorls in young and adults. The results show that there is markedly less

variation in the adults, and consequently some periodic selection. The records of Prof. Weldon for inheritance in mice are reduced and discussed, so far as regards sex-ratio and size of litter; there is little, if any, inheritance in either case, but the figures exhibit some peculiarities. The remaining articles include investigations by Prof. F. Y. Edgeworth on the average time of absence of wasps and bees from the nest, by Miss Wright, Miss Lee, and Prof. Karl Pearson on the wing dimensions of wasps (*Vespa vulgaris*), and by Dr. J. Brownlee on means of estimating the severity of attack in cases of acute disease. There are a few miscellanea, and a bibliography of literature on biometry and Mendelism relating chiefly to issues of 1906.

ON the subject of apogamy in the fern genus Nephrodium, Mr. S. Yamanouchi communicates a preliminary notice of his cytological investigations to the *Botanical Gazette* (August). In the normal gametophyte of *Nephrodium molle* sixty-four or sixty-six chromosomes were counted, and the double number in the sporophyte. In the apogamous developments, the sporophyte was followed from an initial cell, the nucleus of which contained the smaller number of chromosomes, and the same number was found throughout all the stages of the sporophyte.

THE first two numbers for the current year of the *Journal Botanique* of the Imperial Society of Naturalists in St. Petersburg contain two papers by Mr. A. Elenkin on lichens. In the earlier he describes three new lichens for the genera Evernia, Aspicilia, and Lecania, all collected in Russia; in the later he discusses the comparative amount of growth in erect and horizontally growing species of close affinity. The description of a new species of Eremurus from China derives its chief interest from the fact that, as the author, Mr. O. A. Fedtschenko states, this is the first record of that genus from China, and a considerable extension of its distribution south-eastwards beyond the previous limit in or near Nepal.

MR. C. E. C. FISCHER contributes to the *Indian Forester* (August) a list of host plants of various species of Loranthus and Viscum observed in the North Coimbatore Division of Madras. It is stated that these parasites are most frequent in dry, deciduous forests at elevations between 3500 feet and 4500 feet, where practically every tree is attacked. The occurrence of one parasite growing on another parasite is recorded. The method of exploiting the trees of *Terminalia Chebula* for their fruits, the myrobalams of commerce, is described by Mr. J. E. C. Turner. The sound fruits become ridged when they are dried in the sun, and the pericarp becomes exceedingly hard; others do not wrinkle, owing to the decomposition attributed to a fungus of part of the mesocarp into a black powder that has a small value for making ink. For sowing, the damaged fruits are preferable, since germination is not hindered by a hard pericarp.

WITHIN recent years an algal disease, known as the "red rust" of tea, caused by *Cephaleuros virescens*, one of the Chroolepidæ, has become a serious pest in the tea districts in India. Dr. H. H. Mann and Mr. C. M. Hutchinson, scientific officers to the Indian Tea Association, after following the course of the disease for some years, have published an account of their observations in the botanical series of the Memoirs of the Department of Agriculture in India (vol. i., No. 6). The growth on the leaf, being usually confined to the surface, would be unimportant, except for the fact that the sporangia there formed provide the means for the spread of the disease. This is effected either by transference of the sporangia as a whole or of the zoospores. The real danger is due to the penetration of the young stems of the tea plant by the alga, when, if the alga prevails, the leaves turn white and the stems are killed.

IT is well known that tide curves show that, in addition to waves of very short duration due to wind, and those caused by the regular flow and ebb of the tide, pulsations sometimes called "marine seiches" or "vibrations of the sea" occur, with periods of fifteen to twenty minutes, but differing considerably in various localities (see NATURE, January 12 and April 20, 1899). In the *Annuario* of the R. Nautical Institute of Catania, Sicily (vol. i., 1907), Prof. Giovanni Platania contributes an interesting paper on the subject, with the results of some fresh researches made by himself in the Gulf of Catania. Opinions differ as to the origin of these vibrations, which are observed under different meteorological conditions; the author thinks that the principal cause is variations of atmospheric pressure. The microbarograph recently devised by Dr. Shaw and Mr. Dines for recording the minor and sudden fluctuations of the atmosphere will probably help further to elucidate the phenomenon.

THE current issue of the *Central* (vol. iv., No. 12) contains an interesting account of research work carried out recently in the electrical department of the Central Technical College. There is also a well-illustrated description of the cyanide process for the extraction of gold and silver from their ores, written by Mr. Reginald Krall.

THE British South Africa Company has issued a copiously illustrated monograph on Rhodesia, covering 120 pages. It contains much information for travellers generally, and for sportsmen in particular. The illustrations have been admirably reproduced, and the five coloured maps are excellent. The volume should prove of special use to teachers as a class-book.

THE mode of formation of many placer deposits is not clearly understood, and the source of the gold has not been definitely determined. In view of this uncertainty, a recent paper by Mr. J. B. Tyrrell in *Economic Geology* (vol. ii., No. 4) is of special interest. He describes the conditions that prevail in the Klondike district of Canada, a country of exceedingly rich gold-bearing placers, where the origin and processes of deposition and concentration of the gold into its present position are easily recognised. His investigations show that the district owes its phenomenally rich placers, not to the wearing down of highly mineralised gold-bearing veins, but rather to the favourable conditions of long-continued and uninterrupted concentration from a great mass of rock that contained only very minute quantities of gold.

THREE valuable monographs have been issued by the Corps of Mining Engineers of Peru. In *Boletin* No. 51 Mr. F. M. Santolalla describes the mineral resources of the province of Huamachuco. The mineral deposits may be divided into three groups, the veins in eruptive rocks, such as the gold veins of the Toro, the lead-antimony-silver ores of Cerro Negro, and the magnetic iron ores of San Pascual and Potosi de Serpaquino. The coal deposits of the province have been known from time immemorial. In short, the mineral resources might be worked with great advantage if better means of communication were available. In *Boletin* No. 52 Mr. H. C. Hurd investigates two schemes for diverting the waters of the Rio de

Lambayeque. Lastly, in *Boletin* No. 54 Mr. G. Klinge gives the mineral statistics of Peru for the year 1906. The production included 79,969 tons of coal, 70,832 tons of petroleum, 20,226 tons of salt, 2598 tons of borates, 1830 tons of sulphur, 230 tons of silver, 13,474 tons of copper, 2568 tons of lead, 2304 kilograms of mercury, and 1247 kilograms of gold.

M. A. PELLETAN, in the October number of the *Journal de Physique*, expresses his regret that in France there is so much difficulty in finding persons capable of determining the elements of an optical instrument by any of the modern methods. It seems singular that in a country through which a knowledge of mathematics is more widely spread than elsewhere, that knowledge should find fewer practical applications than it does in almost any other country. M. Pelletan suggests the formation of a Government office to which engineers whose knowledge or leisure would not allow them to cope with mathematical difficulties might bring their problems for solution. In the meantime, he gives a clear *résumé* of the general methods of treating geometrical optics which have been developed from Hamilton's characteristic function. These methods are not so well known in this country as they deserve to be, and we have not yet risen to the point of regretting our want of knowledge of them.

THE measurement of the angle between the optical axes of a biaxial crystal has always played an important part in the identification of the crystal, and several methods of making the measurement are in common use. There has, however, been little comparative or critical study of the accuracy of the different methods under different conditions. A considerable portion of the *American Journal of Science* for October is devoted to such a study from the pen of Mr. F. E. Wright, of the Carnegie Institution. During the course of his experimental work, Mr. Wright has constructed a double-screw micrometer ocular with the screws at right angles to each other which he uses to determine the position of any point on the interference figure produced when a thin plate of the crystal is examined in plane polarised convergent light. By this means he is able to obtain more accurate results than were possible with the ordinary micrometer in Becke's method. He advocates the use of the stereographic projection in preference to any other.

