THURSDAY, JULY 3, 1902.

THE NEW INTERNATIONAL CATALOGUE.

The International Catalogue of Scientific Literature. M. Botany, part i. (Published for the International Council by the Royal Society of London, 1902.)

WHEN the idea of a complete index of scientific literature was first seriously put forward, it was thought by not a few persons that the magnitude of the task would prove of so overwhelming a nature that its promoters seemed to be courting almost certain failure.

The older "Catalogue of Scientific Papers" published by the Royal Society, although of considerable value, cannot in any sense be called a complete record of the hordes of papers which were pouring forth in ever-increasing volume from the pens of useful and useless writers alike. Moreover, the publication of this catalogue has been in abeyance since 1883.

It is obvious to anyone reflecting on the matter that it was no longer possible for any single scientific society, unless extraordinary funds were placed at its disposal, adequately to continue the work. For apart from the cost of actual production, the catalogue itself, unless rapidly brought up to date by the publication of complete bibliographies at short intervals, must inevitably lose much of its value to those actively engaged in work. And thus on grounds of convenience and utility, as well as of policy, it was decided that endeavours should be made to place the undertaking on an international basis. A considerable number of leading foreign societies and individuals were approached with the view of ascertaining the possibility of evolving a satisfactory scheme which should at the same time be a practicable one. On the whole the replies were so favourable that it became a plain duty to push forward an enterprise from which, if successful, would accrue results of inestimable value to science and hence of immense importance to the world at large.

A conference was held in London during the summer of 1896, and it was attended by representatives of more than twenty different countries. At that meeting the preliminary steps were taken towards the inauguration of a catalogue of which the volume before us comes as the first instalment. A committee of the Royal Society appointed to investigate the working details of the scheme reported to a second representative conference in the autumn of 1898, and at this meeting the general lines on which the work was to proceed were drawn up. A subsequent international conference was held in 1900 to consider the more detailed schemes which had been drafted as the coordinated results of very extensive inquiries and investigations by the Royal Society. Furthermore, inasmuch as in a costly undertaking of this nature financial as well as other kinds of cooperation forms an essential factor of success, this aspect of the matter also received the full consideration of the delegates, and a satisfactory conclusion was arrived at.

As a result of the deliberations, the Royal Society agreed to act as the publishers of the catalogue and to advance the initial capital required, on the understanding that the latter be repaid during the ensuing five years. The ultimate control of the whole undertaking is vested in an international council, a convention of which is to be held in London in 1905 and thenceforth at ten-yearly intervals. It has been also agreed, and very wisely, that the scheme of the catalogue as now finally approved is to be given a fair trial of at least five years' duration before any serious modification may be introduced.

The first convention was held in December 1900, when it was resolved that the work should begin forthwith and that the contents of the catalogue should be compiled as from January 1, 1901. It is, however, satisfactory to know that the gap existing between the catalogue of 1800-1883 and that of 1901 now incepted is about to be filled up, and that a list of papers published during this interval, together with a subject-index for the whole period, is in actual course of preparation.

Much of what has here been said will doubtless be already familiar to many readers of NATURE. But only those who have watched the untiring activity of the leaders of this enterprise who have thereby succeeded in doing so much for the organisation of science, can at all adequately estimate the continuous strain and effort required to cause it to take a tangible shape.

As at present determined, the main branches of science are treated separately and are arranged under seventeen heads, each being indicated by a letter of the alphabet. The further ramifications of each branch are grouped according to authors and subjects. The classification of the latter (printed in English, French, German and Italian) is based on convenient subdivisions of the particular science concerned, and the respective headings are denoted, for purposes of index and cross-reference, by numbers. The final units are also arranged in alphabetical order.

The first volume of the catalogue which has just made its appearance deals with the literature of botany, and it is stated to be a first instalment of the entire volume due for the year 1901, and it is promised that a second part shall be forthcoming in the near future. As soon as the difficulties inseparable from the commencement of such a work have been overcome, it is intended that an entire volume shall be published in each year. We venture to think that it might have been well to have waited in the present instance until the volume could have been completed, or else that part i. should have been confined to the literature of a stated portion of the year.

The appearance on the title-page of Mr. Daydon Jackson's name is of itself a guarantee as to the care with which the compilation has been effected. The slips actually detected are few, but we confess that we have not been able to ascertain on what principle some of the omissions are to be accounted for. Thus, to take the case of the *Annals of Botany*, there appeared in the June and September issues two papers, both by M. C. Ferguson, dealing with the reproduction processes in pines, and yet, so far as we can discover, only the second one is quoted. We have also noted other omissions from the *Annals*, to confine ourselves to the case of one periodical alone.

Nevertheless, making due allowance for anomalies which experience will soon correct, the volume deserves

the highest praise, for it possesses in a large degree just those qualities that one specially seeks in a work of this nature—qualities that will render it an indispensable addition to the library of every serious student of botany. Papers that have appeared in comparatively inaccessible or little-known periodicals are duly recorded in their places, whilst owing to the clearness of the main subdivisions and the excellence of the system of cross-reference, it is usually easy to search out all the literature cognate to any given subject.

The translation of titles originally printed in unfamiliar languages is a useful feature that this volume will share with those dealing with other branches of science.

Another character of special utility lies in the enumeration, under their appropriate subject-headings, of the new genera and species that have been published during the period covered by the volume. It is sincerely to be hoped that it will always be found practicable to continue to give such *complete* lists, although their preparation must necessarily involve no small amount of labour.

It remains to be said that the typographical arrangements are clear and good, and the few printer's errors on which we have lighted are so trifling as to be almost negligible. Those who have been concerned in its production are to be congratulated on the appearance of this, the first instalment of a great work the value and importance of which it would be impossible to overrate.

J. B. FARMER.

THE GEOMETRY OF COG-WHEELS.

La Costruzione degli Ingranaggi. By Prof. D. Tessari Pp. xvi + 226; with eight lithographed plates. (Turin: Fratelli Bocca, 1902.)

THE study of the proper forms to assign to the teeth of cog-wheels in order that they may run smoothly affords such simple and useful illustrations of the principles of geometry of roulettes that it seems a pity that few mathematical students have time to interest themselves in the mattter. In regard to the assertion of certain empiricists that even if the teeth are not constructed on mathematical principles they will adjust themselves in the course of wear, it is pointed out that an immense amount of power will be wasted in wearing the wheels down, and instead of the teeth becoming adjusted they will run loose.

Whatever form be assigned to the profile of the teeth of one wheel, it is possible to construct a suitable profile for the teeth of the second wheel, and the two profiles are said to be *conjugate*. The condition that two profiles may be conjugate is that they must both be roulettes traced by the same rolling curve on the so-called "primitive" circles of the two wheels. If, however, a number of wheels are to be mutually interchangeable, the profiles of any two must be conjugate, and it is necessary that the generating rolling curve or "epicycle" should be the same for every wheel, and the most convenient form is the so-called epi-hypocycloidal form, in which the portion of the profile outside the primitive circle is an epicycloid and that inside the primitive circle a hypocycloid.

An inferior limit to the number of teeth is determined by the condition that contact between one pair must not cease until contact has taken place between the succeeding pair, and for smooth running it is further desirable for at least two pairs of teeth to be simultaneously in contact. To make the number of teeth a minimum, it is necessary to make the generating "epicycle" as large as possible, in which case the hypocycloidal form becomes a straight line; and it is shown by a diagram that the minimum number of teeth possible is nine for a pair of equal wheels, or six for a rack and pinion arrangement.

Now if the teeth are cut radially down to the base, the narrowness of the base is a source of weakness, especially when the number of teeth is small and their height consequently considerable; moreover, wheels of different sizes constructed in this way are not interchangeable. For such reasons as these another form is frequently adopted in which the profile is an involute of a circle, which is in this case of smaller radius than the primitive circle and is called the "base circle."

We are next introduced to another form of gearing, in which the teeth of one wheel are replaced by circular cylindrical spindles, an arrangement which, by the way, was some years ago tried in the gearing of tricycles for the purpose of reducing friction, and is still illustrated by chain wheels. In this case the conjugate profile is a curve parallel to an epicycloid, or in the case of interior cogs, a parallel to a hypocycloid. A particular case is that in which the ratio of angular velocities is as 1 to 2, when the spindles on the smaller wheel may be reduced to three or even two in number, and these work in rectilinear slots, an arrangement familiar in connection with the so-called "oval chuck" and the "trammel" methods for describing ellipses.

Hitherto the teeth considered have been of cylindrical form, with axes parallel to those of the wheels. We are now led to consider wheels with spiral teeth, an arrangement due originally to Hooke and White, and which is well illustrated by the diagonal rack and pinion coarse adjustment of the modern microscope. This arrangement has been supposed by some writers to eliminate nearly or quite all friction. Prof. Tessari, however, considers that this view is due to an erroneous opinion as to the nature of the contact existing between the surfaces, and, moreover, that further investigation from an experimental standpoint is desirable on the subject of whether any saving of friction is effected by helicoidal cogs as against cylindrical ones. Here is an important subject for researches which might well be carried out in a modern laboratory of experimental mechanics.

In the eighth chapter a new subject is introduced, namely, gears for converting uniform into variable angular velocity, and the first point is the determination of the primitive lines of wheels adapted for the required purpose. In other words, we have to find the form of two perfectly rough curves which by rolling on each other about parallel axes will effect the required transformation. If we assume that the angular coordinates of the two wheels are θ and θ', and h is the distance apart of the axes, the polar equations of the primitive lines for any given relation between θ and θ' are determined from the equations $r + r' = h$ and $rd\theta = r'd\theta'$. Among the possible arrangements we note a pair of ellipses rotating about their foci, and combinations of elliptic, parabolic or hyperbolic arcs, also arcs of equiangular spirals; many of these arrangements are illustrated by elegant

diagrams. The arrangement here called the "Maltese cross," in which the driving wheel moves the following wheel through a given angle once in every revolution, is interesting in connection with machines for counting revolutions. When a pair of conjugate primitive curves have been constructed, the form of the teeth is determined by the condition that in order to be conjugate they must be roulettes traced on the primitives by the same rolling curve.

From wheels rotating about parallel axes, Prof. Tessari passes on to bevelled cog-wheels, giving both uniform and variable ratios of velocities, and finally to the case where the shafts of the driving and following wheels are neither parallel nor concurrent, but are disposed in any positions in space. A simple application is the well-known modification in which the cogs on the driving shaft are replaced by a spiral thread.

While the present work contains no difficult mathematical formulæ, it places the theory of cog-wheels on a perfectly rigorous and logical basis, and the exposition appears remarkably simple and lucid. There are two lessons to be learnt from the perusal of such a book by those who will learn them. The "practical man" has to learn that a study of the why and wherefore of such matters as the shape of cog-wheels is not very difficult, and will help him a great deal more than merely learning up empirical rules. The mathematician, on the other hand, should see that if he will only make his knowledge of the geometry of conics, equiangular spirals, epicycloids and other curves sufficiently accessible to the practical man he will be doing good work, and by such means as this he may succeed in stimulating a much greater demand for his abilities than exists at present. Here we have a subject for the proper understanding of which a connected knowledge of certain geometrical facts is indispensable. But the average mathematician is somewhat apt to discourage the learner from acquiring a mere connected knowledge of facts; in the early stages by the importance he attaches to the performance of what we may call the scales and five-finger exercises of mathematics, and in the later stages by the stress he lays on the solution in the examination room of questions the meaning of which is often difficult even for a skilled mathematician to interpret when reading the paper at his leisure. Consequently, when the student of applied mechanics wants to learn about epicycloids and hypocycloids for the purposes of better understanding such a book as the present, there is great fear that he may not, as he certainly ought, employ the services of the mathematician. G. H. B.

EVOLUTION AND DESIGN.

The Lesson of Evolution. By Frederick Wollaston Hutton, F.R.S., Curator of the Museum, Christchurch, New Zealand. Pp. 100. (London: Duckworth and Co., 1902.) Price 2*s*.

OF the two essays composing this little book, the first formed the inaugural address to the Australian Association for the Advancement of Science at the Hobart meeting in January, 1902. Part of the second essay formed the presidential address to the Geological Section of the same Association at the Sydney meeting in 1898, while the second part of this essay, dealing with "Later Life on the Earth," has been written for the present work. The second essay may be at once dismissed with the remark that it is a tolerably well-digested statement of the facts of biological evolution as revealed by palæontological succession. The first essay, which embodies the "lesson" which the author desires to impress upon a wider public than the audience assembled to hear the address at Hobart, is the one which claims the most critical attention, because the author most unhesitatingly and boldly declares that he has discovered the aim and object of evolution—that the purpose for which this process was designed and set going on this earth is "the development of man's moral nature."

In order to appreciate Captain Hutton's position, it may be as well to state at once that he is a thorough evolutionist. He begins from the very beginning of the process, and devotes some pages to the subject of inorganic evolution, in the course of which he advocates the meteoritic origin of the solar and other systems as expounded by Lockyer and supported by Prof. G. H. Darwin. The motive powers of evolution are gravitation (Newton), the dissipation of energy (Kelvin), and selection (Darwin). But granting all this and accepting to the full extent the teachings of modern science so far as concerns the mechanism of the process, there has hitherto been no attempt outside the theistic pulpit to introduce the doctrine of special design into the philosophy of evolution to the same intimate degree that is attempted in the present work. It is not going too far to say that we have here the ancient teleology, which Huxley used to declare had been killed by the establishment of the doctrine of evolution, revived and amended in terms of evolution. The author's views are anthropocentric in the extreme. Not only is the development of man's moral nature the goal towards which evolution is directed, but every step in the process has been regulated so as to lead to this end. Thus with respect to the distribution of the metals:—

"Also if man was ever to become civilised, gold, copper and other metals in accessible positions were necessary, although they are of no use in the economy of animals and plants. Gold, however, would be almost useless to man if it was abundant, while iron would be equally useless if it was as rare as gold. But we know that these, as well as the other substances, exist in their right proportions" (pp. 24–25).

"We have therefore in the composition, size and position of the earth overwhelming evidence of design. And as we can prove that carbon existed in the Archæan era before life appeared, and that gold, iron and copper existed long before man, we must also allow that the results of evolution had been foreseen and provided for" (p. 27).

If we ask further why this admirable distribution of the metals has been necessitated, we find in a note (p. 25) that it is because gold is the most suitable metal for coinage, copper and iron for weapons. It would perhaps be unkind to inquire further why, after the right proportions had been provided for, the subsequent distribution of one of these metals had been left to take care of itself, as judged by the extraordinary disparity in the quantities possessed by individual members of that most highly civilised human community for which the original

distribution was planned! Also it is rather a matter of surprise that the author should not have made use of the opportunity of pointing out how the sponges and organisms of the Cretaceous seas had been endowed with the power of accumulating silica so that when man was evolved he might find flints ready to hand for the purpose of making his weapons. This suggestion is offered for a future edition.

Speaking frankly, and with all respect for Captain Hutton's beliefs and his perfectly honest and straightforward attempt to square them with the teachings of the modern doctrine of evolution, we cannot admit that the new teleology as thus presented is in any way preferable to the old teleology of the Bridgwater Treatise school. It leads us by a very circuitous track into precisely the same *cul de sac* into which the authors of those famous volumes led us. The argument in favour of design, for example, as drawn from the distribution of the metals, is very suggestive of the well-known story of the providential location of towns so as always to be on the banks of rivers!

In order to avoid misapprehension, let it be stated here that the author's position *may be* perfectly sound. There is nothing in the doctrine of evolution in the abstract which antecedently excludes the possibility of the whole process being the result of design. In calling attention to this point the present work may be regarded as useful. But there is much more of faith than of reasoning in the pages before us, and where belief is substituted for scientific argument—as is the case, for example, in the treatment of the immortality of the "spiritual" part of man (p. 45)—we are afraid that Captain Hutton's address will fall flat upon the world of science. The work which shall bring the doctrine of evolution into absolute harmony with the theory of design in nature has yet to be written.

R. MELDOLA.

A NEW TEXT-BOOK OF PHYSICAL CHEMISTRY.

The Elements of Physical Chemistry. By Harry C. Jones. Pp. xi + 565. (New York: The Macmillan Company; London: Macmillan and Co., Ltd., 1902.) Price 17*s.* net.

THIS very readable book differs in many respects from recent text-books treating of physical chemistry; it resembles more closely a modern version of Lothar Meyer's treatise, but contains, at the same time, the more recent views, the introduction of which dates from van 't Hoff's memorable paper in 1887. It is non-mathematical; indeed, the treatment of the subject might have often been more methodical and clear if symbols had been more freely employed.

Beginning with Dalton's laws, Avogadro's hypothesis, and Dulong and Petit's law, methods of determining atomic and molecular weights are briefly described; too briefly, indeed, unless the student studies the original memoirs, to which copious reference is made in the foot-notes. A general sketch of the periodic arrangement of the elements follows, and some pages are devoted to J. J. Thomson's, to Lord Kelvin's and to Clerk Maxwell's deductions regarding the magnitude and structure of molecules. The normal gas-laws are next treated of, with the deviations, explicable on the theory of dissociation. After some pages on the kinetic theory of gases, their specific heats are dealt with. Passing on to the spectra of gases, a sketch of Balmer's law is given, and, as usual, reference to some of the most recent literature is appended in the foot-notes.

The liquefaction of gases forms the next section, but here some of the facts stated are incorrect; they will doubtless be rectified in a second edition. This gives a natural transition to van der Waals's theory, and the well-known form of the Andrews diagram suggested by the late Prof. James Thomson is reproduced. It is a pity that this diagram, which shows curves greatly differing in form from those calculable by van der Waals's equation, or from those representing deductions from direct measurement, should have ingrained itself in all text-books.

Kopp's classical researches on the boiling points of liquids are next considered; but Walker's later researches, in which the boiling points of the members of certain homologous series are connected by a simple expression, find no mention. Again, while Rowland's results bearing on the specific heat of water at different temperatures are alluded to, those of Griffiths are omitted.

The next section is devoted to the refractive indices of liquids and their rotatory powers. But here the matter is too condensed; in many cases the important points are merely touched, and a beginner would find it difficult, without much fuller explanation, to form correct views regarding the subjects treated.

The same fault must be found with Prof. Jones's synopsis of Kopp's work on molecular volumes; it is really impossible in a single page to give any idea of the nature of the problem to be attacked, the method of attacking it, and the results obtained. On the other hand, methods of determining molecular weights of liquids by their capillary rise receive five pages, although here, too, the arrangement of matter might have been improved.

In all, 165 pages are devoted to what may be termed the older aspects of physical chemistry, and the rest of the book, comprising 383 pages, deals with the more modern developments of the subject, solutions, thermochemistry, electrochemistry, photochemistry, and finally chemical dynamics and equilibrium.

There are a good many inaccuracies in the work; it would have been considerably improved by careful revision. For example, on p. 223, where a proof is given of the relation between osmotic pressure and lowering of freezing point, the symbol M stands for both molecular weight of solvent and of dissolved substance, and p has two meanings—percentage composition and pressure. Such oversights are very apt to confuse the mind of a beginner.

The writer's style is, on the whole, clear; but throughout the work there are careless expressions. For example, "heat is either evolved or *consumed*." Such *lapsus calami* will doubtless, however, be corrected in subsequent editions.

The reviewer's verdict is that the author has, on the whole, given a fairly comprehensive and reasonably exact sketch of the modern aspects of physical chemistry in a

comparatively small number of pages. The book gives a better bird's-eye view of the whole subject than most recent works, and it has the great advantage that copious references make it possible for the student to consult the literature of the subject and supplement from original sources any lacunæ in Prof. Jones's presentation of facts and theories. W. R.

OUR BOOK SHELF.

Other Worlds. By Garrett P. Serviss. Pp. xv + 282. (London: Hirschfeld Bros., Ltd., 1902.) Price 6*s.* net.

WHO amongst us has not, at some time or other, considered the question of the possibility or probability of the habitability of the planets that pass across the face of our sky, and wondered whether any of these worlds is an "earth" with all her attendant phenomena? A very excellent account of our neighbours from this point of view will be found in the book before us, which, although it hails from the other side of the Atlantic, yet will nevertheless be welcomed, as it comes from the land where the most recent and very valuable work on the observations of the surface markings of the planets has been done. As has often been pointed out, it is not the large telescope that is necessary for planetary observation, but clear and still air, a comparatively small telescope, and an intelligent eye. In Arequipa the Americans have such a condition of atmosphere, and it is there that important observations of some of the planets have been made.

In the present volume the author gives the reader a very clear insight into the present condition, so far as can be gathered from observation, of each of the planets, and the information is conveyed in such an enticing manner that the book should be interesting reading to everyone. Besides being accurate, the contents are well up to date, as shown by references to Pickering's work on the observations, and deductions from them, of the lunar surface.

The concluding chapter gives a brief but sufficient account of the means of finding and recognising the planets when they are visible in the sky, and in this is included a set of charts of the zodiacal constellations to facilitate the work of a beginner.

Numerous well-reproduced illustrations, many from photographs and drawings made at the Lick Observatory, accompany the text, and the frontispiece shows the Martian surface as charted by Schiaparelli.

As a popular exposition of the degree of habitability of the planets the book is to be recommended, and the clear large print adds to the comfort of the reader.

The Basis of Social Relations. By D. G. Brinton. Pp. xvi + 204. (London: John Murray, 1902.) Price 8*s.* net.

The Criterion of Scientific Truth. By G. Shann. Pp. 51. (London: Cassell and Co., Ltd., 1902.) Price 1*s.* 6*d.*

THE persons responsible for the publication of the posthumous work of Dr. Brinton, described above, would have done better if they had taken a more comprehensive view of their editorial duties. As we are told in the preface, no attempt has been made at verifying references; so that we have highly debatable statements constantly made on such vague general authorisation as "Plato," "Wundt," "Quetelet," "an American scientist," and so forth. Curious inaccuracies in matters of fact have likewise been allowed to stand in various places, *e.g.* at p. 44, where we read that Crete was the source of "Greek law" (whatever that vague expression may mean), and a well-known citation from the famous Hymn of Cleanthes, occurring in the "Acts of the Apostles," is said to be from "a Cretan poet," and at p. 13, where it is asserted of Jevons's "logical machine" that it "worked as well as the human brain," the truth being, as all logicians know, that that ingenious invention requires all but the purely mechanical part of the inferential process to be performed for it by the operator.

Some of these statements would possibly have been removed by the author had he lived to give the book his final revision, but others are such as could hardly have been made by a writer really acquainted with many of the subjects upon which Dr. Brinton expressed himself with confidence. No serious student of ancient history would subscribe to the assertion that the early Romans were dominated *exclusively* by the lust of conquest, or the Greeks by the love of art (p. 111), nor does a study of the erotic poetry of the Christian Middle Ages lend much support to the notion that "chivalry" was the expression of profound respect for woman as a sex, and devotion to a high ideal of monogamy (p. 173).

As a whole, the book is somewhat disappointing. It is rather a series of *obiter dicta* on the conditions of social development than a connected study. It is hard to understand the author's exact conception of the "ethnic mind." Sometimes (*e.g.* p. 25) we are told that the "group" is a "generic concept" with no "objective existence," yet again (*e.g.* p. 28) that its "actual existence" cannot be denied, and that it is related to the individual mind as the building to its component stones. Dr. Brinton held very strong opinions on some subjects of current controversy. He was, for instance, confident that monogamy was not primitive in the species, and again, that "acquired characters" are transmissible. It is a pity he—or his representatives—should have seen fit to abstain from all citation of evidence or references in dealing with such important questions.

Mr. Shann's little work is a pleasantly written and fairly thoughtful essay in support of the view which sees in scientific truth simply a set of convenient descriptive hypotheses. The "criterion" of truth he adopts is the simplicity and adequacy with which our formulæ enable us to picture a connected train of sensational experiences. Hence he lays great stress upon two points; the origin of all knowledge must be sensational, and no knowledge can be absolute or final. From the standpoint adopted he discusses various cases of the supersession of inadequate by more adequate scientific formulæ intelligently and readably, but he seems not to have realised the grounds on which many able thinkers would dissent from the empirical phenomenalism he advocates. Has he ever asked himself whether his general philosophical theories would enable him to give a reasonable account of mathematical truth? If he will reflect, for instance, on the nature of number, and the difficulties involved in the assumptions that numerical truths are of sensational origin and only relative validity, he will probably discover that there are serious gaps in the phenomenalist theory of knowledge which he advocates. There is no doubt that he has something on this point to learn from Kant, whom he does not mention at all in his historical synopsis, and possibly even more from Plato, whom he dismisses with a sentence or two of vague generality.

A. E. T.

Opere matematiche di Francesco Brioschi. Pp. 416. (Milano: Ulrico Hoepli, 1901.)

THERE could not have been a more fitting tribute to the memory of Francesco Brioschi than the publication of his collected papers in quarto form. In order to carry out such an undertaking, a committee was formed shortly after his death consisting of Profs. G. Ascoli, E. Beltrami, G. Colombo, L. Cremona, G. Negri and

G. Schiaparelli, and the result is a work of which the present is the first volume. It contains fifty-four of Brioschi's papers, of which forty were originally published during the period 1851–1857 in the *Annali di Scienze matematiche e fisiche* under the editorship of Barnaba Tortolini, and the remainder appeared in the *Annali di matematica pura ed applicata*, which formed a continuation of the previous journal, during the years 1858–1861. The last of the series is Brioschi's classical monograph on the theory of covariants and invariants of binary forms and their principal applications. The arrangement adopted has thus been to classify Brioschi's papers according to the journals in which they are published and not according to date or subject-matter.

The committee placed the principal work of editing the volumes in the hands of Profs. Beltrami and Cremona, and on the death of the former the task was continued by Prof. Valentino Cerruti, the papers in the present volume being revised in addition by Profs. Pascal, Gerbaldi, Loria, Pittarelli, Reina and Tonelli. To these names must be added those of Profs. Bianchi and Capelli in connection with the revision of material for succeeding volumes.

A photogravure portrait of Brioschi forms a frontispiece, and a short history of his life will appear at the end of the complete work, forming a lasting monument to the great Italian mathematician.

Webster's International Dictionary of the English Language. To which is now added a Supplement of 25,000 *Words and Phrases.* Edited by W. T. Harris, Ph.D., LL.D., Editor-in-Chief. (London: George Bell and Sons.) Price 2 guineas net.

NO more convincing proof of the extent to which the English language has been enriched as a result of the wonderful activity in scientific circles during recent years could be found than this new edition of the world-renowned "Webster." The supplement, which distinguishes this from the last edition of the dictionary, is largely composed of scientific terms and technical expressions which have come into existence during the last decade. It is only necessary to glance down a list of the names of the men of science who have assisted Dr. Harris in the preparation of this substantial addendum to satisfy oneself that the definitions will prove clear, accurate and complete. Repeated tests have shown that such anticipations are well founded, a conclusion that will not seem surprising when it is stated that among the assistants on whose services the Editor-in-Chief has been able to rely are such scientific experts as Prof. E. S. Dana, Prof. G. K. Gilbert, Dr. E. S. Holden, Dr. T. C. Mendenhall, Prof. E. L. Nichols, Prof. I. Remsen, Prof. A. E. Verrill, Prof. L. F. Ward, and many others of equal authority. The dictionary will continue to merit the confidence with which it has long been regarded.

Education and Empire. Addresses on certain Topics of the Day. By Richard Burdon Haldane, M.P., LL.D., K.C. Pp. xvi + 195. (London: John Murray). Price 5*s.* net.

IN the first two addresses in this volume Mr. Haldane is concerned entirely with educational problems, and in both of them pleads in a convincing manner for more earnest attention to the great need of increased facilities for higher technical instruction and for scientific research in this country. The comparisons which are here instituted between what is done in the United Kingdom and in Germany and the United States of North America in the matter of providing technical colleges and laboratories for scientific research should, if anything will, explain to our manufacturers and merchants the reason for the phenomenal success of our trade rivals.

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.]*

Mr. Marconi's Results in Day and Night Wireless Telegraphy.

I CAN assure Prof. Joly that his explanation (p. 199) will not do.

The observed effect, which if confirmed is very interesting, seems to me to be due to the conductivity, and consequent partial opacity, of air, under the influence of ultra-violet solar radiation.

No doubt electrons must be given off from matter (dust as well as other matter) in the solar beams; and the presence of these will convert the atmosphere into a feeble conductor. Conducting power in the sea-water surface assists and guides the waves, retaining them in two dimensions after the same fashion as a telegraph wire retains them in one; but conductivity in the dielectric itself will tend to dissipate and enfeeble the waves, by a process of reflection resulting in some amount of distortion. OLIVER LODGE.

June 27.

Kinetic Theory of Planetary Atmospheres.

IN the *Astrophysical Journal* for November, 1901, is printed a paper of mine in the first part of which a method is proposed for determining the mean temperatures of the atmospheres of the planets and those of their surfaces. In the second part of the paper an attempt was made with the use of these temperatures to determine the composition of the atmospheres of the planets by the "empiric" method proposed by Dr. Johnstone Stoney and based on the supposition that helium escapes from the earth's atmosphere. The most probable velocity of the molecules of helium is 1093 metres per second at 15°C. (the mean temperature of the earth's surface), and the velocity sufficient to overcome the earth's attraction is 11,170 metres per second. Hence it has been inferred that a gas escapes from the surface of the planet, if the most probable velocity of its molecules is 10·22 times less than that required to overcome the planet's attraction.

Prof. G. H. Bryan (NATURE, No. 1698, p. 54) has remarked that according to his and Mr. Cook's calculations, founded on the kinetic theory of gases, helium cannot escape to any sensible extent from the earth's atmosphere by the motion of its molecules among themselves. But the assumption that helium cannot be retained by the earth's attraction is arbitrary. It is possible that helium exists in our atmosphere in only a very small quantity, because it is contained in the interplanetary medium in very insignificant proportions; its escaping, if it occurs, is effected, perhaps, by ordinary diffusion. We know several substances, as thorium, osmium, &c., which are very rare minerals, though their atomic weight is great. It is possible, moreover, that even hydrogen can be retained by the earth; it seems to be confirmed by the observations of M. Gautier (*Bulletin* de la Soc. chim. de Paris, December 5, 1900, p. 884) and Lord Rayleigh (*Phil. Mag.*, vol. iii., pp. 416–422, 1902), who have found free hydrogen in atmospheric air.

Assuming the last supposition, we must substitute for the number 10·22 some other less than 7·42 ($=\frac{1505}{1005}$, where 1505 is the most probable molecular velocity of hydrogen at 15° C.), for instance, 7, 6, or 5, in order that an appreciable number of molecules may attain the speed sufficient to carry them to infinity; and consequently table iii. in my paper must be changed correspondingly. E. ROGOVSKY.

The Coloured Sunsets.

THE recent fine weather has enabled one to observe the sunsets and after-glows under very favourable circumstances, and the most striking feature observed was the predominance of the beautiful salmon-colour tinge, which became most intense when the after-glow was brightest.

Practically none of the sunsets observed were strikingly red,

but the yellow, purple and pinkish tinges were most general. The sunsets of the 22nd and 26th and the sunrises of the 27th, 28th and 29th were those which showed the salmon tint to the greatest advantage.

In a letter to NATURE of last week, Mr. Krohn recorded some remarkable sunsets at Madeira, while a *Daily Mail* correspondent at Bombay (June 29) writes:—"The extraordinary red sunsets which have been witnessed for several days past are believed to be due to Martinique dust in the upper atmosphere."

There is little doubt, therefore, that the dust is on the move, being carried by the upper air currents, and perhaps we may yet observe more brilliant effects.

WILLIAM J. S. LOCKYER.

Solar Physics Observatory, June 30.

As one of the first, in your pages, to call attention to the import of the sunset glows in 1883, I have additional interest in noting the recurrence of similar glows during the past few days. On three nights, at least, they have been more marked than any seen by me since the eighties.

I observed the glow first on June 26, at Croydon, but it was noted at Street, Somerset, on the 24th (Tuesday last). I was there from the 27th to 29th, and saw glows each evening. On the 27th it was brighter, though less widely spread, than at Croydon on the 26th. But at Street, on the 26th, I am informed by my cousin, Mr. Joseph Clark, that it was brighter than on the 27th.

The following resemblances to the glows in 1883 may be noted:—

(*a*) The distinct interval between the sunset itself, with illuminated lower clouds, and the glow. The latter began 20 to 30 minutes after sunset.

(*b*) The detachment from the horizon.

(*c*) The shade, pink, ranging from salmon tinges (26th, due perhaps to London smoke-haze) to almost purple.

(*d*) The clear interval between a "glow" and "after-glow" about half an hour after sunset (noted on 28th and 29th).

(*e*) The "after-glow" growing as brilliant as the glow. Indeed, on the 29th it was more brilliant, and alone attracted attention from the ordinary observer.

(*f*) The strong and prolonged "counter glow" above the earth-shadow (specially noted on 28th, up to 8.50, or half an hour after sunset).

(*g*) The prolonged ruddiness along the horizon, signs still remaining on 29th at 11 o'clock.