AN interesting account of the processes recently devised for liquefying air on an industrial scale, and for extracting oxygen directly from the liquefied product, is contained in an article by Prof. E. Mathias in the *Revue générale des Sciences* (No. 17, p. 697). Particular attention is directed to the method of liquefaction developed by Claude, in which the principle of expansion with the performance of external work has been adopted with remarkable success. The process patented by Thrupp in 1898, and that described by Linde in 1901, are also described: The problem of separating air into its constituents oxygen and nitrogen, which has formed during the past few years so prominent a goal for the endeavours of engineers of all countries, is dealt with at somewhat greater length, the many schemes suggested being considered in detail. Such success has attended the efforts made to separate the gases of the air industrially by liquefaction that the expenditure involved in preparing 1 kilo. of pure nitrogen on the large scale has fallen below a penny. The article is illustrated by nineteen drawings showing the principle of the various types of plant in use.

A SEVENTH and enlarged edition of the translation by H.R.H. Princess Christian of Prof. Friedrich Esmarch's "First Aid to the Injured," with additional illustrations, has been published by Messrs. Smith, Elder and Co., at 2*s.* net.

NEARLY half of the thirteenth edition of Mr. W. H. Harling's illustrated catalogue of mathematical drawing instruments is new matter. Every requirement of the architect, draughtsman, and student appears to be anticipated. The needs of teachers of practical mathematics have been borne in mind, and considerable space is given in the additional pages to particulars concerning instruments for measuring with precision lengths, angles, and other dimensions.

MR. H. K. LEWIS has published a third edition of "Hygiene and Public Health," by Dr. Louis C. Parkes and Prof. Henry R. Kenwood. The present work grew out of Dr. Parkes's "Hygiene, or Public Health," which appeared in 1899, and was reviewed in NATURE of January 30, 1890 (vol. xli., p. 290). A certain amount of new matter has been introduced into the present edition, but some parts of the previous issue have been compressed and abbreviated. The size of the page, too, has been slightly enlarged.

A FIFTH edition of the late Prof. P. G. Tait's well-known "Properties of Matter" has been published by Messrs. A. and C. Black at 7*s.* 6*d.* The work appeared first in April, 1885, and was reviewed at length in our issue of August 6, 1885 (vol. xxxii., p. 314), by Lord Rayleigh. The present edition has been edited by Prof. W. Peddie, of the University College, Dundee. The recent advance of physical science has necessitated some additions, but these have in every case been placed within brackets and initialed by the editor, so that the original plan of the book has been preserved.

OUR ASTRONOMICAL COLUMN.

A NEW COMET.—A telegram from the Kiel Centralstelle announces the discovery of a new comet by Mr. Mellish on October 13. Its position at 16h. 0m. (Madison-Wisconsin M.T.) on that date was R.A.=8h. 31m., dec.=9° 24′ S., and the comet was moving slowly in a north-westerly direction.

This position lies between one-quarter and one-third the distance from ι to C Hydræ, and the comet is apparently travelling towards Canis Minor. At present it rises a little to the south of east at about 2 a.m., and crosses the meridian at 7 a.m.

SUN-SPOT SPECTRA.—At the June meeting of the Royal Astronomical Society, Prof. Fowler announced that he had found a terrestrial origin for the numerous short, hazy lines, known as "band" lines, in sun-spot spectra which have hitherto remained unorigined. These lines, it now appears, are part of an extensive "fluting" spectrum ascribed by Liveing and Dewar, in 1881, to a compound of magnesium and hydrogen (Proc. Roy. Soc., vol. xxxii., p. 190), and investigated by Sir Norman Lockyer.

The brightest fluting begins near λ 5211, and fades off towards the violet; a second includes the well-known hazy spot lines at $\lambda\lambda$ 5163·2, 5160·1, 5156·8, &c., whilst others begin at λ 5620 and on the violet side of Hβ. A comparison of the laboratory wave-lengths obtained by Prof. Fowler with those observed in the sun-spot spectrum places the identification beyond doubt, and it is estimated that probably several hundreds of the sun-spot "band" lines will be found to agree, in position, with those occurring in the laboratory spectrum (Monthly Notices R.A.S., vol. lxvii., p. 530, June).

THE RED SPOT ON JUPITER.—Mr. Stanley Williams publishes his observations of the Great Red Spot during the most recent opposition of Jupiter in No. 4202 of the *Astronomische Nachrichten* (p. 23, September 30). He records the spot as being as faint as ever it was, and the observing conditions, especially at the commencement of the opposition, were very poor. The rotation period satisfying the observations is 9h. 55m. 42·27s., from 594 rotations, and the longitude is 20°·87 ± 0°·23.

Mr. Williams directs attention to the abbreviated rotation-period which obtained between the oppositions of 1905–6 and 1906–7; during the former it was 9h. 55m. 41·46s., whilst in the interval it was 9h. 55m. 36·25s. This difference is too great to attribute to errors of observation, and indicates a real change in the spot's position. Observations lead to the conclusion that this change of position is in some way due to the large mass of dark material known as the Pyramid Spot, or South Temperate Disturbance, for on three occasions such changes of position have synchronised with the passage of the Disturbance past the Red Spot. The general discussion of a large number of observations of this phenomenon may, as Mr. Williams suggests, throw considerable light on the nature, and possibly the mass, of the Red Spot.

THE PROPER MOTIONS OF STARS IN THE CLUSTER MESSIER 92.—In No. 4165 of the *Astronomische Nachrichten*, Dr. K. Bohlin compared some measures of the stars in the cluster Messier 92, made on an astrographic plate taken at Stockholm in 1898, with those made by Schultz at Upsala in 1873, and found discordances which were attributed to proper motions during the intervening twenty-five years.

Prof. Barnard has had this cluster under observation, with the 40-inch Yerkes refractor, for some time past, and in No. 4202 of the same journal he discusses his observations with the view of testing the theory of proper motions. A comparison of the three sets of measures leads him to the conclusion that the existence of actual proper motions is very doubtful, for the cases of agreement are practically equal in number to those in which the measures do not agree. In a second paper he compares the definite measures made by Schultz of the stars in the bright part of the cluster with those made by himself, and definitely expresses his confidence in the opinion that the discordances are not due to proper motion, but rather to the uncertainty of the measured positions. The knowledge that such uncertainty existed led Prof. Barnard to undertake visual micrometer measures of various clusters with the 40-inch refractor, and he hopes to publish the results of the work in the course of the next twelve months.

THE DOMINION OBSERVATORY, OTTAWA.—From notes in the current Journal of the Royal Astronomical Society (Canada), vol. i., No. 4, p. 264, July-August, it is evident that valuable results may be expected from the investigations now being carried out at the Dominion Observatory, Ottawa. The new spectrograph is performing very satisfactorily, and with the one prism gives spectra of first-type stars, in which Hβ, Hδ, Hε, and Hγ are accurately measurable; Hγ was the only hydrogen line usable on the earlier spectrograms. Seven spectroscopic binaries are under regular observation, and, in addition to the results already published for α Draconis and ι Orionis, it is hoped that the provisional elements of four other binaries will soon be completed. A new method, a modification of Hartmann's, has been applied to the reduction of the plates with considerable accuracy and a great saving of labour. Experiments, having for their object the production of a flatter field, are being carried out, and it is hoped to obtain a field of 8°, instead of the 2° or 3° at present available. A 6-inch first-quality plane grating has been supplied by Dr. Brashear for use with the cœlostat telescope in solar research. Dr. R. G. de Lury, Mr. R. M. Motherwell, and Mr. J. N. Tribble have been appointed to the staff for work on solar research, micrometer observations, and radial-velocity determinations respectively.

THE PERSEID METEORS.—A watch for Perseids was kept at Greenwich from August 10 to 13, but very few brilliant meteors were seen, the display, on the whole, being considered a very poor one. The actual numbers of meteors bright enough to be plotted were twenty-seven on August 10–11, sixty-four on August 11–12, and eight on August 12–13. On the last-named night clouds interfered with the observations, but the other two nights were quite cloudless (*Observatory*, No. 387, p. 366, September).