On June 26 (Croydon) the glow arose to at least 75°; otherwise 55° or so was the extreme limit. So far the pink glows have not been observed later than about 9.10, or, say, 50 minutes after sunset. In brilliancy they cannot compare with those of 1883, but perhaps with the glows two years later.

June 30. J. EDMUND CLARK.

The Halos of May 1, 8 and 22.

SINCE the publication in NATURE of the letters on these three phenomena, my attention has been directed by Prof. S. P. Thompson to the "Memoire sur les Halos," by M. A. Bravais. The first of the above three halos, recorded by Prof. E. E. Barnard, is apparently new, unless the radius of one of the two circles was in reality considerably smaller than that of the other; if this was the case (which from the account seems scarcely likely) this halo might be part of the halo depicted on Plate iii. Fig. 98, and described on pp. 87, 88 and following, and of which Bravais says that the different parts are by no means always visible together.

There is no doubt that the halo described by me is substantially the same as that depicted on Plate iii. Fig. 101, though it will be seen that mine has a cusp not previously described, whilst one of the mock suns given by Bravais is altogether wanting.

Lastly, the halo described by Prof. Grenville A. J. Cole will be found in the same work (Plate iii. Fig. 101), where it is interesting to note that only one parhelion is drawn, and that is the one given by Prof. Cole on the left of the horizontal diameter of the smaller circle. T. C. PORTER.

Eton, Bucks, June 30.

Matter and Motion in Space.

MR. WILLIAM STANLEY, an American philosopher and engineer, said a few days ago that the grandest words ever uttered by any man on this planet were spoken by Lord Kelvin when he said that if all the matter in the universe were reduced to its ultimate atoms and equally divided through all space, the disturbance caused by the beating of the wing of one mosquito would bring about everything that we find in the material universe to-day. I have written to Lord Kelvin asking him where I can find some account of this, but he denies that he ever said anything of the kind. However, as Mr. Stanley declares that it appeared in NATURE, perhaps you can put me in the way of getting a copy of the paper which contains this remarkable utterance, which, by the way, is quite true, and if Lord Kelvin did not say it, I only have to say that he might well have been the author. HIRAM S. MAXIM.

18 Queen's Gate Place, London, S.W., June 25.

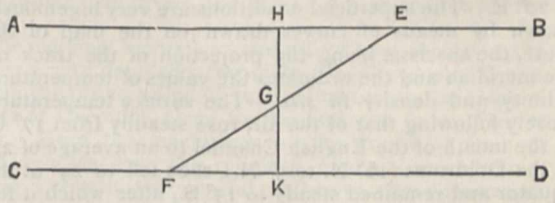
A Method of Treating Parallels.

MAY I venture to suggest through your columns a method of dealing with the theory of parallels which seems to me to possess some advantages?

Since a philosophically rigid proof of their properties may be regarded as out of the question in the present state of our knowledge, the only desideratum in laying the foundation of this important section of geometry is an axiom the truth of which shall be apparent to the mind of a beginner.

I propose that the following should be adopted, as being the property of parallels which is most prominent in matters of ordinary life, and hence to those who have not made a special study of geometry the most obvious:—"A straight line which is perpendicular to one of two parallel straight lines is perpendicular to the other."

The more general property, that parallels are equally inclined to any straight line which cuts them, follows immediately:—



Let AB and CD be two parallels met by a third line at E and F. Bisect EF at G, and draw GH perpendicular to AB and produce HG to meet CD at K. Then HK is perpendicular to AB and CD.

Then in the two triangles GEH, GFK,

angle EHG = FKG (right angles),
angle EGH = FGK (I. 15),
EG = GF (construction).
∴ HEG = KFG (I. 26).

Hartley College, Southampton. S. W. RICHARDSON.

THE FIRST FRUITS OF THE GERMAN ANTARCTIC EXPEDITION.

THE protracted voyage of the *Gauss* from the Elbe to Cape Town excited some anxiety at the time, and called forth a few comments unfavourable to the sailing power of the ship. It appears, however, that the delay was due mainly to the fact that many days were spent in carrying on oceanographical and magnetic work, although the change of programme which led to the abandonment of a visit to Ascension shows that the duration of the passage did to some extent exceed anticipations. The *Gauss*, we may recall, left the Elbe on August 15, 1901, passed the Lizard on the 20th, called at St. Vincent in the Cape Verde Islands on September 11, and reached Cape Town on November 23. The work done in various branches of science was discussed in a preliminary manner on board, and an account of it was issued in March in a paper of

108 pages, with numerous maps and diagrams, by the new Oceanographical Institute in Berlin and the Geographical Institute of the University of Berlin, under the direction of the head of both institutions, Baron F. von Richthofen.[1] The work, though mainly of value in the instruction it afforded the workers, still constitutes a contribution to our knowledge of the Atlantic, and promises well for the scientific harvest which we hope the *Gauss* has by this time begun to reap in less known waters.

The memoir consists of four parts—a general report of the expedition by the leader, Prof. E. von Drygalski, seven reports on the scientific work by the various specialists on board, technical reports by the chief engineer and the captain of the ship, and finally a special report on the establishment of the auxiliary station at Kerguelen.

As the investigators on the *Discovery* brought themselves into working order by monographing the island of South Trinidad, those on the *Gauss* set about the general description of St. Vincent in the Cape Verde group as their first exercise. Dr. Emil Werth describes the topography and types of vegetation of the island, and Dr. Philippi gives a brief account of the geology. The island is described as an ancient volcano, the central plain corresponding to the crater, the rim of which survives in parts as a peripheral mountain-chain.

The more systematic work of the expedition commences with Prof. von Drygalski's report on the oceanographical observations which were his special care. As far as the equator these were confined to the surface, but from the equator southwards deep-sea observations were added at regular intervals, along the course which lay alternately a little to the west and a little to the east of the meridian of 20° E. The superficial conditions are very ingeniously shown by means of curves drawn on the map of the route, the abscissæ being the projection of the track on the meridian and the ordinates the values of temperature, salinity and density *in situ*. The surface temperature, closely following that of the air, rose steadily from 17° C. at the mouth of the English Channel to an average of 27° in the Doldrums (16° N. to 5° N.), then fell to 24° at the equator and remained steady to 15° S., after which it fell steadily, reaching 18° C. in 30° S. The salinity curve showed maxima in the tropics both north and south, separated by a minimum in the belt of calms at 7° N. The density of surface-water *in situ* remained constant between the temperate zone and the tropics in both hemispheres, but fell to a single minimum in the equatorial belt of calms, where the maximum temperature met the minimum salinity. Samples for the determination of density and chlorine were collected every four hours and a number of different methods were employed for making the determinations. Titrations of chlorine were controlled by Knudsen's standard samples of sea-water, which were supplied to the expedition for the purpose. In addition to two patterns of direct-reading hydrometers, a set of Nansen's total-immersion hydrometers by the use of which the troublesome factor of surface-tension is eliminated were utilised, and a refractometer was also employed for the optical determination of the density of the sea-water. The value of the salinity deduced by Knudsen's tables from the chlorine determinations was always found a little lower than when deduced from hydrometer or refractometer observations; the mean error of the determinations was found to be least for titration of chlorine and greatest for the refractometer. The chief difficulty with regard to that instrument was found to be the temperature correction; but Prof. v. Drygalski points out the very decided advantage of the immersion refractometer with which the *Gauss* is provided over the differential refractometer formerly used.

[1] Bericht über die wissenschaftlichen Arbeiten auf der Fahrt von Kiel bis Kapstadt und die Errichtung der Kerguelen Station.

The colour of the sea-water was systematically observed, but the range of Forel's xanthometer being found insufficient, the more extensive scale of colours used by Luksch on the *Pola* expedition was adopted instead.

Deep-sea soundings were made with a modified Sigsbee machine. Using a detaching weight of 35 kilogrammes as a sinker, soundings were completed in 5000 metres (2770 fathoms) in seventy minutes in calm weather. Prof. v. Drygalski found the Negretti and Zambra reversing thermometer unsatisfactory for deep soundings, on account of the shaking of mercury out of the inverted bulb in hauling up through the hot tropical surface-water. The Miller-Casella thermometers, on the other hand, acted admirably, and he regretted not having taken a larger supply. We think, however, that in the very different conditions of the polar seas this opinion of the relative utility of the two types of instrument will very likely be reversed.

On the voyage between 37° N. and 34° S. no fewer than thirty successful deep-sea soundings were taken, of which nine gave depths exceeding 5000 metres (2770 fathoms), and the deepest as much as 7230 metres (3950 fathoms). The positions of the soundings were chosen so as to throw light on special problems of suboceanic configuration.

Opportunity was taken to test the Pettersson-Nansen insulating water-bottle in these depths, and the result was to show that the great contrast of temperature between the bottom and surface in the tropical seas was too much for the power of insulation, and that the inner cylinder of water altered its temperature somewhat before a reading could be made. This difficulty will, of course, not be experienced in the more uniform temperatures of polar seas.

An interesting fact brought out by the determination of salinity as well as temperature at each point of observation was that about the depth of 800 metres, where the sudden change in the temperature curve occurs between the warm upper and the cold lower waters, there occurs an actual inversion of the salinity curve, showing that a stratum of minimum salinity is interposed between the two salter layers.

The study of oceanic deposits brought out some new facts, and suggests problems not very easy of solution. By using sounding tubes of 2 or 3 centimetres diameter and 200 centimetres long some very long cores were obtained. One of these, from the depth of 7230 metres (3950 fathoms), in 0° 11′ S., 18° 15′ W., showed distinct stratification. The core was 46 centimetres long; the uppermost 13 centimetres consisted of red clay containing numerous fragments of volcanic rock, then followed in order four bands of different colour, passing from brownish-grey to dark and then light grey. The dark grey layer distinctly resembled a terrigenous deposit, and the light grey layer, the lowest of all, was the only one containing a perceptible proportion of calcium carbonate. The bearing of this observation on past changes in the configuration of the ocean and the distribution of land is pointed out. A still more curious specimen was a core 69 centimetres (say 2 feet) long, obtained in 35° 52′ S., 13° 8′ E., from a depth of 4957 metres (2750 fathoms). The uppermost 11 centimetres consisted of a brown clayey quartz sand with very little volcanic or calcareous material, while the next 12 centimetres were almost pure globigerina ooze with fragments of the upper layer, and the greater mass of the section consisted of material similar to the upper layer, but with the clayey material predominating over the sand. Dr. Philippi could not account for this appearance of sand in a pelagic deposit by considerations of the prevailing wind (which blows towards, not from, the South African deserts), or by currents, so he is driven to suggest that the material is ice-borne, though he acknowledges the

difficulty of icebergs in sufficient numbers reaching so low a latitude.

The biological work was very fully developed on the voyage, and in addition to a close watch being kept on the changes in the surface plankton by continuous tow-netting, attention was devoted to the use of very large wide-meshed nets (one was of 7 metres diameter) for horizontal towing, and to a vertical net of 2 metres diameter. A somewhat unexpected result of the latter was the discovery that very young fishes increased in number with the depth. Thus in a vertical draught from 500 metres twelve "fischchen" were found, in one from 800 metres fifteen, from 1000 metres thirty-two, from 1200 metres thirty-six, from 2000 metres forty-three and from 3000 metres no fewer than ninety-six. Most of them belonged to the genus Cyclothone.

Dr. Bidlingmaier enters very fully into the methods and difficulties of magnetic work at sea. The two principal instruments in use are a Bamberg's deviation magnetometer and a Lloyd-Creak inclination instrument identical with that supplied to the *Discovery*. The results are not yet ready for publication, but a number of observations were made both at the ports of call and at sea. At Cape Town Profs. Beattie and Morrison repeated the comparison of their own instruments with those of the expedition which they had made a short time previously with the *Discovery's*, thus enabling a comparison of the instruments of the two exploring vessels to be made.

The report concludes with a letter from the auxiliary station at Kerguelen which was established by Herr Enzensperger on the shores of Royal Sound in November, and was visited by the *Gauss* on her way southward in January, 1902; but the letter had been dispatched some weeks before the ship arrived.

We miss any detailed account of the meteorological work of the expedition, or particulars as to the placing and working of the various self-recording instruments on board.

It is impossible to overrate the importance of preliminary work in comparatively easy conditions before grappling with the manifold difficulties of the polar seas. Indeed, we believe that those who organise polar expeditions for scientific work would be well advised to insist on a preliminary trip of at least three months' duration before the final plans and equipment are settled. The result would not be waste of time; it would render fruitful a vast amount of work, which without preliminary experience is sure to be wasted. In this respect Antarctic expeditions are more advantageously situated than those to the Arctic regions, where the ship is in the midst of its field of work before the men have settled down to life on board and to work under the countless limitations which harass the man of science at sea.

H. R. M.

RURAL EDUCATION IN FRANCE.[1]

ONE is always being reminded afresh of the essential solidarity of the thought of civilised man; no movement seems to begin with one man or in one place; the tide rises, and though this or that first receives the impulse and takes credit for being the creator, yet the wave has already reached many a distant creek and inlet. In two or three years the idea of giving an agricultural colouring to the work of the rural elementary schools of England has been getting itself translated into codes and circulars and syllabuses; the Agricultural Education Committee gave the needful push, but if anything else were wanted to prove that it only supplied the "starter" to a medium already prepared to react, it would be a consideration of the work done in the same direction in France, as set out in the report before us. And the United States, our Australian Colonies and Canada, to name no more cases, would all report similarly—their educators have begun to realise that primary education has been systematised on bookish and artificial lines, which can nowhere be more pernicious or more easily avoided than in the purely country school, with trees and fields around it.

Unfortunately, the pioneers of any movement, just because they are pioneers and have brought a certain amount of original thought to the work, are apt to forget that there must be other people progressing on the same lines; they shut themselves up in their own schemes, and bit by bit work through the same mistakes which everyone else has previously made.

Here comes the special value of such reports as the one we are now considering, and had this account of the attempt in France to impart an agricultural bias to the rural primary school been available a year or two earlier, many experiments destined to failure might have been avoided, and much well-meant effort directed into more fruitful channels.

The problem in France is like that of England, there is the same depression in agriculture, the same dominance of the town in the organisation of the State, the same increasing distaste for a farming life—in a word, the same impossibility of the primitive industry, with its toil, its small returns, its isolation, competing either for men or capital with the specialised affairs of the town. But as Mr. Brereton reminds us, France is more of an agricultural country than we are, so the problem was taken in hand earlier there; the economic difficulties were palliated by protection, and the primary education of the country was overhauled to ensure that it should stimulate, rather than divert, the child's desire to live on the land.

The volume before us consists of two reports; the first is a very detailed account by Mr. Cloudesley Brereton on the organisation of rural education in the Departments of Calvados, Orne, Sarthe, Indre et Loire, Loir et Cher. Here the machinery for the education both of child and teacher; the relations, financial and administrative, between the central authority, the department and the commune; the status of the teachers, the inspectorate, the departmental professors, &c., are set out at length, together with the personal impressions of the author while visiting typical schools in the district indicated. Mr. J. C. Medd, the author of the second report, deals with the country bordering Mr. Brereton's on the north and east; he is, perhaps, more specially concerned with "l'enseignment agricole" than with the general machinery of education. The first thing that strikes us is the predominance given in both reports, and indeed in the French system, to the programme. Most new movements in education narrowly escape being choked in their early days by a programme, and as we in England are still struggling to free ourselves from the wrappings of syllabuses, it is interesting to read how the vastness of the schemes framed by the departments in response to the law of 1879, resulted in practically no teaching except by a few enthusiasts. This was realised, and the Ministry issued in 1897 a well-reasoned scheme "on the teaching of elementary notions of agriculture in rural schools,"[1] which forms the basis of the work that is proceeding to-day. Even this circular seems to err in attempting instruction which is too definitely technical for the primary school, and so degenerates into text-book repetitions. The study of manures and artificial fertilisers has an extraordinary attraction for the sort of man who teaches in a primary school; he needs to be warned that they do not constitute the whole of agriculture, rather than encouraged to devote his "champs

[1] Vol. vii. of "Special Reports on Educational Subjects," published by the Board of Education.

[1] A translation appears in the Report of the Irish Commission on Primary Schools [c 8925].

d'expérience" and his pot cultures to demonstrating the effect of nitrogen, phosphoric acid, potash, &c. Whatever happens to this sort of teaching in England, we hope the primary school will be left uninvaded by theories of manuring. Practical farmers have sometimes denounced the whole race of agricultural teachers as advertising agents for the artificial manure makers, and if when they happen to visit the village school, they hear little lads of twelve and thirteen glibly reciting scraps about nitrates, kainit and the like, there will only be one strong prejudice the more against "education."

All the programmes set out by Mr. Brereton and Mr. Medd are based too much on chemistry, which in an elementary school is necessarily academic instruction, and too little on botany and zoology, which can be made real, and interwoven with the child's daily experience of field and garden. Nor is there any indication of work done by the children themselves; the instruction seems wholly didactic.

But after all a syllabus should only be regarded as a series of boundary walls; it should say, "do what you like within these limits, but don't think yourself called upon to do it all." It does harm when it becomes a stereotyped substitute for the teacher's judgment. On the teacher the whole thing depends, and this is thoroughly recognised in both reports. It is because the current generation of teachers is not prepared for the work, either in England or France, that the work of vitalising the instruction of the village school must proceed slowly. France has the advantage of a properly organised system of training colleges through which all their teachers pass, and in them a course of agriculture is given by the departmental professor. In Mr. Brereton's opinion he has so many more pressing duties that this part of his work is performed in a somewhat perfunctory fashion; the teaching is too academic, and not enough use is made of the garden for practical instruction. It is difficult to see the value of "a lot of hard digging" for students when the gardener is left with the more ticklish operations that follow. We do not gather that the training colleges have arrived at any conception of a "normal" course in these studies bearing on agriculture and horticulture, which would practice the teacher in the very experiments, indoors and out, that he will want to pass on to his scholars. No one is in more need of this kind of drilling, for the primary teacher's training is always disposing him to think that if he knows how to describe an experiment he knows how to do it. Mr. Medd found a teacher who was afraid to do experiments lest his boys should meet with accidents and he himself be involved in claims for compensation; and Mr. Brereton records how unsuccessful the manure experiments, either in the open or in plots, were apt to be, which indeed is only "pretty Fanny's way."

However it is clear that the crux of the whole problem, lies with the teacher. Turn him out with an adequate preparation, keep him encouraged on the right lines by the inspectorate, and let him work out his own salvation. Uniformity is the least of virtues in this matter; the spirit the teacher puts into the task alone tells, and his individuality ought to be reflected in the instruction he gives, until each school has a special character of its own.

We trust these reports will be widely circulated and widely read; they will show what can be done, and may save us from expecting too rapid a progress. Mr. Medd speaks, perhaps, with more knowledge of country life, more experience of the same kind of thing at home, even if his enthusiasm does lead him to see things rather as they are meant to be than as they are. Mr. Brereton has the keener pedagogic eye for the place where the organisation becomes paper only. But both reports are eminently readable. Mr. Brereton is not afraid of letting his own personality appear, and if the final homilies which he addresses to the farmer, parson and squire suggest that Mr. Brereton is young, and knows the country chiefly *en bicyclette*, those poor sinners are too chastened already to take his advice otherwise than with a smile.

A. D. H.

THE SMITHSONIAN INSTITUTION: ITS DOCUMENTARY HISTORY.[1]

THE Smithsonian Institution, the great scientific establishment at Washington, which, in many respects, is to the United States of America what the Royal Society is to this country, was founded under the will of James Smithson (b. 1765), a son of Hugh Smithson, afterwards Duke of Northumberland, by Elizabeth Macie, a cousin of the Percys. The story of how it came to be founded, and of its great work for the United States and for the world, has been more than once recounted in this Journal. An article contributed by the late Dr. G. Brown Goode (NATURE, vol. liii. pp. 257, 281) in January, 1896, contained a very full account of the origin of the Institution and of the system of its administration; and, when the same writer edited, under the auspices of the Institution itself, a work on the "History of its First Half-Century," we took occasion in reviewing it to give a comprehensive outline of the rise and progress of this great centre of scientific energy (NATURE, vol. lviii. p. 271).

The work at present under review does not perform the same function as that of Dr. Goode. It is not a history of the Smithsonian Institution, but, as the title-page declares, it is a collection of "documents relative to its origin and history." In fact, it brings down to date a volume with the same title which was published in 1879. In the latter volume the documents relative to the inception and organisation of "the Smithsonian" from 1835 to 1837 were printed, and the present volumes cover the whole period from 1835 to 1899.

In compiling and editing these documents, Mr. William Jones Rhees, the keeper of the archives of the Smithsonian Institution, has very admirably performed a most arduous task. A compiler is not called upon to produce a work of high literary art, but he is called upon to give with faithfulness and accuracy all that comes strictly within the scope of his compilation, and this Mr. Rhees appears to have done. He has given us two classes of documents: first, the will of James Smithson, with correspondence, &c., relative to the bequest, and, secondly, a full reprint of those congressional proceedings which contain legislation relative to the establishment of the Smithsonian Institution. The extraordinary minuteness of the information preserved in these documents, especially of the first class, is sometimes almost amusing. Not only have we the will of James Smithson and the documents in the Chancery suit brought by the U.S. Government against the British Government, but we have the lawyers' bill for costs of the suit and the full account of the expenses of Richard Rush, who came over to fetch the money. We not only have a list of the stocks transferred by decree of the High Court of Chancery and a schedule of the personal effects of James Smithson, but we have all the details of Smithson's tea-service—12 cups and saucers, 6 coffee cups, teapot, slop basin, sugar basin and lid, &c. Indeed, such a mass of material, important and unimportant, as is printed in these two volumes would be overwhelming were it not accompanied by a good index. But this, by the editor's care, has been given, and those who have had experience of biographical or historical authorship and who have sighed over the lack of particulars which so often belongs to the early stages of a history will not quarrel with a minuteness of detail

[1] "The Smithsonian Institution: Documents relative to its Origin and History, 1835–1899." Compiled and edited by William Jones Rhees. 2 vols. (Pp. liii. + 1044 and xvi. + 1045 to 1983.) (Washington, 1901.)

which is thus made readily available. Mr. Rhees's volumes will doubtless become for the future historian a storehouse of information great and small, and for the official a book of reference of permanent value.

In the voluminous reports of congressional proceedings which are here reprinted, many things will be found which are of special interest to English readers. There are numerous allusions to our own institutions, such as the Royal Society and the British Museum. Among other matters of the kind we note, in the proceedings of the thirty-third congress (1853-55), a letter of Prof. Agassiz, in which he mentions that Smithson's magnificent bequest of 105,000*l.* sterling was originally intended for our own Royal Society, but that certain scientific papers which that gentleman offered for publication in the *Philosophical Transactions* were declined, "upon which he changed his will and made his bequest to the United States." One can scarcely, however, grudge the loss to our own country in view of the liberal spirit and the enlightened policy which have always ruled the affairs of "the Smithsonian," and have done so much to advance the cause of science.

That policy has not been maintained without many a struggle. It took, to begin with, eight years to decide what form the establishment for "increase and diffusion of knowledge" was to take. Schemes for "a library, a botanical garden, an observatory, a chemical laboratory, a popular publishing house, a lecture lyceum, an art museum," all fought together and killed each other, and when this consummation was reached and the Smithsonian Institution was erected upon the battlefield, the ghosts of two at least of the old schemes—the library and the college—continued to haunt the proceedings of congress and cause endless trouble. It was in the course of one of these after-battles—a battle with those who desired to divert the funds of the Institution from scientific work to the foundation of a great library—that a letter from Prof. Benjamin Peirce was read which makes honourable mention of the scientific work both of the foundation and the founder, an extract from which may serve as an appropriate conclusion to this notice:—

"The valuable contributions to knowledge which have already been made by the Smithsonian Institution are a living proof that vast libraries are not necessary to the development of new thoughts. If you will compare these memoirs with the scientific productions of the same period in Europe you may find them, perchance, inferior in erudition, but not in profoundness and originality of thought. Do you believe that Smithson, who was himself engaged in chemical investigations, could have intended a library by his words 'an institution for the increase and diffusion of knowledge among men'? If you will examine his nine memoirs to the Royal Society, of which he was an active member, and his eighteen other contributions to science, you will not find one of them which required a library for its production. Each was the natural growth of a deeply thinking mind. Smithson was emphatically a maker, not a collector of books; and, in the scientific circle to which he belonged, the ordinary use of language would have totally precluded the interpretation which some men of quite a different cast of mind have presumed to impose upon his words" (p. 557). H. R.

ARCTIC MAGNETIC OBSERVATIONS.

A SYSTEMATIC series of observations on terrestrial magnetism, atmospheric electricity and aurora was commenced by Prof. Birkeland and his assistants in 1899-1900, and a report upon some of the results was published last year.[1] The first observations were made at Bossekop (Finmarken), in the north of Norway. For magnetic observation, self-recording photographic apparatus was employed of the Eschenhagen pattern, the drums carrying the paper being capable of rotation at two speeds, the faster supplying a very open time scale. Fast runs were made simultaneously on certain prearranged days at Bossekop and Potsdam. A comparison of the records showed the simultaneous, or practically simultaneous, occurrence on several occasions of small regular magnetic waves at the two stations. Similar previous comparisons by Eschenhagen and others have led to similar results, but the comparatively great distance—some 2000 kilometres—between the two stations in the present case makes the results of special interest.

Only a portion of the report mentioned in the foot-note is devoted to the work at Bossekop. A considerable part is occupied with the description of experiments with electric discharges in vacuum tubes, in which Prof. Birkeland has succeeded in producing phenomena having a close resemblance to some of the more prominent features of aurora. Reference is also made to work by Prof. J. J. Thomson and other recent investigators in vacuum-tube discharges. There is also a discussion of the bearing of the observations and experiments on Prof. Birkeland's theory of the cause of aurora and magnetic storms. This he believes to be electric currents in the upper atmosphere, the ultimate source of which he ascribes to kathode rays or other electrical emanations from the sun. The observations and experiments are illustrated in the text and in various plates at the end of the book.

This work is to be regarded only as introductory to a larger scheme in which Prof. Birkeland is about to embark, and in which he desires the cooperation of magnetic and meteorological observatories. The further scheme is described in two circulars which have recently been widely distributed.

The Norwegian Government is to maintain four stations in operation from August 1, 1902, to June 30, 1903. They are situated at Bossekop and in Iceland, Spitzbergen and Nova Zembla. At each of the stations there will be continuous photographic registration of the horizontal and vertical components of magnetic force and of the declination. The instruments are of the latest Eschenhagen pattern, similar to those supplied to the German and British Antarctic expeditions, with arrangements for running at ordinary or at rapid rates. Rapid runs are to be made on certain specified days and times, mainly during the 'term' hours on the 1st and 15th of each month, according to the scheme agreed on between the British and German Antarctic expeditions.

In addition there are to be rapid runs from 9 to 11 p.m., G.M.T., on December 2 to 8, 1902, January 2 to 8 and February 3 to 9, 1903. Prof. Birkeland is anxious that as many magnetic observatories as possible should participate in this scheme of rapid registration. He also asks for the cooperation of meteorologists in observing cirrus clouds, and especially in recording the direction of cirrus bands when such exist. This information is more particularly desired during the days of special magnetic observations referred to above. Prof. Birkeland thinks it probable that high cirrus may be influenced by the electric currents which he believes to exist in the upper atmosphere, and to which, as already stated, he ascribes a principal, if not an exclusive, part in the production of aurora and magnetic disturbances.

One of the principal objects of having four stations in Arctic regions is to obtain data from which calculations can be made as to the direction, altitude and intensity of atmospheric electric currents, if such exist. Prof. Birkeland hopes to obtain quantitative results sufficiently definite to put his theory to the test. The completeness of the test will, however, be much enhanced by the

[1] "Expédition Norvégienne de 1899-1900 pour l'étude des aurores boréales. Résultats des recherches magnétiques." Par Kr. Birkeland. Pp. 80; with 12 plates. (Christiania, 1901.)

cooperation of existing magnetic observatories in Europe and other parts of the world.

As one of the principal desiderata is magnetic curves with very open time scale, it may not be out of place to explain that it is not necessary for this purpose to have a specially constructed magnetograph of the Eschenhagen or any similar pattern with small magnets. The ordinary Kew pattern magnetograph, with the usual damping arrangements, requires only a simple addition to the clock to work admirably as a rapid-motion instrument. Additions of this kind have been made to the Mauritius magnetograph by Mr. Claxton, the Director of the Royal Alfred Observatory, and a similar arrangement has been made at Kew itself at a trifling cost. The objection has, indeed, been raised to the use of ordinary magnetographs for this purpose, that the natural period of vibration of the magnets may coincide with that of the short magnetic waves which it is especially desired to investigate. When Eschenhagen described his early observations he apparently believed that the earth magnetic waves were restricted to one or two definite short periods, notably one of about thirty seconds; and he approved a short period of vibration for the magnet system so as to avoid possible synchronism. The records at Potsdam and Bossekop, however, discussed by Prof. Birkeland, and those taken elsewhere, show waves of all periods from eight or ten seconds up to several minutes, the longer-period waves being identical with those long familiar to all concerned with the records of the older types of magnetographs run at the ordinary slow rate. It would thus appear that synchronism is likely to happen very rarely, whatever type of magnetograph is employed. In some respects, of course, a very short period in the magnet system has its advantages, but it is not without its drawbacks. It means small magnets, entailing the use of small mirrors, and so necessitating a more intense light or more sensitive paper than is requisite when heavier magnet systems and larger mirrors are used. The greater robustness of the large-magnet systems is also a recommendation to those responsible for obtaining the records, especially at stations which do not possess a skilled mechanic and are not situated near large towns, a situation which the spread of electric tramways is fast rendering impossible.

C. CHREE.

CORONATION HONOURS TO MEN OF SCIENCE.

AS we went to press last week, news of the King's serious illness was published, and national rejoicing at the anticipated Coronation ceremonies was suddenly changed to sorrow and deep anxiety. Since then, the nation has been slowly recovering from the shock, and the favourable bulletins which the King's physicians have issued this week encourage the hope that the crisis has been successfully passed and that His Majesty's convalescence is assured.

The operation for perityphlitis, from which the King has been suffering, was decided upon by Lord Lister, Sir Thomas Smith, Sir Francis Laking, Sir Thomas Barlow and Sir Frederick Treves, who are in attendance upon the Sovereign. It is beyond our province to describe the medical history of the illness or the nature of the operation performed by Sir Frederick Treves; but we are glad to know that scientific knowledge renders it possible to give relief to the sufferer without the fear of complications which made the surgeon's work almost hopeless before the introduction of antiseptic methods. Remembering this, we trust that the dark days have been passed and that progress towards recovery will be uninterrupted.

When the illness of the King became known, it was scarcely expected that the honours to be conferred in connection with the Coronation would be announced. But by His Majesty's express wish the list was published on Thursday last, and we give below the names of men of science included in it. The new Order of Merit which has been created by the King is of particular interest. We have applied to the Lord Chamberlain for a copy of the Warrant of the Order, but so far have not received one; the general principles upon which the Order is founded will, however, be gathered from the following information given to and by the *Times*:—

The new Order is clearly founded on the lines of the well-known Prussian "Ordre pour le Mérite." It will have the same comprehensive range and character, including, besides British subjects who have won conspicuous distinction in the naval and military services, those who are exceptionally eminent as men of letters and in the fields of art and science. The number of its members will be, as is right, very restricted. It is, of course, primarily and essentially a British Order, but provision will be made for taking into its ranks distinguished foreign personages as honorary members. The badge of the Order, to be worn by its members, will consist of a cross of red and blue enamel of eight points, having the words "For Merit" (the motto of the Order) in gold letters within a laurel wreath on a blue enamel centre. The reverse of the badge will show the King's Royal and Imperial cipher in gold (two silver swords with gold hilts, placed saltirewise between the angles of the cross, being added in the case of members chosen for military or naval distinction) also within a laurel wreath, on a blue enamel centre; and the whole will be surmounted by the Imperial Crown enamelled in colour, and suspended by a parti-coloured ribbon of Garter blue and crimson, two inches broad. The Sovereign's insignia, except, of course, for the modifications necessary to distinguish the Royal dignity of the wearer, will be similar to the insignia worn by the ordinary members of the Order. The ceremony of the investiture will be from time to time conducted by the Sovereign as in the case of any other Order, the members designate being introduced by the officer of the Order in attendance. Members of the Order will be entitled to attach a facsimile of its badge and ribbon to their arms. The Seal of the Order will show a facsimile of the badge, impaled with the Royal Arms, on a white ground, with the legend "The Seal of the Order of Merit." June 26, as the day originally fixed for the Coronation ceremony, will be observed as the anniversary of the Order.

The Order only comprises one class of ordinary members, and of the twelve eminent men chosen as the first to be admitted, four are men whose names are familiar throughout the world of science.

Among the new Privy Councillors are Lord Kelvin and Lord Lister.

The new Baronets include Sir Andrew Noble, K.C.B., Sir Francis Laking and Sir Frederick Treves.