BOTANICAL CONGRESS AT DRESDEN.

THE German Botanical Society has this September celebrated its twenty-fifth anniversary at Dresden under the presidency of Prof. Schwendener, who justly emphasised the promptness of publication and value of the contents of the society's journal. Owing possibly to the wording of the invitation to members to contribute papers to the meeting, only one communication was made, by Dr. Winkler, on parthenogenesis in plants. The same botanist aroused great interest, and a short but lively discussion, by exhibiting a growing plant obtained by grafting *Solanum nigrum* with a tomato variety, and by encouraging, to the exclusion of other buds, a composite bud, arising at the point of contact and fusion of the two plants. The resulting shoot shows, from node to node upwards, especially well seen in the leaves, alternately, right and left, the characteristics of each plant. The term "graft-bastard" proposed was objected to by many. No doubt more will be heard of the specimen if it forms flowers. Prof. Bower and Colonel Prain were elected honorary members of the society.

In the earlier part of the week (September 8–15) the Society of Applied Botanists and that of the Systematists held their meetings. The applied botanists were present in force, and many important papers were read. The society by resolution agreed to urge on the Government the necessity of making better provision in many of the technical colleges for botany in its various branches. A few weeks previously the professors in the universities and technical colleges met to form a union, one object of which is to secure greater freedom of action and less Government interference, without, however, loss of Government funds.

Ule's finely illustrated account of the flora of the Brazilian province of Bahia, Hiltner's soil-bacteria investigations, and Lindner's beautiful mould cultures, were outstanding features of this part of the meeting. The systematists made a delightful excursion to the Bohemian Mountains (Rollberg, &c.) to compare their varied flora with the more uniform flora of the Elbe sandstone. On the basaltic Rollberg *Asplenium septentrionale*, *Woodsia Ilvensis*, *Ribes alpinum*, *Allium strictum*, and many other interesting alpines were obtained.

In the following week the German Society for the Advancement of Science and Medicine met also in Dresden. The botanical section was strongly represented under the presidency of Prof. Pfeffer, who contributed a paper on sleep movement in plants, Wettstein one on the phylogeny of the angiosperm flower, Molisch one on ultra-microscopic organisms, while Prof. Drude gave a demonstration in the botanic garden of his cultural work on *Cucurbita Pepo*. He showed a well-established hybrid between *C. Pepo* and *C. instititia*, the fruit having the mottled colour of the latter, the size and form of the former. Throughout Prof. Drude and his assistants, Drs. Schorler, Naumann, and Schwede, did everything possible to ensure the comfort of visitors and the success of the meetings. The forestry school and arboretum at Tharandt were visited; but, owing to sudden illness, Prof. Neger was unfortunately absent. Nobbe's Seed Station, formerly at Tharandt, is now at Dresden under Dr. Simon's direction. The botanical garden at Dresden, though small, shows many interesting features. There are groups illustrating geographical distribution, *e.g.* plants characteristic of South Africa, Australia, &c. The illustrative plants throughout the garden are kept small to economise space. By using differently coloured labels, the periods of introduction into European cultivation of our garden plants are indicated

T. J.

WATER AND ICE, TO-DAY AND IN THE GLACIAL EPOCH.

MR. G. K. GILBERT'S survey of the Niagara Falls (see NATURE, vol. lxxv., p. 607) is not to stand alone. In the "Summary Report of the Geological Survey Department of Canada for 1905" (Ottawa, 1906) Dr. J. W. Spencer promises a full account of the Niagara district, which he is agreeably confident will reveal "discoveries of the greatest importance" (p. 91). Soundings have been made in the gorge below the falls, in areas previously untested, and wells have been sunk to prove the depth of an interesting buried channel, filled with glacial drift.

In contrast with this region of attractive turmoil and erosion, Mr. T. W. Kingsmill takes us to the lower Hwangho, in China, where the river "is prevented by the laws of hydraulics from excavating its bed, and has in consequence to flow on the surface" ("The Hydraulics of Great Rivers Flowing through Alluvial Plains," Shanghai, North China Herald Office, 1906). If once this great body of water effects a breach in one of its banks, it "shows no disposition, when the flood subsides, to return to its bed, but invariably finds some easier course to the sea." The Hwangho, according to Mr. Kingsmill's interesting historic sketch, broke its right bank in 1854, and from that date to 1870 wandered over a wide stretch of country, depositing a layer of sand from 6 feet to 8 feet thick. In Horan, not far from Mangtsin, 250 feet of river-alluvium, thoroughly pervious to the water above it, were passed through in sinking for a coal mine. Much of the drainage thus reaches the sea by underground channels, and the main river actually diminishes in volume below Mangtsin. The extensive deposits that are forming in the Gulf of Pechili, at the rate of 208,000 tons per day (p. 31), increase the difficulty of controlling the river in the interior. We learn that fishermen on stilts may be met with out at sea miles before the low coast is sighted. Mr. Kingsmill's suggestions for correcting the stream are enlivened by the printing of a discussion of them by Mr. Tyler. Mr. Kingsmill proposes to continue banking up the river; Mr. Tyler would organise floods at selected points, and let the river build its huge conoidal plain under proper supervision. The silt would then be disposed of in an orderly manner, and the river-bed would cease to rise. The titanic struggle of man with the Colorado River (NATURE, vol. lxxv., p. 501) suggests, however, that Mr. Tyler's dumping-grounds might at times get more water and less silt than they were prepared for.

There are many districts that have been assailed by diluvial flooding and deposition in comparatively recent times, where now desiccation has set in, with the accompaniment of the formation of löss and sand-dunes. The extremely uncomfortable conditions that prevailed in Europe at the close of Glacial times are shown by Prof. Steinmann to have been paralleled in South America ("Uber Diluvium in Süd-Amerika," *Monatsberichte d. deutschen geol. Gesell.*, 1906). The author believes that the vast extent of fluvio-glacial deposits, which have filled up the hollows of the Cordillera and spread so freely over Patagonia, can only be accounted for by a series of glacial epochs. He sees, moreover, in the level expanses of calcareous mud round the salt-lakes of Bolivia and Argentina the evidences of former fresh-water lakes, in which Bythinia flourished. "The traces of the last ice-age may be followed across the equator as far as Cape Horn." The climatic differences that prevail at the present day are now shown to have existed, both in Europe and South America, during the melting of the last ice-sheets; and "hence we shall do well to discard all attempts at explaining glacial epochs that are not of a universal character."

In a paper furnished with an abstract in French ("Till Frågan om Ost-Finmarkens Glaciation och Nivåförändringar," *Bull. Comm. géol. de Finlande*, No. 18, 1907), Herr V. Tanner describes the course of the ice in Finmark in glacial times as being from S.W. to N.E., and traces the variations in the sea-level by observations on terraces cut in the rock and on gravelly raised beaches. While the ice was melting from the land, the continental mass was rising, and thus offered a more and more extended front to the action of the waves.

While the terminal tongues of glaciers in Alberta and British Columbia have not in all cases shown a marked retreat in recent years, Messrs. George and W. S. Vaux prove that the ice-masses have become greatly reduced (*Proc. Acad. Nat. Sci. Philadelphia*, December, 1906, p. 568). The Illecillewaet Glacier has withdrawn about 250 feet in eight years; but its annual rate of recession is becoming slower, and its rate of flow is now actually greater than in 1899. Conical moraines appearing through the ice on the Wenkchemna Glacier (p. 577) are witnesses of the immense amount of ice removed in recent times by surface-melting.

FIG. 1.—Margin of the Malaspina Glacier, August 11, 1906, showing mingling of moving ice-blocks with trees still in leaf.