The honour of Knighthood has been conferred upon Dr. J. W. Collins, F.R.C.S., Mr. A. Cooper, F.R.C.S., Mr. H. Croom, president of the Royal College of Surgeons (Edinburgh); Dr. T. Fraser, F.R.S., president of the Royal College of Physicians of Edinburgh; Mr. Victor Horsley, F.R.S., Mr. H. G. Howse, president of the Royal College of Surgeons; Principal Oliver Lodge, F.R.S., Prof. W. Macewen, F.R.S., Principal Rücker, F.R.S., and Mr. J. Thornycroft, F.R.S.

In the Order of the Bath (Civil Division) Sir William Church, Bart., president of the Royal College of Physicians, and Prof. W. Ramsay, F.R.S., have been appointed Knight Commanders. Major Ronald Ross, F.R.S., and Prof. A. M. Worthington, F.R.S., have been appointed Companions of the same Order.

In the Military Division of the Order of the Bath, Admiral Sir Erasmus Ommanney, F.R.S., has been appointed Knight Commander.

The Kaisar-I-Hind medal for public service in India has been granted to Mr. Edgar Thurston, superintendent, Government Central Museum, Madras.

Finally, the new Order of Merit includes the names of four distinguished men of science, namely, Lord Rayleigh, Lord Kelvin, Lord Lister and Sir William Huggins.

NOTES.

IT is announced that Signor Schiaparelli has been elected an associate of the Paris Academy of Sciences in succession to the late Baron Nordenskiöld.

THE Albert medal of the Society of Arts for the present year has, with the approval of H.R.H. the Prince of Wales, president of the Society, been awarded to Prof. Alexander Graham Bell, "for his invention of the telephone."

THE Panama Canal Bill, which was adopted by the United States Senate a few days ago (p. 205), has been accepted by the House of Representatives and signed by President Roosevelt, so that it has now become law.

THE summer excursion of the Geologists' Association this year will be to the Ipswich and Norwich districts, the directors being Mr. W. Whitaker, F.R.S., and Mr. F. W. Harmer. The party will leave London on Saturday, July 26, for Ipswich, which will be the headquarters until July 31. Norwich will then be the centre until August 5, when the party will return to London.

THE council of the Society of Arts offers the Fothergill prize of 50*l.* and a silver medal for a paper on "Existing Laws, By-laws and Regulations relating to Protection from Fire, with Criticisms and Suggestions." The paper should consist of about eight to ten thousand words, and be written with a view to its being read and discussed at an ordinary meeting of the Society. Papers submitted for the prize must be sent to the secretary on or before October 1. Each paper must be typewritten, and bear a motto, the name of the writer being enclosed in a sealed envelope with a similar motto. The judges will be appointed by the council.

REPORTS of recent volcanic disturbances and related effects continue to be published. A despatch from Honolulu says that a violent eruption from the Kilauea volcano took place on June 3. It is further stated that when the Mont Pelée eruption was at its height, and during the six hours St. Pierre was overwhelmed, there were marked magnetic disturbances in the observatory on Oahu Island. A telegram from Fort de France to the French Minister of the Colonies, dated June 26, says that the scientific expedition which was sent to Martinique considers that the destruction of St. Pierre was caused by a rush of gas at a very high temperature, travelling from north to south. The destruction of Le Prêcheur and Ste. Philomène is attributed to torrents of mud, which overwhelmed them. No appreciable sinking of the sea bottom near the coast has been found.

EVIDENCE of the assistance given to agriculture by the Technical Instruction Committee of the Essex County Council is afforded by the report just published on the various branches of work carried on. Farmers within the administrative County of Essex can obtain from the County Laboratories, for a nominal fee, reports upon chemical, botanical and entomological specimens and materials. Thus, for the fee of one shilling for each subject, reports can be obtained upon the germinating power and purity of seed; the species of a weed or other plant, with a report on its nature and habits and any means of checking or destroying its growth; any disease affecting farm or garden crops; any insect or other pest affecting farm or garden crops, or stock, with advice as to its prevention or destruction. Work of this kind forms a very valuable part of the functions of Technical Instruction Committees in agricultural districts. The biological work carried on under the auspices of the committee has been of a very helpful character. To enable teachers in rural schools to obtain a knowledge of natural history sufficient to inspire interest in it in their pupils, class and field meetings were held during the year and proved very successful. The subject selected for systematic treatment was plant-life, considered in its broadest sense, so as to give the teacher-students a fairly interesting introduction to the wider subject of nature-study.

AT the meeting of the French Society for the Encouragement of National Industry held on June 13, the Minister of Marine announced that, following the recommendation made at the congress held at Zurich in October, 1900, as to the adoption of an international system of screw gauges, he had, with the concurrence of his technical advisers, decided to render the new system a service regulation so far as it concerned the heads and worms of screws. He had accordingly given instructions that for all sizes used in the French navy the length should be made equal to 1·4 diameters plus 4 millimetres (L = 1·4d. + 4mm.); so that from any one part every bolt could be distinguished at first sight from the bolts of other dimensions, either by the head or by the body of the screw; and that, leaving out exceptional cases, the sizes should be determined by the above simple formula.

THE twelfth international congress of the International Tramways Union and the second International Tramways and Light Railways Exhibition were opened at the Agricultural Hall, Islington, on Monday, by Mr. Gerald Balfour, President of the Board of Trade. Mr. Gerald Balfour, in proposing "The Union Internationale Permanante de Tramways," at the subsequent luncheon, remarked that in the industry represented by their own international union, he was afraid that this country had probably more to learn from distinguished friends who had come from the other side of the Channel than they had to learn from us. He hoped that this inferiority, of which he was painfully conscious, was not going to last for ever. In this country we had been taking a nap, but he thought he saw some signs of an awakening. It was with the introduction of the overhead trolley system that the supremacy of electric traction and light railways was established. He believed that this system was not so quickly appreciated in the United Kingdom as it was by our neighbours. The consequence was that we had undoubtedly got a little behind.

THE annual general meeting of the Marine Biological Association of the United Kingdom was held in the rooms of the Royal Society on June 25. The officers and council elected for the year 1902-3 were as follows:—President, Prof. E. Ray Lankester, F.R.S.; hon. treasurer, Mr. J. A. Travers; hon. secretary, Dr. E. J. Allen; council, Mr. G. P. Bidder, Mr. G. C. Bourne, Mr. Francis Darwin, Prof. J. B. Farmer, Dr. G. H. Fowler, Dr. S. F. Harmer, Prof. W. A. Herdman, Prof. G. B. Howes, Mr. J. J. Lister, Prof. E. A. Minchin, Prof. C. Stewart, Prof. D'Arcy W. Thompson and Dr. R. N. Wolfenden. The following governors are also members of council:—Mr. J. P. Thomasson (the prime warden of the Fishmongers' Company), Mr. E. L. Beckwith (Fishmongers' Company), Sir J. Burdon Sanderson, Bart. (University of Oxford), Mr. A. E. Shipley (University of Cambridge), Prof. W. F. R. Weldon (British Association for the Advancement of Science). Special reference was made in the report of the council to the loss sustained by the Association through the death of Mr. Robert Bayly, one of the governors of the Association, whose generous support and valued assistance contributed very largely to the successful establishment of the laboratory at Plymouth.

DEAN HOLE presided at the conference on roses organised by the Royal Horticultural Society in connection with the Coronation Show at Holland House on Tuesday, June 24. He had much to say in praise of the blossoms with which his name is associated, and having commented on the value of the papers to be read, called upon Mr. J. G. Baker, F.R.S., to give an

account of *Rosa stellata* and *R. minutifolia*, recently discovered in New Mexico and California respectively. These roses are characteristic, the first having its leaves, or rather the three terminal leaflets, arranged like those of a Potentilla and unlike any other allied species. *R. minutifolia*, as its name implies, has very small leaves which are deeply toothed. These forms are alike in having red flowers, and in habit they resemble the Scotch rose, *Rosa spinosissima*. Only the second species has as yet been grown in this country, and that with little success. The question of the origin of the hybrid tea rose was touched upon by the Rev. J. H. Pemberton in his general paper on this form. Mr. Alexander Dickson stated that as a result of almost a life's work in the hybridisation of roses he had not been able to reduce a single theory to a certainty, and not one feature as regards colour, shape or fragrance could the experimenter ensure in an artificial hybrid. The need for a strain of roses that will stand the English climate was emphasised by Mr. Edward Mawley. Many points of cultural interest were raised, and many papers will appear in the report which time did not permit of being read, such as those on "The Production of New Hybrid Roses," by M. Viviand-Morel, "Wild Asiatic Roses," by M. Maurice de Vilmorin, and "Recently Discovered Chinese Roses," by Mr. George Nicholson.

A PECULIAR appearance at and after sunset was noticed by a number of observers several evenings last week. Dr. C. B. Plowright, of King's Lynn, and some friends with him, observed after sunset a number of rose-red beams of light radiating upward in the western sky, with the sun as the centre. These beams were not of long duration, and changed in position and brilliancy in the course of a few minutes. Sometimes they extended 30° or 40° upwards towards the zenith. On Wednesday, June 25, the beams were brightest about 9.10 p.m. On Friday, 27th, the phenomenon lasted from about 8.50 to 9.10 p.m. After the beams died away, the upper part of the western sky was tinged by a delicate pink haze. Mr. A. R. Jenkin sends a similar account of the beams as seen by him at Trewirgie, Redruth, on June 27, at 8.45 p.m. He noticed at first "a pink glow low down in the south-east, exactly opposite the sun; this soon sent out streamers. Meanwhile, a pink patch of considerable extent had appeared about midway between the horizon and the zenith in the north-west above the sun, and this also quickly resolved itself into rays converging towards the sun corresponding to those in the east, so that at one time they could almost be traced right through the zenith, and one of the rays lower down to the north could be plainly seen right across from west to east. As the western glow increased so the eastern diminished, until at 9 p.m. there was nothing to be seen in the east, but in the west the rays were most striking. Appearing to rise out of a clear belt of lemon-yellow colour along the horizon, they extended high up into the sky. As the sun got further north below the horizon the rays rotated on their axis (the sun) in the opposite direction. They could be distinctly seen up to 9.20 p.m., when they had almost sunk into the belt on the horizon, which by this time was of a similar pink colour."

IT is officially declared that the statement recently made to the effect that the Meteorological Department in India has indicated the probability of a deficiency of rain, more especially in Gujerat, is incorrect. The Government of India have, however, decided not to make public the forecasts which the department submit to them from time to time, on account of the imperfect data on which such forecasts are necessarily based. The weekly reports which are sent home by the Government of India, and published in this country, give the most trustworthy indications that can be obtained, both of the actual facts and of the prospects for the future. The last of these reports, for the week ended June 22, stated that the monsoon had given heavy rain in the west coast districts, light rain in the Deccan and Sindh, and showers in Gujerat. Good rain has also fallen in Burma, Assam and Lower Bengal, and agricultural prospects up to the present are on the whole satisfactory.

THE discussion of the origin of eskers has led to a large amount of literature. Many geologists now believe that these winding ridges of glacial gravel are the product chiefly of the subglacial drainage of an ice-sheet. Mr. W. O. Crosby (*Proc.* Boston Soc. Nat. Hist., vol. xxx. May, 1902) seeks to show that under normal conditions the deposits of gravel and sand formed in a superglacial channel may be let down upon *terra firma* without obliteration and without loss of the distinctive features of an esker.

DR. S. HEPITES has recently issued the fifteenth volume (for 1899) of the *Analele* of the Meteorological Institute of Roumania. One of the most valuable memoirs contained in it deals with the rainfall of the kingdom, and is illustrated by a map drawn to the scale 1 : 1,000,000 and based on observations made during the fifteen years 1884-1898. Dr. Hepites also describes briefly six slight earthquakes felt during 1899.

EARLY last month the *Standard* and other newspapers contained reports of tremors and rumbling sounds observed on the night of June 3 chiefly in the west of Essex. The times given are not very exact, but were roughly about 11.15 and 11.45 p.m. The resemblance to earthquakes must have been somewhat close, several persons accustomed to earthquakes in other countries being convinced that the disturbances were of seismic origin. The long duration of the vibrations, however, and their apparent transmission through the air, point to an artificial origin, and there can be no doubt that they were caused by the firing of heavy guns that took place at the mouth of the Medway at about the times mentioned. The tremors were noticed and were attributed to earthquakes at places as far as North Mimms and Elstree in Hertfordshire, which are 46 miles from the mouth of the Medway, and at Little Shelford, near Cambridge, distant 55 miles.

THE third volume of the *Annales* of the National Observatory of Athens has been published recently. Besides the usual meteorological tables, it contains two memoirs by the director, Dr. D. Eginitis, one on the observation of shooting-stars at Athens during the years 1897–1899, and the other on the earthquakes felt in Greece during the year 1899. From the latter we learn that 567 earthquakes were recorded, the mean annual number for the six preceding years being 531. Of this large number, 421 were felt in Zante, though some were not entirely confined to that island. The most important earthquake was one that occurred on January 22 in the province of Triphylie on the west coast of the Peloponnesus. This was strong enough to throw down houses over a district 18½ miles long and 10 miles wide, though the total area disturbed was less than 15,000 square miles. It was recorded at Shide, in the Isle of Wight, the mean velocity to that station being 2·1 km. per second.

PHYSIOLOGISTS have during late years regarded hæmoglobin and its derivatives in the animal organism as occupying a somewhat analogous position to that of chlorophyll and its derivatives in the vegetable kingdom, a view which may be said to be the outcome of recent chemical and spectroscopical research. It is well known, for example, that these complex organic pigments produce characteristic absorption bands in the ultra-violet part of the spectrum. Just lately, however, it has been shown by MM. L. Bier and L. Marchlewski (*Bulletin International de l'Académie des Sciences de Cracovie*, April, 1902) that this fact is not apparent in the spectra of all the derivatives of the colouring matter of the blood (hæmoglobin); for these observers

have demonstrated by photographs of the spectra of bilirubin, biliverdin, urobilin and proteinchrom that the characteristic bands in the violet part are absent. But from this observation we must not necessarily infer that these organic pigments are not derivatives of hæmoglobin, for, as these investigators point out, the characteristic absorption bands in the violet area of the spectrum produced by the complex molecule of hæmoglobin may not depend on the constitution of the nucleus forming the basis of this complicated mother substance, but may arise from certain atomic groups which may not appear in some of its derivatives.

A CORRESPONDENT directs attention to the absence of any reference to Dr. Gaskell's work in the note in our issue of June 19 (p. 184) on Prof. Patten's account of the affinities of Trematapis. The same absence characterises Prof. Patten's paper, to which our remarks were restricted.

IN the geological series of publications issued by the Field Columbian Museum, Mr. E. S. Riggs describes the Triassic and Jurassic of the Rio Grande, Colorado, which have yielded so many remarkable dinosaurian remains. The paper is illustrated with some excellent photographic reproductions of the striking scenery of the district.

IN describing a species of "sand-fly" allied to *Ceratopogon albopunctatus*, Mr. W. R. College, in vol. xvii. part i. of the *Proceedings* of the Royal Society of Queensland, states that it is probably only the females of these irritating insects which attack human beings. Out of fifty specimens caught on the author's own hands, only one was a male. The sexes are readily distinguishable by the antennæ, which are plumose in the female and filiform in the male.

WE have received from the authors, Messrs. Eckel and Paulmier, a copy of a synopsis of the snakes of the north-eastern United States published in the *Bulletin* of the New York State Museum and forming the first instalment of a complete catalogue of the reptiles and amphibians of New York. In the present part the distinctions between venomous and harmless serpents are indicated in a clear manner, while the various species are well described and in many cases illustrated by figures of the head.

We have received from the authors copies of two papers relating to the iguanodons of Bernissart, in Belgium, and the nature of the country at the time of the entombment of their remains. The one, by Mr. L. F. de Pauw, who restored the skeletons, appears in vol. iv. of the *Memoires* of the Hainaut Scientific Society, while the other, by Prof. van den Broeck, is issued in the *Bulletin* of the Belgian Geological Society for the present year. Both writers support the view of Messrs. Cornet and Schmitz that the Bernissart iguanodons inhabited the margins of a lake, and not, as has been supposed, a narrow gorge cut in Carboniferous rocks and filled up by deposits of Wealden age. The features in the section which led to the promulgation of the latter view may be explained by earth-movements of post-Wealden age. Mr. Pauw has made an interesting restoration of a group of iguanodons round the old Bernissart lake, a photographic reproduction from which accompanies the memoir. The author believes that these reptiles often walked on all fours, especially when leaving the lake.

AMERICAN naturalists are devoting more and more attention to the mammals and other vertebrates of the Old World, and by means of vigorous collecting are adding largely to the list of species and races. In the *Proceedings* of the U.S. Museum, for instance, Mr. G. S. Miller describes a large collection of mammals from the Andaman and Nicobar Islands, in the course of which he names a number of mice, as well as other forms. No less than thirty-five species of mammals are definitely recognised from these islands. Another paper by the same author, dealing with oriental mammals, based on specimens collected by Dr. W. L. Abbott on the islands of the Malay and China seas, appears in the *Proceedings* of the Philadelphia Academy for March, and likewise contains descriptions of a number of forms regarded as new. In a third contribution, published in the journal last mentioned, Mr. A. E. Brown describes a collection of reptiles and amphibians from Borneo and the Liu-kiu Islands, in the course of which a few new names are proposed. In the case of mammals, forms inhabiting different islands, no matter how closely related, are regarded as distinct.

THE *Lancet* of June 21 publishes the report of a lecture delivered by Dr. Rose Bradford before the University College Medical Society on the relation of biology to medicine. After remarking that the subject may be regarded from three points of view—from its educational value, from its relation to practice, and the influence which it has exerted, and probably will exert, on the progress of medical research—the lecturer calls attention to the value of biological study, and more especially to the work of the field-naturalist, as a means of promoting accurate observation. Biological studies, both anatomical and physiological, have a further great advantage to the medical student in giving him a broader conception of the complexity of living matter than if he confines his studies to the human subject. In regard to the relation of biological study to medical practice and research, Dr. Bradford emphatically urges its importance, pointing out the number of diseases now definitely known to be due to animal or vegetable organisms, such as malaria and other blood-affections, and the morbid processes originated by the presence of funguses. It is further suggested that the true nature of cancer may be discovered by biological rather than by purely pathological researches. The lecture concludes by emphasising the importance of a careful study of variation and heredity to the medical practitioner who hopes to advance his profession.

THE Report of the Field Columbian Museum of Chicago for 1900–1901 indicates a continued and rapid progress of this institution. "Inappropriate and undesirable material," writes the director," is constantly disappearing, to be supplanted by that which is nearer the standard, and the Museum is doing *museum* work; while the laboratory and the study are not neglected, yet the fact that the Museum is dedicated to the enlightenment, instruction and in a measure to the entertainment of the public is not ignored, and those things calculated to advance this policy are those that most engage the attention of the officers of the institution. As a natural consequence, the general appearance of the Museum is never the same, constant additions, changes and renewals, &c., making the exhibition halls always fresh and inviting." The Field Museum was one of the first to adopt the system of mounting the larger mammals on artificial groundwork in imitation of their natural surroundings, and the Report before us contains a photograph of a big-horn sheep and another of a "sounder" of wart-hogs taken from groups in the Museum, which serve to show the careful and realistic manner in which the plan is carried out. An exhibit of much interest is a model of a limestone cave, with natural stalactites and stalagmite, and specimens of the animals which inhabit such situations. This model is lit up by electricity. The idea is so excellent that it might be adopted by other museums.

THE Hull coins and tokens in the Hull Museum have been described by Mr. William Sykes, an authority on the subject, and issued as one of the illustrated penny guides to th

collections of the Museum. We have previously drawn attention to this excellent series of museum publications, which is due to the energy of the curator, Mr. T. Sheppard.

THE sixth annual report of the New York Zoological Society gives a very favourable account of the progress of the "zoological park" now established on the northern confines of New York, so far as the plans of the Society have yet been carried out. The objects in contemplation by the founders of the association were the creation of a zoological garden with a special view to the preservation of the larger native animals of North America (now, alas! fast becoming extinct) and the

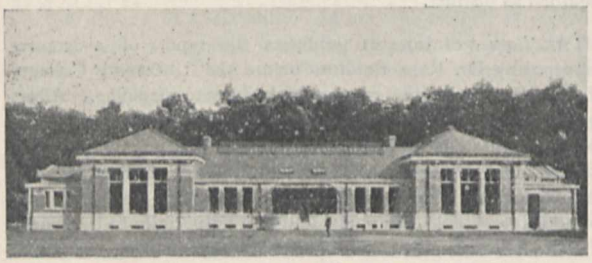


FIG. 1.—Primates' House.

general promotion of the science of zoology. Although the Society is of a private nature, its relations to the city authorities are of the closest kind, and are pronounced in the report on the whole to be in an extremely satisfactory condition. The various buildings in the park are making good progress. One of the chief of them, the "Primates' house," was completed and opened in December last with a series of 114 living specimens of the order Quadrumana, amongst which were two large examples of the rare Gelada baboon of Abyssinia, besides orangs, chimpanzees and gibbons. Of the collections of bears and the herds of prongbucks and other animals, good reports are also given, but as the new "park" contains an area of some 260 acres, it will take some time to fill it. We are glad to see

FIG. 2.—Prong-horned Antelope Herd in 1902.]

that the scientific element is well represented on the council of of the Society, as is testified by the names of Dr. Allen and Mr. Chapman, of the American Museum of Natural History, and of Mr. H. F. Osborn, of Columbia University. Besides these authorities, the director, Mr. W. T. Hornaday, is well known in zoological circles. The report is illustrated by a front view of the new Primates' house (Fig. 1), a sketch of the herd of prongbucks (Fig. 2) and other good plates. The present number of members of the Zoological Society of New York is stated to be 1182, which in such a populous and wealthy city might well, we think, be considerably increased if such a valuable institution were supported as it ought to be.

THE harpoon is the most complicated of the devices invented by uncivilised peoples. The harpoon is the climax of piercing inventions, and may be held in the hand or hurled from it with or without the aid of devices for propulsion. It has no limits in its application, being equally efficient on the land, in the air, in the water or through the ice, at long range or short range, with short shaft or long shaft, some examples being known in which the shaft is 100 feet in length. The simplest forms have three rude parts; the most highly developed have a score or more. With characteristic detailed description and wealth of illustration, Dr. Otis T. Mason has published a monograph on "Aboriginal American Harpoons: a Study of Ethnic Distribution and Invention," in the Report of the U.S. National Museum for 1900 (1902, p. 189). As the old whaleship has been replaced by the ship driven by steam, so the Eskimo at present kills the seal, the walrus, the whale and the Arctic land mammals with a rifle and explosive bullets instead of the ancient harpoon. Should the Eskimo use his great weapon at all it will be to retrieve his game on the edge of the ice after it is shot, and not as a killing device.

AN industry that promises to make progress in Russia consists in the manufacture of oil cakes from the seeds of the sun-flower, and (says the *Engineer*, June 20) good results have already been obtained. The seed with a proper crushing and treatment yields, roughly, 23 per cent. oil, 40 per cent. oil cake and 37 per cent. stalk; the stalk is also used for driving the machinery of the mill, and the ash by being further treated produces 25 to 30 per cent. of potash.

"THE Niagara Falls Power Plant as a Factor in Engineering Development" forms the subject of an instructive and impressive article in the editorial columns of the *Engineer* (Cleveland, June 2). The power of the Falls is practically unlimited, for the amount of falling water has been estimated by Prof. Unwin at 300,000 cubic feet per second, and this amount at a head of 165 feet would generate 10,000,000 horse-power. The plant as put down eleven years ago consisted of two-phase alternating current dynamos of 5000 horse-power (250 revolutions per minute), with a voltage of 2200 and a "frequency" of 25 cycles per second; these were coupled to vertical turbines placed in the wheel pit by shafting 136 feet long. The turbines were of double design, whereby at normal load the lifting action of the escaping water would balance the weight of the revolving parts of the machine. This plant, after eleven years' running, is about to be enlarged and a considerable increase of power derived from the falling waters, and thus we find record again broken at Niagara, where three generators (each of 10,000 horse-power) will be placed in the power house on the Canadian side and will form the nucleus of a plant with a 100,000 horse-power capacity. These generators will be double the size of the old ones and three phase instead of two phase, with a voltage of 12,000 as against the 2200 used before, and the "frequency" and speed will be the same, namely, 25 cycles per second of the former and 250 revolutions per minute of the latter. The transmission voltage in all probability will be fixed at 60,000, which, if adopted, will be 10,000 volts higher than that used in California by the Standard Electric Company on their famous long-distance line.

BOTANISTS who are desirous of filling gaps in their herbaria of cryptogamic plants will be interested to know that Mr. J. Brunnthalers of Johann Straussgasse, Vienna, has published a list of these plants which are for exchange or for sale. The series of Pteridophyta is exceedingly meagre, but the remaining groups are fairly well represented.

A BIBLIOGRAPHY of the analytical chemistry of manganese from 1785 to 1900 has just been published by Messrs. H. P.

Talbot and J. W. Brown, and forms part of vol. xli. of Smithsonian Miscellaneous Collections. The same volume contains a compilation of the statistics of the chemical societies of the world for the year 1900, by Dr. H. C. Bolton.

ACCORDING to a new patent of the Chemische Fabrik Griesheim-Elektron, lead dioxide is now produced electrolytically from a solution of an alkali chloride in which litharge is suspended. The dioxide is formed at the anode by the action of nascent chlorine and sodium hypochlorite on the sodium plumbite produced from the litharge and the sodium hydroxide set free at the kathode. No loss of chlorine takes place at the anode during this electrolytic process.

VOL. xxxvii. of the *Proceedings* of the American Academy of Arts and Sciences contains the results of an investigation of the decomposition of mercurous chloride by dissolved chlorides, by Messrs. T. W. Richards and E. H. Archibald. It is shown that this decomposition is quite considerable if the chloride solutions are fairly concentrated, a point of considerable importance in the analytical determination of mercury as mercurous chloride. The action is not of a catalytic nature, but a definite condition of equilibrium is set up, the dissolved mercury existing probably in the form of a complex ion represented by the formula $HgCl''_4$ in the solution.

WHILE admitting that the evidences of embryology, vestigial traces, and geographical distribution have rendered it indisputable that species have arisen in our world, not through creation in each fresh case, but through descent from other kindred species with variation, Mr. James B. Johnston maintains, in an article "What About Natural Selection?" in the *Contemporary Review* for July, that the proved influence of natural selection is being written down as less and less every day. The article is concerned only with the evidence of palæontology.

THE additions to the Zoological Society's Gardens during the past week include a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, presented by Mr. J. M. Hemingway; an African Tantalus (*Pseudotantalus ibis*) from West Africa, presented by Mr. C. T. Reaney; two Black Salamanders (*Salamandra atra*), an Alpine Newt (*Molge alpestris*) from the Alps, presented by the Rev. J. W. Horsley; a Common Viper (*Vipera berus*) British, presented by Mr. E. Ball; a Chacma Baboon (*Cynocephalus porcarius*), a Natal Sternothere (*Sternothoerus sinuatus*), from South Africa, a Ludio Monkey (*Cercopithecus ludio*) from West Africa, two Grey Lemurs (*Hapalemur griseus*) from Madagascar, two Azara's Opossums (*Didelphys azarae*) from La Plata, a Botta's Snake (*Charina bottae*) from North America, deposited.

OUR ASTRONOMICAL COLUMN.

CHANGES ON THE MOON.—The June number of the *Century Magazine* contains a popular account of the observations of the moon made by Prof. W. H. Pickering at Flagstaff, Arizona, and Jamaica, illustrated with pictures from drawings and photographs. Previous workers have already shown that some markings on the lunar surface were in all probability of a variable nature, but the new observations demonstrate beyond doubt that the surface of the moon is subject to distinct changes, and Prof Pickering gives some very decisive instances where radical alterations have actually been observed. Attention also is drawn to the existence of seas, canals and lakes on our satellite's surface, terms which have very generally been adopted with reference to the planet Mars, but which are employed here with the full understanding that they do not imply in any way the existence of water in the liquid form. These canals are described as being smaller than those on Mars, but broader in proportion to their length; in colour they are grey and yellowish-white. Many of the changes on the lunar surface are caused by the growth, as Prof. Pickering states, of the lunar vegetation itself, and he quotes a particular region situated just to the right of the central peaks of Eratosthenes where he observed the most marked change; reference is further made in some detail to the changes observed in some of the canals and lakes. The importance of these observations to selenography and the great interest attaching to them should undoubtedly stir up a new desire in many workers to follow and continue these researches, which require no very great instrumental equipment.

REMARKABLE NAKED EYE NEBULOSITY.—MR. W. H. Robinson, writing from the Radcliffe Observatory, Oxford, sends us a description of a curious object observed by him on May 28. Whilst observing with the Radcliffe transit circle at 11h. 19m. G.M.T., his attention was directed to a nebulous object about eight degrees from the zenith. "It was small, but bright and well defined, elliptic in form (major axis 2°, minor axis 1°·5), and situated about half-way between η Ursæ Majoris and α Lyræ, but a few degrees south. The object very much resembled the Præsepe when that cluster is visible in a somewhat hazy sky, an atmospheric condition which prevailed at this time. At first I supposed the object to be a comet, but was soon disillusioned on this point, for in a few minutes its evanescent character was revealed, and, gradually fading, by 11.30 G.M.T. it had entirely disappeared."

The position of the nebulosity was found by means of a star atlas to be

R.A. 16h. 15m.
Decl. + 44°.

The sky was watched until midnight for any return of the phenomenon, but nothing was seen except at about 11h. 42m., when a faint patch of light appeared for a few seconds only, about two degrees east of the above position. The luminosity was apparently not of an auroral nature, and Mr. Robinson suggests that it may have been the trail of a meteor, several instances of meteor clouds of this character having been recorded.

Other observations of the object observed on May 28, if forthcoming, would probably enable a determination to be made of its distance and nature.

A THEORY OF VOLCANOES.—In a forcible exposition of a theory which supposes high-tension terrestrial electricity to be the immediate cause of volcanic eruptions, M. A. Taquin, in the *Revue Scientifique* for June 14, brings together some remarkable observations of the connections between volcanic, solar, magnetic, and terrestrial electrical phenomena. The author provides for the disruptive forces and the heat which attend volcanic actions, by the discharge of this high-tension electricity, and then connects this electricity with the previously observed relations between solar, and terrestrial electrical and magnetic phenomena.

M. Taquin accounts for the remarkably sudden deaths of the inhabitants of St. Pierre by supposing that they were electrocuted, and proceeds to urge, in the following words, the establishment of observatories in volcanic districts:—"I am convinced that the study of the manifestations of terrestrial electricity in such districts will give us the means of foreseeing these volcanic eruptions."

THE FRENCH GEODETIC MISSION TO THE EQUATOR.—Commandant Bourgeois gives an interesting and detailed account of the first year's work of the French geodetic expedition in the *Bulletin de la Société Astronomique* (June, 1902). M. Bourgeois first explains that the *raison d'être* of the mission is "to determine certain elements by which to calculate the dimensions of the earth," and he then proceeds to answer the following self-imposed questions:—(1) What are these elements? (2) How are they to be determined? (3) Why is it necessary to make the observations in a place which is so distant and so difficult to reach? In answering these questions the author describes the inauguration, the organisation, and the journey of the mission to Riobamba, Ecuador, S.A., and also explains why Riobamba was fixed upon as the centre of operations. The whole report, which was communicated to the Société Astronomique, gives an instructive account of the work already achieved, and is illustrated by photographs which give the reader a clear idea of the methods pursued by the mission.

OBSERVATIONS OF NOVA PERSEI.—In No. 3796 of the *Astronomische Nachrichten*, Prof. E. E. Barnard gives a brief *résumé* of the various observations of the Nova which were made at Lick subsequent to July, 1901.

The spectrum of the Nova suggested that it might display the same peculiarity of focus that we find in regard to planetary nebulæ, but a series of observations made between August, 1901, and January, 1902, failed to give any indications of this phenomenon.

The determined position of the Nova with regard to fourteen stars in its immediate vicinity—of which Prof. Barnard gives a chart—agrees fairly well with that already published by Prof. Aitken (Lick Observatory *Bulletin*, No. 8), and a comparison of the two sets of observations confirms no real motion of the Nova.

The observations of brightness, which extend from July 30, 1901, to April 15, 1902, show a gradual decrease in the magnitude of the Nova, with occasional brightenings in which, however, there appears to be no definite periodicity. After special measurements, Prof. Barnard disagrees with the Potsdam magnitude of the reference star B.D. 43° 270 and uses his own estimated value, which is about 0·2m. fainter than that of Potsdam, *i.e.* it is 7·56m.

Careful observations with the great telescope have failed to reveal, visually, the nebulosity surrounding the Nova, the light of which is probably mainly photographic, nor has Prof. Barnard been able to discover the 12·0m. star recorded by Prof. Ceraski as being 0·3is. following and 7″ south of the present position of the Nova (*Astronomische Nachrichten*, No. 3755).