The famous Malaspina Glacier of Alaska has, however, started on a new career. Prof. R. S. Tarr ("Second Expedition to Yakutat Bay, Alaska," *Bull. Geographical Society of Philadelphia*, January; see also *Bull. Geol. Soc. America*, June) describes the rapid and unexpected changes that are taking place in it, and in certain other glaciers close to its eastern margin. Crevassing has occurred in previously quiescent and moraine-covered masses, accompanied by a marked advance. Prof. Tarr found that the alder and cottonwood trees growing on the Malaspina Glacier developed their leaves in 1906, but were then in part swallowed up and over-ridden by the active ice. The scene of visible movement, with falling trees and ice-blocks, and sliding soil from the moraines, is paralleled by the attack of the adjacent Atrevida Glacier on its marginal forest. Other glaciers as yet have not been influenced; and Prof. Tarr refers these remarkable movements to the shaking of the district by the earthquakes of 1899, or even of some earlier date. The fall of masses of snow into the gathering-grounds would thus have taken seven years to in-

fluence the ice-front; but the author points out that the crushing of the resisting masses in the lowlands is just what might be expected from a sudden addition of snow to the reservoirs in the hills. Changes of level, moreover, amounting to as much as 47 feet, took place in Alaska in 1899, and these may in part account for local variations. The description of the broad alluvial fan of the Hayden Glacier, with its streams changing in position and depth from day to day, is impressively interesting, as an illustration of the rate at which our own "glacial gravels" may have been distributed.

Perhaps Prof. Tarr's remarkable but modest paper will be hailed by M. Edouard Piette as an argument in favour of his more startling views ("Déplacement des Glaces polaires et grandes Extensions des Glaciers," Saint Quentin, 1906, pp. 36). M. Piette attributes the glacial climate of the northern hemisphere to the release of ice-masses by earthquakes at the pole. He urges that this would be assisted by the uprush of volcanic vapours and hot springs along the fissures, while cataclysms like that of the Straits of Sunda would fling the ocean waters irresistibly against the polar ice-cap. The Atlantic continent from Ireland to Iceland fell in about the same time by an "affaissement définitif," and the whole ice sped southward, leaving the pole for a time free. We confess that we can read M. Piette's paper far more sympathetically, now that we have the advantage of Prof. Tarr's conclusions; but there is a whirl of death and horror about his description of the great catastrophe that reminds us of the old diluvial theories, to say nothing of Dante's second circle. We read, moreover, that icebergs nowadays (p. 6), running aground on the coasts "d'Irlande ou d'Ecosse, y déterminent des froids intenses, capables de geler la végétation." Such a phenomenon would attract thousands of excursionists, and would surely be mentioned in our veracious daily papers.

The erosive power of glaciers is clear, wherever joints or any other planes of division in a rock are so arranged as to slope up against the direction of movement of the ice. "Plucking" then becomes a feature of the district. But, even on ice-smoothed surfaces, signs of rock-fracture under the pressure of the glacier are occasionally found. Prof. G. K. Gilbert discusses these "crescentic gouges" (*Bull. Geol. Soc. America*, vol. xvii., 1906, p. 303) as due to the presence of subglacial boulders. A line of type omitted on p. 313 renders one of the sentences obscure; but the argument put forward is that ice must have "greater power of resistance [to flowage] than some students have been disposed to admit. . . . The more rapid the flow the stronger the resistance. Therefore the crescentic gouges . . . may testify also to the relative rapidity of glacier movement." Prof. Gilbert's photographic illustrations are excellent, as are those of subglacial potholes in a subsequent paper on moulin work (*ibid.*, p. 317), in which it is pointed out that such moulin-hollows may be bounded during their formation on one side by rock and on another by the ice, leaving a rock-surface with flexuous incurvings when the glacier has disappeared by melting.

Prof. R. S. Tarr ("Glacial Erosion in Alaska," *Popular Science Monthly*, vol. lxx., 1907, p. 99) discusses the broader features of glacial erosion as displayed in hanging valleys. He postulates, in common with other writers, a considerable deepening of the main valley by ice; but may we not presume that the lateral valleys were largely developed and cut back by the frost-nibbling, under glacial conditions, on which Profs. Penck and Davis lay such proper stress? A main valley, with feeble lateral tributaries, may be occupied up to a certain level by ice, which widens it, deepens it somewhat, and wears back the poorly developed projecting spurs. The lateral valleys are at the same time rapidly weathered back under the new and more strenuous conditions of high-level erosion, and rocky cirques are formed at their heads in place of confluent stream-grooves. Tributary ice gathers in each lateral hollow, and the erosion above it, and also below it, where a rushing stream emerges on the crevassed main glacier, cannot operate below the level where the two masses unite: and finally, if melting is rapid, hanging valleys are left, which will in time be cut down by ordinary weathering to the level of the main valley-floor. If the main glacier diminishes by ablation slowly, the tributary glaciers and their subglacial streams cut down their valleys to keep pace with the falling surface, and these valleys finally cease to be of the hanging type, though showing glaciated floors. This seems to have been the case in much of central Connemara. This is not the place, however, to attempt to modify the theory of the deepening of glacial valleys so brilliantly put forward by Prof. W. M. Davis. Suffice it that Prof. Tarr disposes successfully of several of the fantastic theories put forward to account for a phenomenon of very wide occurrence in glaciated areas.

In the *Verhandlungen der schweizerischen naturforschenden Gesellschaft*, St. Gallen meeting, 1906, pp. 261–307, Herr J. Früh, of Zürich, writes a general essay, "Ueber Form und Grösse der glazialen Erosion," illustrated by personal observations on the topography of Switzerland. Hanging valleys, Alpine lakes, and "Uebertiefungen" are discussed, and useful references are given to Davis, Penck, and Brückner.

Lastly, we must not forget the work of water in its immense circulatory systems below the surface. The investigation of the "Underground Water Resources of Alabama," by Mr. E. Allen Smith (Geological Survey of Alabama, Montgomery, Alabama, 1907), has provided us with a neatly bound volume which is in many ways a guide to the geology of the State. The conditions favouring underground flow and the emergence of springs are discussed in pp. 32 to 63 in a manner that will interest engineers in general, as well as the ordinary citizen between the Tennessee River and the Gulf of Mexico. The great region for artesian water-supply in Alabama lies along the band of Cretaceous limestone, the Selwa Chalk, which passes just south of Montgomery. Several medicinal springs occur among the Tertiary strata towards the Gulf, including one (p. 320) that has been said to give protection against malarial fever.

G. A. J. C.

ENDOWMENTS FOR SECONDARY EDUCATION.

WHILE writing this article the following questions have been in mind:—(1) What are the number and extent of the educational endowments of our great public and other endowed schools? (2) What were the intentions of their founders? (3) How far are such intentions at present realised? (4) Can the endowments be made more generally available so as to increase their benefit to the public with the minimum departure from those intentions?

The answer to the two latter questions must be that it is largely a question of degree; from the nature of the case an expression of opinion, not a precise estimate, is all that can be attempted. The first two questions relate to definite matters of fact, the answers to which *ought* to be ascertainable, but are only approximately to be determined. A better reply to (1) would be forthcoming had either the late or the present Government fulfilled their promises to obtain a return, to be presented to the House of Commons, giving statistics of the finance of all endowed schools. We are informed that the Charitable Trusts Division of the Board of Education is considering the details to be sought in such inquiry, and it is to be hoped that considerations of its cost will no longer be allowed to stay its fulfilment. In the meantime, the following condensed account, based on such materials as were obtainable, is submitted as calculated to correct some of the grosser errors prevalent with regard to the subject of our ancient endowments. The writer wishes to acknowledge his indebtedness to the writings of Mr. A. F. Leach (Charity Commissioner) and to the courteous help of the officials at the Education Board, of course without implying that they have any responsibility for the statements which follow.

Endowed Schools before the Reformation.