NEW VARIABLE STARS.—The two new variables, as given below, are recorded in No. 3796 of the *Astronomische Nachrichten*.

11, 1902, *Lyrae*.—Mr. Stanley Williams reports the variability of the star, the position of which, as measured on various negatives, is 19h. 7m. 37s.·4 +41° 3′·7 (1855); its magnitude ranges from 11·10 to 12·20. Examination of the various records shows that the brightness of this star was approximately the same, in September, in 1899, 1900 and 1901, so that its period is probably exactly one year, or possibly one half-year.

12, 1902, *Pegasi*.—Herr K. Graff reports the variability of the star, the position of which is 22h. 7m. 30s.·15 +14° 4′ 10″·0 (1902), its range of variability being from 8·7m. to 9·4m.

DELAY OF THE MINIMUM OF U CEPHEI.—In No. 3796 of the *Astronomische Nachrichten*, Mr. J. Plassman records a delay of about 2h. 27m. in the minimum of U Cephei, on April 27, after the time of minimum recorded at Münster.

EARTHQUAKE NOTES.

THE seventh and eighth numbers of the new series of publications issued by the Earthquake Commission of the Kaiserlichen Akademie der Wissenschaften in Wien respectively refer to earthquakes which have been noted in certain parts of the Austrian Alps and in the Carpathians. The first of these, by Dr. R. Hoernes, is a register of 208 shocks observed in Styria between the years 1000 and 1870. Many of these disturbances are described in detail, and to each description there is appended a criticism of the various sources from which the author has derived his information. To complete this work, earthquakes which shook Styria, but originated beyond its borders, have to be considered, and, lastly, the districts shaken and the lines along which shocks have been distributed have yet to be determined. In short, what E. Suess has done for lower Austria and H. Hoefer for Carinthia is to be done for Styria. The second publication, by Prof. W. Láska, is an historical account of the earthquakes of Poland. It refers to a period practically identical with that considered by Dr. Hoernes. The author commences by saying that "earthquakes in Poland are rare," but as reference is made to earthquakes of distant countries which were synchronous with observations made in Poland, the description of Galician shocks extends over thirty-six pages. As an example of these references we read that the first earthquake in 1834 occurred on January 23 at 8h. 45m. and was observed in Tarnopol. On the same day there was an earthquake in England, the epicentrum of which was five miles north of Chichester, and it is worthy of note that there was a similar coincidence in 1666. The probability, however, is that if we had before us a register of all the earthquakes of the world, a coincidence might be found for each of the Carpathian records. In the general remarks attached to these registers we find several interesting notes on the emotional effects produced by those who have predicted the occurrence of earthquakes on specified dates. An accidental realisation of a widely published prediction took place on February 27, 1786, with the result that processions were organised and prayers were offered that earthquakes should not only shake Poland, but that a few should be arranged for Prussia.

In November, 1900, Prof. E. Ōdone gave an account in the *Bollettino della Società Sismologica Italiana* (vol. vi.) of forms of apparatus he proposed to introduce into seismometry which did not have the character of pendulums. The object of the first piece of apparatus was to measure the relative motion of two points of ground separated by a short distance. A seismographic arrangement identical with that proposed by Prof. Ōdone was used in Japan in the years 1884 and 1885. It showed that for fourteen earthquakes the relative motion of the heads of two stakes 3 feet from each other varied between 1 mm. and ·08 mm. (*Trans. Seis. Soc.*, vol. xii. pp. 63–66). The second piece of apparatus has the character of a manometer, and in its improved form as now constructed is described in the *Rivista di Fisica* (Pavia), December, 1901. It consists of a chamber about 2 m. in height and holding 200 l. of water, embedded in the foundations of a wall. At the upper and lower ends of this chamber are two passages closed by sheets of iron. On one side these sheets are in contact with the soil in which the foundations are buried and on the other side with the water of the manometer. Should a shock be transmitted through the soil, these metal diaphragms are deflected, with the result that the water from the chamber rises in a small tube 0·85 cm. in diameter, which is attached to the upper end of the manometer. The effect of vibrations due to explosions of powder in mines—in one instance amounting to 10,000 kgr., the apparatus being at a distance of 1 km.—have been studied, and it is seen that the changes of level in the manometric gauge are such as can be easily measured. From this apparatus it is expected to obtain certain direct measurements of earthquake energy, and from a manuscript note attached to the copy of the paper describing the same it is also anticipated that it may record volcanic sounds.

STATISTICAL METHODS IN BIOLOGY.

THE third part of *Biometrika*, published in April, contains several important contributions, the first of which is by Prof. Karl Pearson, who describes "a systematic method of curve-fitting by moments." For practical purposes it is found that if good quadrature formulæ are used this method is as good as the well-known method of least squares, and in some cases is applicable where the older method fails. Examples of the application of the new method are given. A communication on the sources of apparent polymorphism in plants comprises an editorial introduction and four papers by Messrs. G. Udny Yule, W. L. Tower, Dr. Alice Lee and Prof. Karl Pearson, and Mr. Yule respectively. Those who have considered the "multimodal" character of many botanical distributions as furnishing evidence of the existence of subspecies or local races will find reasons for reconsidering their views in these papers. In this part also Prof. Pearson contributes a controversial paper under the title "On the Fundamental Conceptions of Biology," in which he deals with discontinuity, differentiation and variation, and replies to Mr. Bateson's criticism of his memoir on the principle of homotyposis published in the *Philosophical Transactions* (vol. cxcvii. pp. 285–379). Another controversial paper by Prof. Weldon deals with Prof. De Vries's first volume on the theory of the mutation of species ("Die Mutationstheorie," &c., Bd. 1, 1901). The facts adduced by De Vries in favour of this intermittent and apparently anomalous mode of evolution are considered by Prof. Weldon to be inconclusive, and he comes to the conclusion that the evidence is insufficient to warrant the acceptance of this theory in preference to the selection theory of Darwin.

Among other contributions we may call attention to Mr. Blanchard's paper on "grandparental inheritance," in which he emphasises the need for further experimental work on "blending" as distinguished from "alternative" inheritance, and suggests for this purpose insects and some of the smaller mammals. Miss Lewenz publishes the completion of an investigation first started by Miss Whiteley and Prof. Pearson on the variation and correlation of the bones of the hand in woman. The conclusion is suggested "that if efficiency depends on high correlation, it is not to external measurements of the skull that

we must look for tests of intellectual efficiency." Not the least interesting paper at the present time is Dr. W. R. Macdonell's note on the result of previous vaccination on the effect of small-pox when incurred. According to the abstract "he shows that the correlation of foveation and size of scar with severity of attack is only moderate, but that there is very considerable correlation indeed in all the recent epidemics, not only between recovery from, but between the severity of the attack and the existence of the scar." It has not hitherto been found possible to obtain statistical data for deducing the correlation between the presence of the scar and the habit of life of the persons attacked. To the miscellanea Mr. Yule contributes a note on local death rates. It is evident from this synopsis that the standard of the publication is being well maintained and that the new biometric methods are capable of extension over the most diverse fields of biological science.

AVIAN ORGANOGENY.[1]

DR. MITCHELL has already devoted considerable attention to the study of the intestinal tract of birds, and in the present contribution he gives us the results of his latest researches, which have embraced all orders of birds and many of the smaller groups.

Adopting the method of investigation pursued by Cuvier, the intestinal tract is removed from the body by severance at the plyorus and the cloaca, and along the mesentery close to the body-wall. Next, the cut ends of the gut are pinned down and its coils unravelled, until they stand revealed as a corrugated tube suspended by the ventral edge of the mesentery.

In tracts so displayed, Dr. Mitchell recognises three distinct loops, a duodenal, a rectal, and a large loop lying between these two which he calls Meckel's tract. The comparison of the varied forms which these loops take constitutes the subject of Dr. Mitchell's researches.

Evolution is rightly the key-note of this work, and accordingly the author starts with a detailed description of what he regards as the most primitive type of gut, from which all others have been derived. This type—found not, as one might have expected, in one of the Ratitæ, but in the ancient goose-like bird, Palamedea—he calls the archecentric type, whilst modified conditions thereof are distinguished as apocentric. Three kinds of apocentricity are recognised—multiradial, uniradial and pseudocentric. Multiradial apocentricities are those which are purely adaptive or homoplastic, and accordingly are of no value as indications of kinship, since they may, and do, occur repeatedly and independently in different groups. Uniradial apocentricities, on the other hand, Dr. Mitchell defines as complex modifications "of a kind that we cannot well expect to be repeated independently, and. . . . must be the most certain guides to affinity."

Not seldom a uniradial apocentricity will form a new centre around which new diverging modifications are produced, and such centres he proposes to call metacentric.

Pseudocentric apocentricity appears to be extremely common and very difficult to distinguish from the archecentric condition. Generally, however, its secondary nature is revealed by some small and apparently meaningless complexity.

The valuation and nomenclature of these characters form a special section of Dr. Mitchell's paper. It is extremely suggestive, and will be read with interest by many who are not directly interested in avian morphology.

The systematic description, which follows this discussion, occupies the bulk of the paper, the intestinal tract of every order of birds being reviewed, copious illustrations serving to bring out, not only the very striking modifications which have taken place, but also the difficulty of the work undertaken.

Space forbids us dwelling, as we would fain do, on this section and the summary thereof at greater length. Suffice it to say that the very remarkable modifications of these loops, which Dr. Mitchell has brought to light, are extremely interesting and very suggestive. We venture to doubt whether a good case has been made out for the position, near the Ralline forms, which has been assigned to the Tinamous. Markedly apocentric though they may be in the matter of their intestinal coils, yet we see no reason why they should not be allowed to remain among or very near the Ratitæ.

The concluding section, on "Characters and Classification," forms a most admirable summary. "In the systematic descriptive part," the author writes, "my task was to treat the characters of the patterns displayed by different birds as nearly as possible as if the gut were the whole animal, and the various phylogenetic figures and the three plates display what I take to be the relations of the intestinal tracts, and not necessarily the relations of the possessors of these tracts. I have been taking, in fact, the anatomical structure as the unit, and not the individual or the species. . . . Granting that the plates attached to this paper represent with approximate accuracy the phylogeny of the intestinal tract in birds, we have yet to learn the relation of the phylogenetic tree of this structure to the phylogenetic trees of other structures, and the relation of all these to the phylogenetic trees of those impermanent combinations of characters which we call species."

We would fain quote more of this interesting section, but enough has, we trust, been set down here to draw the attention of morphologists generally to a contribution which is at once valuable and suggestive, and likely to remain the standard work of reference on this subject for some years to come.

W. P. P.

[1] "On the Intestinal Tract of Birds: with Remarks on the Valuation nd Nomenclature of Zoological Characters." By P. Chalmers Mitchell, M.A., D.Sc. (*Trans.* Linn. Soc., vol. viii. part vii. 1901.)

PHOTOGRAPHY AS APPLIED TO ARCHITECTURAL MEASUREMENT AND SURVEYING.[1]

WHILE the impressions which a photographic picture yields to a casual observer may or may not be correct, the relationship which exists between a photograph and the objects the images of which are depicted is always definite, and a little careful attention in arranging the conditions under which a picture is taken will suffice to make easy the correct interpretation of it.

To understand the geometric nature of a photograph it must be noted and always remembered that for practical purposes a photograph is a surface of two dimensions, which for choice should be a plane surface, and it is only possible to obtain by photography exact copies of similar object surfaces, and these only when the surfaces to be copied are exactly parallel to the picture surface.

Under these conditions written or printed documents or drawings can be, and often are, copied by photography, so as to be practically exact copies of the originals. The copies may be the same size, or larger or smaller, but all proportionate dimensions will be the same, whatever the relative sizes of object and image may be.

To illustrate the first elementary principles of the subject a photographic picture of straight lines and right angles, arranged to form a set of regular squares, was projected on a movable screen. It was shown how, when the screen was parallel to the lantern slide, there was no perceptible bending of the lines and no perceptible enlargement or diminution of any of the angles, from which it might be concluded that there could have been no perceptible distortion in any part of the picture. By moving the screen nearer to, and further from, the lantern, it could be seen that while the forms of the squares remained constant their areas varied with the distance, in obedience to the ordinary laws of rectilinear radiation, from a point, and it was shown how a photographic picture may be legitimately regarded as being made up of a number of points, each one of which is at the picture end of a straight line, which may be taken for practical purposes to have travelled from a corresponding object point through a station point at the apex of a cone of rays radiating towards the picture.

The geometric relationship between distant objects and photographic images of those objects can be most easily appreciated if the lens is supposed to be replaced by a pinhole at the station point, when it is evident that a straight line from any point of the image to the pinhole will, if prolonged, pass through the corresponding object point, and *vice versâ*. Thus any number of true direction lines can be obtained at will.

For making plans, these direction lines can be projected as horizontal rays on a ground plane as in plane table surveying, and positions can be fixed on the plan by the intersection of

[1] Abstract of a paper, by Mr. J. Bridges Lee, read before the Society of Arts on April 16.

such rays from two stations, and checked by rays from photographs taken at a third station when the original intersections are not good or the identification of points doubtful.

When the positions on a ground plan have been fixed and horizontal distances from the different stations have become known, altitudes of points above or below the station can be ascertained by observing the position of the points on the picture and substituting values in a simple formula $h = d \tan \alpha$, where h is the height required, d is distance from the station

FIG. 1.—View from roof of Drummond's Bank overlooking Trafalgar Square.

point for the particular photograph under observation and tan α is $\sqrt{\frac{y^2}{x^2+f^2}}$, where x and y are abscissæ on the principal horizontal and vertical lines as rectangular coordinate axes and f is focal distance for the picture. The practical working of this method of plotting horizontal intersections for obtaining a ground plan and then computing altitudes was illustrated by reference to a series of survey photographs from the south and

FIG. 2.—View from corner of roof of Union Club overlooking Trafalgar Square.

west sides of Trafalgar Square, looking north-east and east, and a plan of the square and neighbourhood on which horizontal traces of the picture planes were drawn. It was explained how in practice the horizontal distances of points from the principal vertical line of a photograph are first set off on narrow strips of paper, which are then transferred to the picture traces on the plan and direction lines set off from the station points through the selected points on the strips, when in all cases the direction lines would pass through the corresponding points on the ground plan of Trafalgar Square and the visible region round. It was also explained how to compute the height of St. Martin's Church from the pictures.

Two of the pictures used for illustration are here reproduced. It will be seen that these pictures bear some markings on their faces which are not usually found on ordinary photographic pictures.

(1) The horizontal line right across the picture is the horizon line, which marks the trace of the horizon plane of the lens (or station). It contains the principal axis of the lens.

(2) The vertical line is the trace of the principal vertical plane, which also contains the principal axis of the lens and the station point.

(3) The intersection of (1) and (2) is the centre or principal point of the picture perspective.

(4) The scale at the top is part of a compass scale, and serves to show the magnetic orientation of the principal axis of the view, the vertical line serving as index.

(5) The scale immediately below, which stretches as a band across the picture, is a scale of reduced horizontal angles (a tangent scale to a great circle of a sphere of radius equal to the exact working focal length).

The MS. notes in the corners are memoranda originally noted on slips of celluloid by the photographer and put in place in special carriers before each picture was taken. All these markings were printed as latent images at the same time exactly and by the same exposure as the picture.

It was explained how all these markings were accurately obtained by aid of a simple mechanism specially designed by the author, who is responsible for introducing the system of recording automatically on the picture face information necessary for interpreting the picture, and how by aid of this information practical photo-surveying, which used to be often difficult, has become very easy and much more certain and accurate than formerly. The apparatus specially designed by the author and used for obtaining these pictures was shown and explained in some detail.

The lecturer concluded by expressing a hope that in due time a simple standard type of working camera, fitted with a good lens and accurate recording mechanism (which could be easily removed and replaced at will), would find its way into general favour, and that regular libraries of standard readable pictures of interesting objects would come into existence.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The following is the text of the speeches delivered by Prof. Love in presenting Dr. W. H. M. Christie, C.B., F.R.S., Astronomer Royal, and Dr. A. W. Rücker, F.R.S., Principal of the University of London, for the Degrees of D.Sc. *honoris causa*, at the Encænia, on June 24.