The records included in Mr. A. F. Leach's book entitled "English Schools at the Reformation" (Constable) show that 200 grammar schools at least, and more probably

300, flourished before the Reformation. The majority of these were abolished or crippled by the Government of Edward VI., who, by the strange irony of fate, is commonly credited with founding many of our endowed schools. Generally, it is correct to say that a King Edward VI. school means a foundation which was maimed by Edward VI., *i.e.* by the actual regent at the time. These schools were of various types, some existing as independent institutions, while many were connected with one of the following:—cathedral churches, monasteries, colleges, hospitals, guilds, or chantries. The endowments varied widely, Eton and Winchester having well-paid masters and seventy scholarships apiece, while Launceston paid an old man 13*s.* 4*d.* a year to teach young children. In addition to public schools and grammar schools there were choristers' schools and elementary schools. What we now call secondary education existed in fact, though not in name; with scholarships tenable at the schools, and exhibitions thence to the universities. According to the above authority, the boys were mainly of the middle classes, with younger sons and poor relations of the upper classes, and occasionally bright boys from the real poor. The character of the learning certainly supports this contention, Latin, dialectic and rhetoric, being taught up to a standard fitting the youth of sixteen to eighteen years of age for entrance to the university. Without entering into details (which it were easy to do), it can be asserted that the English schoolboy of the sixteenth century was immeasurably superior to his successor at the present day in respect to knowledge of Latin. Further, it appears to be true, alike of the past and the present, that, given good *quality* of education, the numbers seeking to avail themselves of its provision will take care of themselves. In round numbers, we find in the England of 1546 a population of two and a half millions, with 300 grammar schools, or one school for 8300 people. This compares well with the one school for 23,000 of the year 1865. One is tempted to wonder, though of course it is mere idle and somewhat melancholy speculation, what would have resulted had some wise statesman developed these disconnected but useful, and, for their day, efficient, institutions into an organised system of national education. Should we have become as a nation more scientific and artistic, but less robust and individual? As facts are, and as they have to be faced, the opportunity was lost, destruction and spoliation took the place of development, and to-day we are left with endowments, not indeed to be despised, but utterly inadequate to provide a tithe of the cost of higher education of the country.

1864 TO PRESENT DAY.

Under the chairmanship of Lord Clarendon, a commission of inquiry reported in 1864 on "The Revenues, Management, Instruction, and Studies of Eton, Charterhouse, Merchant Taylors', St. Paul's, Westminster, Winchester, Harrow, Shrewsbury, and Rugby." In 1868, the date of the Public Schools Act, there were 2956 scholars in these nine schools, and their net aggregate income, including exhibitions, was about 65,000*l.* a year. In 1905 the number of scholars was 4100, and their income, as to which only partial information is accessible, has increased in far larger proportion than the number of scholars. The position of Eton and Winchester Colleges is one of such independence that the Board of Education has no information as to their present financial position. They are undoubtedly wealthy, and their national importance makes periodical audit and publication of financial statements the more desirable. In 1890 the gross income of St. Paul's School endowment was stated to be 15,426*l.* A recent question raised by a member of the House of Commons has fortunately led to an investigation of the case of Harrow School. Here it appears that the endowment is worth about 1000*l.* annually, roughly half of which goes to the lower school of John Lyon, and the rest might easily be spent on clerical, legal, and office expenses connected with the foundation. In short, Harrow School is supported by the fees of the pupils. If any reader of this article should have been under the delusion that our ancient endowments are vast stores of unused or misused wealth, this fact may prove one step in his disillusionment. It is to be hoped that the Board of Education will give us information about the income of the remaining five schools. Not being subject to the Endowed Schools Acts, they are not included in the Roby Return of Charitable Foundations presented to the House of Commons in 1892 (and reprinted in the Report of the Secondary Schools Commission of 1895). It does not appear from the reports of either the Clarendon or the Schools Inquiry Commission that the segregation of these schools was justified on any clear legal, proprietary, educational, or national ground. The following extract from the Clarendon Report is of interest:—

"Are the classes by whom these benefits are now enjoyed the same as those for whom they were originally intended? There is no doubt that the collegiate schools were primarily though not solely designed for the assistance of meritorious poverty; the independent grammar-schools primarily though not solely for the benefit of some particular town, village, or neighbourhood. . . . Speaking generally, it must be said that the difficulty of assigning a precise meaning to the word poverty, the doubt what class of persons, if any, at the present day really answers to the *pauperes et indigentes scolares* of the Lancastrian and Tudor periods, and the further doubt whether poverty is not after all best served by giving the widest encouragement to industry, coupled with the interest which every school has in collecting the best boys from the largest surface, have tended, and will continually tend, to render the qualification of indigence practically inoperative. We do not think it necessary to recommend any change in this respect."

One more extract refers to local privileges, often the right to gratuitous education:—

"The question we have to consider is, whether the maintenance of the local privileges in favour of these persons, and of the few permanent residents who desire a public-school education for their sons, is recommended either by respect for the founder's intentions or by any other sufficient reason. We think that it is not." (We may note that "these persons" refers to immigrants attracted to the town or village by cheap education through the foundation.)

Following the "Clarendon" Commission there was "The Schools Inquiry Commission" under Lord Taunton's chairmanship, which reported in 1867 on all the remaining schools, numbering 100 first-grade and 247 second-grade endowed grammar schools, including twenty-two in Wales. Of these, a few have ceased to exist or have become elementary, while occasionally the endowment has become a bursary or scholarship. Perhaps one-seventh have thus been lost to secondary education; the remaining six-sevenths still form to-day the core of the public secondary education of England.

Despite the remarkably able character of the commission and its arduous labours, we cannot altogether rely on the accuracy of an important part of the information contained in its voluminous report and minutes of evidence (twenty-one volumes), that part, viz., which purports to give the ancient history of the foundations. The commissioners mainly relied for this history on the earlier reports of the commissioners for inquiry concerning charities, 1818 to 1837. In a chronological list of schools given in his "English Schools at the Reformation," Mr. A. F. Leach assigns a different date from that given by the commission in a large majority of cases, differences amounting in some cases to centuries! As Mr. Leach is probably our best authority on this subject, we can feel but little confidence in the findings of the commission with regard to the original documents, deeds, and charters, particularly of the older foundations. This consideration does not, of course, affect the accuracy of their statements as to the position of the endowments in 1867, but it gives some support for further amendment of the Public Schools Act of 1869, which was avowedly based on the Taunton Report. Apart from amendments in detail, this Act governs most of our grammar schools to-day.

The powers of the Charity Commission to establish and amend schemes, which were transferred to the Board of Education by an Order in Council in 1901, were powers

under the 1869 Act. For example, head and assistant masters are dismissible "at pleasure" in nearly all endowed schools at this day, because the law of 1869 so enacts. Its importance may be indicated further from the fact that during 1905 alone there were 649 orders made, 470 relating to secondary and 179 to elementary education, by the Board in its exercise of these powers. Returning to the 1867 report, we find that there were in England and Wales 782 distinct foundations, 820 schools, 36,874 scholars, and annual income 210,000*l*., exclusive of the nine great schools. Including these, but excluding elementary schools, we have 40,000 scholars and an income of 277,000*l*. a year. This was for a population of twenty-one millions. In an appendix is an interesting table showing the estimated number of boys (eight to fifteen years) of upper and middle class parents to be:—in towns, more than 15 per thousand; and in rural districts, 11 per thousand. Local inquiries made the number of boys in day schools other than elementary to be 16 per thousand of the population, so that private schools were responsible for the greater number. It is known that the standard represented by "secondary education" in most of these schools (public and private) was very low, in many cases decidedly below that of a good board school in the last decade.

In 1895 the Commission on Secondary Education, under the chairmanship of Prof. James Bryce, reported that for seven selected counties the number of boys was 2·48 and of girls 3·6 per thousand of the population in endowed and proprietary schools. In London the proportion of boys was slightly higher, that of girls decidedly less. Nor could it be seriously contended that private schools made up by their number, size, and efficiency for this most serious state of affairs. It has to be acknowledged that the attempt to leave secondary education to be provided by private enterprise and endowments has had disastrous effects. The great improvement made in the last decade, though in part due to a raising of the tone and standard of teaching in schools, both private and endowed, could not have advanced so far as has already been the case; still less could it make the needful progress we hope for in the immediate future, without the aid of the national exchequer and the local rates. It may be thought that by pooling the endowments and re-distributing them the expense to the rate-payer and tax-payer might have been avoided. The writer is not of this opinion. Some re-distribution would undoubtedly be of advantage, by making the endowments more generally available, and thus much benefit might accrue, as a comparatively small addition to the funds of a struggling school will often make a relatively enormous increase in its efficiency; but unfortunately the sums available are far less than is often supposed. The precise amount is not readily ascertained. The annual reports of the Charity Commission give no information on the subject; the "Statistics of Public Education in England and Wales," published by the Board of Education, despite its comprehensive title, merely deals with grant-aided schools; the balance-sheets of county education committees usually omit to give the endowments of the schools aided; and the inquirer has to fall back upon the Roby Return.

The return gives the gross income for the year 1890 of each individual charitable trust, but does not specify which part, if any, is educational. The 1895 Bryce Commission Report adds notes on the apportionment of each trust to educational and other uses, but often the directions are hopelessly intricate. No digest or summary is attached to these documents, and the present writer must be held responsible for the following statements, based on a rough analysis of the return:—In 1890 the number of foundations the endowments of which could provide entirely for the education of 100 boys (at 18*l*. per annum) was thirty-five; moreover, the number of boys and girls being educated at the schools of each foundation exceeded the number which the endowment alone would suffice to educate efficiently, the difference being made up by fees at the more expensive schools, and in other cases partly by fees and partly by Exchequer and local grants. When it is considered that in 1905 the Board paid grants amounting to 211,254*l*. on 51,779 scholars in 575 secondary schools, that these schools had in addition 30,000 scholars not earning grants, and that the annual increase in grant-earning scholars is estimated to be 30,000, it is obvious that no large measure of financial relief to the community is to be found in re-distribution of endowments. What has happened is rather the inverse process; the municipal authorities have rescued impoverished schools with too meagre endowments.

The near Future.

The control exercised by the Board of Education over schools aided by grants of public money has greatly increased during the last two years, and is destined to become more and more penetrating. It is inevitable that this development of bureaucratic influence should bring with it the usual concomitant advantages and evils. To make the most of the advantages, and to minimise the evils of centralisation should be our goal. We want local public interest in our schools, and a strong profession of teachers. One of the worst results of the extreme regard paid to the "individuality" of our schools has been to produce a body of schoolmasters suspicious of, if not hostile to, organisation, even of their own profession. This unfortunate sentiment is happily growing weaker, and will become evanescent as soon as it is realised that the schools themselves are becoming subject to a common authority, with its potency for good or ill to all under its sway. What the country as a whole needs is a proper devolution of responsibility to local education committees, with reservation to the central authority of certain functions the performance of which locally is open to serious objection. Among the latter may be placed the training of teachers, and the inspection of schools as regards conditions of health, while the local authorities should supply statistical information required by the Board. Each endowed school should have a board of governors, including members representing the local authority, and while the management of the school should be entrusted to the governors by the scheme, it should nevertheless be the duty of the latter to present to the former a yearly budget. Any pooling and re-distribution of endowments might be so limited as to preserve the benefits of each foundation to the area of the local authority in which it exists. This would largely limit the vehement opposition usually raised to any proposal to translate an endowment to a populous centre from a village where it is wasted, at the same time fulfilling in a reasonable manner the intention of the pious founder to provide for the native inhabitants of the place he endowed. For the smaller endowments (by far the greater number of those existing) this plan implies the extension of that municipalisation of endowments for which a precedent was set at Derby last year. With reference to the larger endowments, a word of caution is not out of place.

The leading public schools of England are among our most important national assets. Dating, as some of them do, from six, seven, or even eight centuries back, they have the advantage of unrivalled traditions, of inestimable value in influencing their character and tone. It would be a disastrous policy to destroy these for the comparatively trivial pecuniary gain to be achieved; but the question of reforming their constitution raises important questions of principle, which cannot be more than hinted at in this article. It appears to the writer that some mild infusion of democratic influence might be of mutual advantage to the schools and the neighbouring communities. There appears to be justice behind the claim for admission of fit boys from every social rank, and although such admission would only be of real benefit to the exceptional boy of poor parentage, the principle is not to be lightly disregarded. By sacrificing their "splendid isolation" and becoming associated with the national system of education, the great schools would be more truly doing their duty to the country, and the benefits reaped from their association with schools of all grades would not all be on the side of the humbler institutions. For these and other reasons one may hope that the Government will proceed with part ii. of the Education Bill (1906), which was dropped last year, a reprint of which those interested may find in "The Schoolmaster's Year-book for 1907" (Sonnenschein). Briefly, it conferred upon the Board enlarged powers to make new schemes and to amend old ones, with consider-

able simplification of procedure. Universities and their colleges were excluded from the operation of the Bill, and the segregation of the great schools of the 1868 Act was to be continued by their reservation from the more sweeping clauses; indeed, Eton and Winchester would only be affected so far as their governing bodies consented. Safeguards relating to the religious character of certain foundations were introduced, although Clause 16 states, and very rightly, that "in making a scheme regard shall be had primarily to the educational advantages to be derived from the scheme." May we not hope that the matter will be discussed and legislated upon in this spirit?

G. F. DANIELL.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The next combined examination for sixty-six entrance scholarships and various exhibitions at Pembroke, Gonville and Caius, King's, Jesus, Christ's, St. John's, and Emmanuel Colleges will be held on Tuesday, December 3, and following days. Mathematics, classics, and natural sciences will be the subjects of examination at all the above-mentioned colleges. A candidate for a scholarship or exhibition at any of the seven colleges must not be more than nineteen years of age on October 1, 1907. Forms of application must be sent in on or before Tuesday, November 26.

Mr. A. H. Lees, of King's College, has been appointed to the studentship in medical entomology for the period of one year. The studentship was recently established on the basis of a grant from the "Tropical Diseases Research Fund," administered by the Colonial Office. Mr. Lees will pursue research under the direction of the Quick professor of biology.

Of the four fellowships awarded last week at Trinity College, two were for classics; one of the remaining two was awarded to Mr. A. S. Eddington, senior wrangler in 1904, and first class, first division, part ii. of the mathematical tripos, 1905; and the other to Mr. V. H. Mottram, first class, part i. of the natural sciences tripos, 1903, and first class (physiology) in the same tripos, part ii., 1905.

Mr. A. Wood, who took his degree in chemistry and physics in 1904 as an advanced student, has been elected to a fellowship at Emmanuel College.

Mr. A. Berry, of King's College, has been appointed chairman of examiners for the mathematical tripos, part i. (old regulations), 1908.

At a Congregation to be held to-day, the honorary degree of Doctor of Science will be conferred on Prof. Emil Fischer, of Berlin.

LIVERPOOL.—Prof. J. Reynolds Green, F.R.S., lately professor of botany to the Pharmaceutical Society of Great Britain, has been elected to the Hartley lectureship in plant physiology, recently instituted in the botanical department through the generosity of Mr. W. P. Hartley, of Aintree.

Dr. J. H. Grindley has been appointed principal of the Government School of Engineering at Ghizeh, Cairo. The school is under the Egyptian Ministry of Education for the training of engineers for the various departments of the Egyptian public works.

Mr. W. MacGregor Wallace has been elected lecturer on applied mechanics in place of Dr. Grindley (resigned).

MANCHESTER.—The honorary degree of Ph.D. has been conferred upon Prof. Ernest Rutherford by the University of Giessen.

The following appointments have been made:—Dr. C. H. Weizmann, lecturer in chemistry; Mr. J. N. Pring, demonstrator in electrochemistry; Mr. F. H. Gravely, assistant lecturer and demonstrator in zoology. Mr. Frank Howson has resigned the position of demonstrator in physiology on his appointment to a similar post at the Armstrong College.

Dr. R. S. Hutton, on leaving Manchester, is resigning his position as lecturer in electrochemistry and assistant director of the physical laboratories, but has been appointed a special lecturer in electrochemistry.

THE Herter lectures before the medical department of the Johns Hopkins University are to be given this session by Prof. E. A. Schäfer, F.R.S., professor of physiology in the University of Edinburgh, at the end of April, 1908.

WE have received the current issue of the year-book of the Michigan College of Mines. It covers 136 pages, and contains full details of the courses arranged for the session 1907–8. The courses are admirably planned, and the situation of the college in the copper- and iron-ore district of Michigan, where its students live in a mining atmosphere, has brought to the institution a large measure of success.

UNDER the will of the late Dr. Nathaniel Rogers, the Senate of the University of London offers a prize of 100*l*., open for competition to all members of the medical profession in the United Kingdom, for the best essay or dissertation setting forth the results of original investigations made by the candidate on any medical pathological subject during the preceding two years. Candidates will be permitted to present papers published during the preceding year as the dissertation. The essay or dissertation, by preference typewritten or printed, must be sent in not later than May 1, 1908, addressed to the clerk of committees at the University.

THE prospectus for the session 1907–8 of the Belfast Municipal Technical Institute should prove of real assistance to intending students seeking guidance in planning their courses of work. It is quite clear from the volume, which runs to nearly 250 pages, that the chief object of the institute is to provide instruction in the principles of those arts and sciences which bear directly or indirectly upon the trades and industries of Belfast, and to show by experiment how these principles may be applied to secure industrial advancement. The classes are designed to assist persons engaged during the day in handicrafts or business, and desire to supplement the knowledge gained in the workshop or warehouse. The time-table of classes is published as a separate pamphlet, and with it a sensible letter of advice to students from the principal of the institute, Mr. Fras. C. Forth, indicating several directions in which students can assist the staff to secure success in the work of the various departments. Arrangements have been made for full courses of study in the various branches of science, art, technology, and commercial subjects.

AMONG the advanced lectures on scientific subjects announced in connection with the University of London to be held during the present session may be mentioned a course of eight lectures, by Mr. A. D. Hall, on the function of the mineral constituents of the soil in the nutrition of plants, to be given at the Chelsea Physic Garden on dates to be announced later. Mr. J. B. Leathes commenced a course of eight lectures on October 15 at the University physiological laboratory on problems in animal metabolism. At the same place four lectures on the construction of diets in health will be commenced by Dr. E. I. Spriggs on November 8. Three lectures on the principles of classification will be given at University College by Mr. G. A. Boulenger, F.R.S., beginning on October 28, and three lectures by Mr. J. T. Cunningham on sexual dimorphism, beginning on November 18. The University reader in meteorology will deliver at the University a course of twelve lectures on meteorological organisation and methods of dealing with meteorological observation, commencing on October 21.

THE *Electrician* for October 11 contains an interesting description of the electrotechnic institute of the Technical University in Karlsruhe (Baden), by Mr. Stanley P. Smith. The writer describes the general lay-out and equipment of the institute buildings, which were specially designed for the various branches of engineering carried on within them, but the description mainly deals with the electrotechnic institute itself. The cost and equipment of this building was between 270o*l*. and 280o*l*., and from the plans and description given there is no doubt that it is very perfectly arranged and fitted up. The general idea of the

curriculum followed is also given, and it will be of interest to both engineers and others to note that the course at Karlsruhe includes political economy and labour problems. There is also a greater tendency in Germany for the various branches of engineering to be treated by professors who are also engaged in practical work. On another point the institution at Karlsruhe differs from the colleges in this country, namely, the students themselves. There appear to be no student organisations, and the sociability so characteristic of an English college is almost entirely wanting.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 27.—"The Annealing of Copper, with Special Reference to Dilatation." By Prof. T. **Turner** and D. M. **Levy.** Communicated by Prof. J. H. Poynting, F.R.S.

The authors have employed a special form of extensometer, in conjunction with a Le Chatelier pyrometer, in order to trace the changes in the length of metallic rods during the process of annealing, and have thus obtained continuous curves connecting dilatation and temperature. The rods, which were ¾-inch in square section and 35 inches long, were uniformly and regularly heated in a gas-fired furnace. The chief feature of the apparatus was the use of water-cooled copper tubes for connecting the rod with the extensometer, a plug of non-conducting material being used to prevent any cooling of the end of the rod by the water. By this method the whole of the rod was in the furnace and uniformly heated, while the rest of the system was maintained at a constant temperature. The water-cooled tube attached to one end of the rod was firmly clamped, the other being free to move. On to this tube was screwed a brightly polished brass disc, against which pressed a finely rounded projection attached to the short arm of a bell-crank lever, which, traversing a scale, indicated the expansion of the rod.

The scale was divided into millimetres, each millimetre representing 1/1200-inch expansion, corresponding to a magnification of 48 : 1. The suitability and delicacy of the apparatus were ascertained by testing bars of wrought iron and steel; from the former a regular line was obtained, while the latter gave a curve showing a marked change of volume at the critical point (about 690° C.), thus agreeing with Le Chatelier's results obtained by an entirely different method. Hard-drawn copper bars gave a perfectly regular line, similar to that obtained with wrought iron; annealed copper also gave a straight line. Experiments on rods of brass of different composition, on gun-metal, and on phosphor bronze gave similar results.

It thus appears that the change from the hard, elastic condition of worked copper and copper alloys to that of extremely soft metal is not accompanied by any alteration in length. On the other hand, it is known that allotropic changes in an element, such as occur in pure iron at about 880°, or such chemical constitutional changes as occur in iron-carbon alloys at critical temperatures, are accompanied by marked alterations in volume, and the authors therefore conclude that the changes brought about by mechanical work, or by annealing of worked metals, produce only internal re-arrangement of the metallic molecules, but are of a different order from the chemical and physical changes, such as are correctly regarded as allotropic.

"Experiments on a New Kathode Dark Space in Helium and Hydrogen." By F. W. **Aston.** Communicated by Prof. J. H. Poynting, F.R.S.

This paper is a description of a new dark space, close up to the kathode and inside the Crookes dark space, discovered by the author while investigating the length of the latter phenomenon in helium, and later found to be exhibited in a less marked degree in hydrogen. The length of the new dark space, which under measurable conditions varies from 0·2 mm. to 1·0 mm., is almost unaffected by the pressure of the gas, but varies roughly with the inverse square root of the current density.

Careful observations show that *the fall of potential across the new dark space is constant* for the same gas under all observed conditions, and is in helium 30 volts, in hydrogen 15 volts. The phenomenon may be accounted for by the supposition that the energy required to ionise a molecule of helium is a definite quantity, and that an electron liberated from the surface of the kathode virtually at rest must fall freely through a definite potential in order to acquire that energy, so that the new dark space may be regarded as *the distance through which the electrons fall in order to attain sufficient energy to ionise the gas by collision with its molecules.*

The intense blackness of the new dark space in pure helium bears out this theory, by which also the following effect was predicted:—Since the behaviour of electrons liberated from molecules of the gas by collisions should be the same as that of those derived from the kathode, if the ionisation just beyond a potential distance from the kathode of 30 volts is sufficiently concentrated there will be a further maximum of ionisation—and therefore of light—just beyond a potential distance of 60 volts, another beyond 90 volts, and so on, each getting less definite than the previous one, so that the light in the Crookes dark space should be striated in appearance. By suitable adjustment of conditions, several successive striations can be seen and photographed in helium. Combining the potential differences obtained from the length of the new dark space with the accepted values of e and m for the electron, the following values of the energy required to ionise and the velocity of the ionising electron are obtained:—

Hydrogen	...	$1{\cdot}7\times10^{-11}$ ergs	$2{\cdot}25\times10^{8}$ cm. per sec.
Helium...	...	$3{\cdot}4\times10^{-11}$,,	$3{\cdot}2\times10^{8}$,,

Not the slightest indication of the phenomenon has yet been observed in any other gas.

Received July 5.—"The Dispersion of Double Refraction in Relation to Crystal Structure." By Dr. T. H. **Havelock.** Communicated by Prof. J. Larmor, Sec.R.S.

In this paper the object is to consider to what extent it is possible to regard double refraction, whether produced artificially or occurring in natural crystals, as due simply to an æolotropic distribution of similar particles. The ordinary theory of double refraction amounts to considering the medium as a collection of crystal molecules in cubical order, all the varieties of dispersion being postulated of the single particle; and similarly in artificial double refraction, the æolotropy is assumed to originate wholly in the individual molecule, and to be effected through the quasi-elastic force under which the polarisation electrons are supposed to vibrate. On the other hand, a theory which confines the effect to a re-arrangement of the molecules in space will express the result by a modification of the effective electric force operative at each particle. From this point of view the author develops a theory of the optical properties of a homogeneous assemblage of isotropic particles. If the medium behaves like a uniaxal crystal, it is found that the double refraction, equal to the difference between the two principal indices, is proportional to $(n_0^2-1)^2/n_0$, where n_0 is a mean value measuring the refractive index of a medium composed of the same particles in the same density, but arranged in simple cubical order.

This gives a law of dispersion of the double refraction, provided the dispersion of the mean index n_0 is known. The formula is applied first to the double refraction produced artificially in simple isotropic media. Experimental data are available for the dispersion of the double refraction produced in carbon disulphide by an electric field, and these results are found to agree well with the formula given above.

In the case of natural crystals, where the effect is larger, the theory indicates that the quantity

$$(n_1^2-1)^{-1}-(n_2^2-1)^{-1}$$

should be independent of the wave-length, n_1 and n_2 being the ordinary and extraordinary indices of the crystal. This relation is found to hold very well for quartz over a wide range, and gives in this case the equation

$$n_2^2-n_1^2=0{\cdot}01441(n_1^2-1)(n_2^2-1).$$

It follows, further, that the double refraction decreases in absolute value with the mean index n_0, that is, it decreases in general with increasing wave-length. This is the rule of dispersion in most actual crystals, but there

are various exceptional cases of anomalous dispersion, and to cover these a modified theory of uniaxal crystals is given in the following terms. The molecules (or crystal units) of the medium are not necessarily to be supposed ellipsoidal in shape, but are optically æolotropic, so that the subsidiary equations connecting the polarisation of a particle with the effective electric force are æolotropic, with an axis of symmetry; the particles are supposed to be arranged in a homogeneous assemblage, such that the effective cavity may be taken as a spheroid of small ellipticity with its axis of symmetry coincident in direction with that of the crystal unit. Hence an explanation is given of the anomalous dispersion of the double refraction in regions free from absorption, that is, when a medium composed of the same crystal units arranged in regular cubical order would give regular dispersion. The theory is considered finally in its general application to dispersion in biaxal crystals.

The author has attempted to connect the varieties of dispersion of double refraction with the structure of the crystal under the following assumptions. The crystal unit contains vibrating electrons, so that their combined effect is expressed by three principal equations connecting the polarisation of the unit with the effective electric field; if, then, these units are arranged in regular cubical order, we have a medium with principal refractive indices along three fixed directions in space, and in this case it is assumed that there is regular decrease of the double refraction with increasing wave-length in regions away from absorption bands; but considering in general any other homogeneous assemblage, the effect is expressed by a change in the effective electric field acting on the crystal unit; this effect is estimated by supposing, as a sufficient approximation, that the effective cavity is slightly ellipsoidal instead of being spherical. Thus differences of packing of the crystal molecules are represented optically by variations in the ratios of the axes of the effective cavity and in their directions in space compared with the polarisation axes of the individual unit. Combining these assumptions, it is shown that they are sufficient for a descriptive theory covering the varieties of dispersion of double refraction found in natural crystals.

PARIS.

Academy of Sciences, October 7.—M. Henri Becquerel in the chair.—The spectrum of the Daniel comet, 1907*d*: Jean **Bosler.** The spectrum of the nucleus of the comet was photographed on the nights of August 8 to 9, 18 to 19, and 19 to 20, with exposures of forty minutes, one hour, and one hour and ten minutes. Details are given of the lines observed, which appear to indicate the presence of hydrocarbons and cyanogen. There are also some lines of which the origin is uncertain.—Trigonometric series: Marcel **Riesz.**—The execution of a geodesic chain of precision in the Savoy Alps: Paul **Helbronner.** Particulars are given of the immediate objects of the survey, together with a list of the thirty-three stations, mostly mountain peaks, proposed to be included in the survey. Of these, twenty-six were completed between June 12 and September 28.—Spectroscopes with mirrors: Maurice **Hamy.** The substitution of mirrors for objectives is often used in spectroscopes. The present note gives a study of the theory of the best position to give the face of the last prism or grating to obtain a field of images as flat and as extended as possible.—The thermoelectricity of nickel; the influence of foreign metals: H. **Pécheux.** Three specimens of nickel were studied, the chemical analysis of each being determined. Couples were formed of each of these with pure copper, and the thermoelectromotive forces studied for a temperature range of 640° C. The curves of electromotive force of the three couples were not parallel, but the results are comparable, differing only by about 0·25 per cent. on the average. The simultaneous existence of copper and cobalt in a specimen of nickel produces the most marked deviations of E.M.F.—Phenyl migrations in the aromatic iodohydrins by the elimination of HI from the same atom of carbon: M. **Tiffeneau.** The theory developed in previous papers regarding the migration of the phenyl group in compounds of the type

$$(Ar)R—C(OH)—CHI—R'$$

has been extended and confirmed by a study of the corresponding ether oxides.—The phases of development of the Epicaridæ; experimental verification of the nature of the Micronisicidæ: Maurice **Caullery.**—The presence of Tyroglyphinæ in the long bones of the wings of birds: E. L. **Trouessart.**—The existence of statoblasts in the scyphistome: Edgard **Hérouard.**—The necessity of cultures in the study of the gonococcus: A. **Guépin.** The absence of the gonococcus, and of any other pathogenic microbe, can only be admitted as proved after negative results have been obtained from systematic cultures.—Some new fossil plants from the travertine of Sézanne: René **Viguier.**

DIARY OF SOCIETIES.

FRIDAY, OCTOBER 18.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—The Indicated Power and Mechanical Efficiency of the Gas Engine: Prof. B. Hopkinson.

THURSDAY, OCTOBER 24.

CHEMICAL SOCIETY, at 8.30.—The Constitution of Phenol- and Quinol-phthalein Salts: a Contribution to the Quinonoid Theory of Colour: A. G Green and P. E. King.—Poly-ketides: J. N. Collie.—Production of Orcinol Compounds by the Action of Heat on the Sodium Salt of Ethylacetoacetate: J. N. Collie and E. R. Chrystall.—A Simple Gas Generator for Analytical Operations: J. M. Sanders.—Some Double Ferrocyanides of Calcium, Potassium and Ammonium: J. Campbell Brown.—Halogen Determination in Organic Substances: J. Moir.—Racemisation by Alkali as applied to the Resolution of *r*-Mandelic Acid into its Optically Active Isomerides: A. McKenzie and H. A. Müller.—The Optical Activity of Cyclic Ammonium Compounds: F. Buckney and H. O. Jones.—Keten. A New Anhydride of Acetic Acid: N. T. M. Wilsmore.—The Action of Phosphorus Pentachloride on Hydroxy-trimethyl Succinic Ester. 1:2-Dimethyl Trimethylene 1:2-Dicarboxylic Acid: H. Henstock and B. E. Woolley.

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