Inter mathematicos, qui Cantabrigiæ quattuor et triginta abhinc annos graduati sunt, clarum erat nomen Willelmi Henrici Mahoney Christie, nunc inter omnes omnium gentium astronomos clarissimum. Astronomorum profecto ille annus magno proventu floruit cum in eodem Tripode Georgii Darwin nomen contineatur. Ambo hi viri Collegii Sanctæ Trinitatis socii creati sunt, sed in astrorum scientia alter alteram insistebat viam. Ille solis stellarumque soli parentium ultimam vetustatem investigabat: hic noster se negotio utiliori dedit ut solis stellarum siderumque omnium et locos qui nunc sunt et motus accuratissime notaret. In hoc opere tantam peritiam adeptus est ut iam viginti abhinc annos et Astronomus Regius et Societatis Regalis Sodalis crearetur. Hoc gubernante fere omnia in Observatorio Regio maximo vel novata vel in melius mutata: neque enim id solum curavit ut novis instrumentis cederent vetera, sed ut eadem paullo immutata idonea fierent ad sidera observanda observationesque ita factas memoriæ tradendas quemadmodum iubent astronomi recentiores. Ita vir peritissimus et rem felicissime navavit et ærario publico pepercit. Summa eius in rem publicam merita agnovit Regina nostra Victoria quæ eum titulo Comitis de Balneo ornavit: insigni honore prosecutæ sunt Academiæ Parisensis Petropolitana aliæque complures quæ eum inter externos litterarum commercio sibi adiunctos receperunt. Huius nomine inter Doctores nostros inscripto monstrabit profecto Academia nostra se

memorem esse quantum et doctrinæ et hominum utilitatibus Astronomiæ scientia profuerit.

In Arturo Willelmo Rücker ornando Academia nostra honore prosequitur alumnum suum, virum in docendo in rebus administrandis in rerum natura cognoscenda præclarissimum. Hūius laudes agnovit Collegium Aenei Nasi, cuius olim scholaris erat, cum eum inter Socios honoris causa adsciscerent: agnovit etiam Societas Regalis quæ duodeviginti abhinc annos Sodalem creatum numismate etiam regio pro singularibus meritis donavit. Huic de tenuissimarum bullarum natura subtiliter quærenti contigit ut de magnitudine et ratione primarum illarum atomorum e quibus, ut antiquitus docuit Lucretius, omnis materia rerum constat, ipse multa reperiret, res altissimis tenebris abditas luce quadam scientiæ patefaceret et illustraret. Hic etiam de vi magnetica qua orbis terræ animatur peritissime disseruit, et insularum Britannicarum descriptionem magneticam denuo faciendam curavit. Neque ei satis erat ut Naturæ arcana ipse reseraret: idem, cum Britannicæ Societatis conventui præesset, contionem habuit luculentissimam de ratione quæ intercedat inter sententias philosophorum et physicorum de materia rerum docentium, quæ effecit ut multi de hac re loquerentur, plures cogitarent: idem in Regio Scientiæ Collegio Professor physicorum et in docendo et in rerum gubernatione summa laude inclaruit: eodem denique Secretario Societas ipsa Regalis tanquam in dapem omnium virorum doctorum naturam rerum ubique indagantium symbolam maiorem contulit. Hic vir tam impiger tamque ingeniosus qui omni hominum societati, quæ eo duce et auctore usa est, laudem et felicitatem semper attulit, nunc Academiæ Londinensi denuo constitutæ primus Præfectus latiorem profecto campum inventurus est in quo virtutes eius excurrant et cognoscantur.

CAMBRIDGE.—Prof. A. R. Forsyth, F.R.S., has been appointed a governor of University College, Liverpool, and will represent the University of Cambridge at the Abel Centenary to be celebrated in Christiania next September.

Mr. G. B. Mathews, F.R.S., senior wrangler 1883, has been re-elected to fellowship at St. John's College. At the same college Mr. J. H. Vincent, D.Sc. London, has been elected to a Hutchinson studentship for research in physics.

Mr. W. N. Shaw, F.R.S., secretary of the Meteorological Council, has been admitted to the degree of Doctor of Science.

The late Rev. Henry Latham, master of Trinity Hall, is succeeded in the mastership by Mr. E. A. Beck, senior tutor. The late master has left some 17,000*l.* to the University to form a benevolent fund, from which grants, annual or occasional, may be made to members of the University who are incapacitated for their academic duties by age or infirmity, and to their widows and families when these have been left inadequately provided for.

The complete degree of M.A. *honoris causa* has been conferred on Mr. T. H. Middleton, the new professor of agriculture. In presenting him the public orator referred to the short stay of Prof. Somerville, his predecessor in office, and added "Studiorum academicorum in provincia tam nova occupanda, speramus professorem nostrum novum iuventutis nostræ ingeniis excolendis multo plus quam biennium esse impensurum."

MR. G. W. RUNDALL, head master of the High School, Newcastle-under-Lyme, Staffs., from 1891 to 1900, has been appointed Registrar of the Teachers' Registration Council, Board of Education.

Mr. M. J. R. DUNSTAN, director of the Midland Agricultural and Dairy Institute, and director of technical instruction to the Notts County Council, has been appointed principal of the South-Eastern Agricultural College, Wye, in succession to Mr. A. D. Hall, who was recently appointed director of the Rothamsted Experiment Station.

THE Storey Institute of Science and Art at Lancaster was given to the town by the late Sir Thomas Storey to commemorate the jubilee of Queen Victoria. But though excellent work has been done in the Institute it has been handicapped in recent years by the want of accommodation for the technical and secondary departments. The handsome coronation gift of 10,000*l.* which Mr. Herbert L. Storey has just placed at the disposal of the Corporation of Lancaster, for the purpose of erecting a technical schoo on a site adjoining the Institute, will make a desirable educational development possible. Wealthy men in other centres should emulate Mr. Storey's public-spirited action.

THE Hartley Institution, Southampton, which has just been added to the list of University Colleges, and will in future be styled the Hartley University College, was founded in 1850, and has in recent years been greatly improved as a centre of scientific influence. The Institution is at present regulated by a scheme established by the High Court of Chancery in 1859 as altered or supplemented by eight schemes of the Charity Commissioners. The movement for the formation of a University College has been enthusiastically supported locally, and as soon as it became known that H.M. University Commissioners had pronounced the local University income to be 600*l.* short of the required 4000*l.* per annum, three gentlemen, interested in the College, combined together to supply the deficiency for this year, and the governing body was assured that the income should be maintained at the required sum in the future if a portion of the Treasury grant to University College was allotted to the Hartley University College. The College is primarily intended to provide the residents in the counties of Hampshire and the Isle of Wight, Dorset and Wilts with higher education, and is admirably situated geographically for that purpose. The south of England is generally supposed to be deficient in educational enterprise, and this is an additional reason why the activity which is being displayed by Southampton in the formation of this College should be welcomed by all those interested in education. It is felt that the present buildings of the Institution are inadequate for the growing number of students, and a movement is on foot for raising a sum of 100,000*l.* to enable the University College to be suitably housed. It is hoped that a beneficent millionaire will be found willing to interest himself in the scheme, and help in supplying a great deficiency in the educational equipment of the south coast. The principal of the college is Dr. S. H. Richardson.

ON June 25, in the House of Commons, the consideration of the Education Bill in Committee was resumed on the second clause, which empowers the new authorities to make provision for higher education. From the *Times* report, we learn that an amendment was moved with the object of introducing words defining the duties of the education authorities, and directing them to supply secondary, technical and higher education, and to provide for the organisation and coordination of all forms of education, including the training of teachers. It was not accepted by the Government, but a compromise was arrived at; and it was agreed that the authorities should take such steps, after consultation with the Board of Education, as might seem desirable to secure the training of teachers and the general coordination of education. An amendment was carried providing that the funds colloquially known as whisky money should be used without deduction by the county councils in promoting higher education. On Monday the Bill was again before Committee of the House. A proposal that the county boroughs should be exempted from the operation of the provision which restricts to 2*d.* the amount of the rate leviable for higher education was accepted by the Government. An amendment was brought forward empowering the Board of Education to authorise the county councils to strike a rate exceeding 2*d.* The clause gives the Local Government Board the right to increase the rate by provisional order on the application of a county council. Objection was made to this clause, and after discussion it was decided to dispense with the elaborate machinery of provisional orders and to substitute for it the simple assent of the Local Government Board to a proposed extension of the 2*d.* rate. The limit to the rating power for secondary education has thus been abolished entirely for county boroughs and conditionally for rural counties. Passing to the third clause, which proposed to give to the councils of boroughs with a population of more than 10,000 and to the councils of urban districts with a population of more than 20,000 the right to levy a penny rate for the purpose of supplying higher education, an amendment was agreed to on Tuesday conferring the same right on all non-county boroughs and urban districts. Another amendment which would have given non-county boroughs and urban districts unlimited rating power was negatived. After further discussion it was agreed that the clause as amended should stand part of the Bill.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 12.—"On the Parasitism of *Pseudomonas destructans* (Potter)." By M. C. Potter, M.A. F.L.S., Professor of Botany in the University of Durham College of Science, Newcastle-upon-Tyne. Communicated by Sir Michael Foster, K.C.B., Sec.R.S.

The author gives an account of his further study of the action of the cytase and toxin, secreted by this bacterium, upon the living turnip cell; and he has succeeded in tracing the passage of the bacterium into the cells, through the cell-wall. The observations were made from pure cultures, under the most rigid sterile conditions, by means of the hanging drop. The action of the cytase and toxin was surprisingly rapid; the swelling of the cell-wall and contraction of the protoplasm could be observed almost immediately, upon the introduction of the Pseudomonas. Within an hour and a half the cell was dead and its walls in an advanced stage of disintegration. The original cell was kept under observation for some days, and after patient and continuous watching certain of the bacteria were observed slowly forcing their way through the wall, until finally they emerged into the cell-cavity. The penetration of the wall was observed on several occasions, and numerous individuals could be seen in all stages of the process. The time required varied with the thickness of the wall, but on an average occupied about three hours.

Important evidence of the perforation of the cell-wall by *P. destructans* was also afforded by the method of paraffin sections; by fixing and double staining, the cell-wall and bacteria were distinctly differentiated, the latter being shown fixed in the actual process of perforating the wall, and various stages of penetration could be distinguished.

Experiments showed that the old and fully developed cuticle is apparently proof against the action of the enzymes excreted by *P. destructans*, but this parasite can readily effect an entrance into its host through the undeveloped epidermis of young and tender structures.

A comparison of the parasitism of *Botrytis cinerea*, as demonstrated by Nordhausen, presented an exact parallel. The point was established that this bacterium has the power of destroying the living cells of the turnip, and, subsisting upon their dead contents, continues to work its way through the host, and it thus acts in precisely the same manner as one acknowledged parasitic fungus.

Chemical Society, June 18.—Elimination of a nitro-group on diazotisation. Dinitro-*p*-anisidine, by Prof. Meldola and Mr. J. V. Eyre. When dinitro-*p*-anisidine is diazotised in presence of hydrochloric acid the 3-nitro-group is replaced by chlorine.—Preliminary notice of some new derivatives of pinene and other terpenes, by Prof. Tilden and Dr. H. Burrows. Pinene nitrosochloride, when treated with potassium cyanide in alcohol, is converted into pinene nitrosocyanide, a colourless crystalline substance melting at 171°. The latter reacts readily with various reagents, furnishing well-crystallised reaction products.—The colour-changes exhibited by the chlorides of cobalt and some other metals from the standpoint of the theory of electro-affinity, by Messrs. Donnan and Bassett. These colour-changes are shown to be due to the gradual dissociation of the complex molecules of the salts.—The stereochemical formula of benzene, by Mr. Marsh. A discussion of the various possible space formulæ of benzene and a reply to Graebe's objections to the stereocentric representation.—An accurate method of determining the compressibility of vapours, by Dr. Steele. A description of a special apparatus devised for this purpose.—A new type of substituted nitrogen chlorides, by Dr. Chattaway. The author describes a group of these substances containing three negative radicles directly attached to the nitrogen atom, such as dibenzoyl nitrogen chloride, $(C_6H_5CO)_2$:N.Cl.—The preparation of pure chlorine and its behaviour towards hydrogen, by Messrs. J. W. Mellor and E. J. Russell. The chlorine was prepared by electrolysis of fused silver chloride, and the hydrogen by the action of steam on sodium. Mixtures of these gases were found to be exploded by electric sparks even after several months' drying over phosphorus pentoxide.—Derivates of dibenzoyl mesitylene, by Mr. W. H. Mills and Dr. Easterfield.—The molecular condition of borax in solution, by Mr. H. S. Shelton. The author, from a series of measurements of electric conductivity of borax solution of diminishing concentrations, shows that hydrolysis into boracic acid and sodium hydroxide occurs to the extent of 4 per cent. at 25°.—On the union of hydrogen and chlorine, v. and vi., by Dr. Mellor. The author concludes that the chemical change occurring when moist chlorine is exposed to sunlight is due to interaction between the chlorine and the moisture contained in it. No intermediate compound, such as hypochlorous acid or chlorine monoxide, seems to be formed.—On some hydroxy-pyrone derivatives, by Messrs. Tickle and Collie. A description of hydroxydimethylpyrone and hydroxycomenic acid obtained by oxidising dimethylpyrone and meconic acid respectively with hydrogen peroxide.—The absorption spectra of phloroglucinol and some of its derivatives, by Messrs. Hartley, Dobbie and Lauder. The absorption spectra of phloroglucinol and its trimethyl ester are almost identical, whence it follows that the parent substance possesses an enolic structure.—Solubility of mannitol, picric acid and anthracene, by Dr. Findlay. An investigation of the general applicability of the rule recently observed by the author connecting the solubilities of substances.—Menthyl formylphenylacetate, by Messrs. Cohen and Briggs. A description of the principal properties of this substance is given differing in some points from those assigned to it by Lapworth and Hann.—Transformation of diacetanilide into aceto-*p*-aminoacetophenone, by Dr. Chattaway.—Nitrogen chlorides and bromides derived from *ortho*-substituted anilides, by Dr. Chattaway and Mr. Wadmore. A description of several members of this class obtained by the interaction of hypochlorous and hypobromous acids with the corresponding anilides.—Substituted nitrogen chlorides containing the azo-group, by Dr. Chattaway.—The action of chlorine and bromine on nitroaminobenzenes, by Dr. Orton. A description of *sym.* trisubstituted chloro- and bromonitroaminobenzenes obtained by the interaction of the above substances.—The transformation of diazoamido- into aminoazo-compounds and of hydrazobenzene into benzidine, by Dr. Chattaway. A new method of formulating these changes is suggested.—Tribromophenolbromide, by Mr. E. W. Lewis. The melting point of this substance when pure is 148°, not, as generally stated, 118°.

Royal Astronomical Society, June 13.—Dr. J. W. L. Glaisher, president, in the chair.—M. Bigourdan gave an account of the long series of observations of nebulæ which he is making at the Paris Observatory, his aim being to obtain accurate micrometric measures of a large number of nebulæ. M. Bigourdan presented to the Society two volumes of his observations, and also the volume of Pingré's "Annales Célestes," which the author had left in MS., and which M. Bigourdan had now edited and published.—Dr. Downing read a paper on the distribution of the stars in the Cape Photographic Durchmusterung. He had reduced the places of the stars to galactic coordinates, to investigate their distribution with reference to the Galaxy. The results showed a ring of bright stars nearly in the Galactic plane, stars in the groups mag. 6·5 to 7·0 being more uniformly distributed. After magnitude 8·0 there is a greater difference between the density of the polar and equatorial zones of the Galaxy. The Cape Durchmusterung agrees with the Bonn Survey in assigning an ellipsoidal form to the visible universe.—Mr. Thackeray read a paper on a comparison of Groombridge's and Struve's right ascensions of close circumpolar stars, prefacing it with an account of the life of Stephen Groombridge. The paper was accompanied by a table showing, from an independent comparison of a certain number of Groombridge's stars, that the probable error of an observation is about 0s.·053.—Mr. Filon read a paper on reduction of measures of Swift's comet (*a* 1899) from photographs taken with a portrait lens of 30-inch focus and 5-inch aperture. Apart from the intrinsic value of the comet places, it appeared of interest to determine the degree of accuracy obtainable from measures of stars on plates taken with an ordinary portrait lens, and to find if photographs thus taken would repay the labour of measurement and reduction. The author concluded that such plates can give star places accurate to about 0″·83 of arc.—Mr. Hinks read a paper on the reduction of photographs of Eros for the determination of solar parallax. He concluded that the direct comparison of simultaneous photographs by linear reductions is the most convenient method. He desired to propose that seven or eight observatories, spread over as long an arc of longitude as possible, should agree upon a common list of comparison stars, and measure all their plates taken within a period of nine days. It might then be possible to find out in two or three years whether Eros will give as good results for parallax as other less favourably situated minor planets.—A paper by Mr. H. C. Plummer, on the principle of the arithmetic mean, and other papers, were taken as read

Geological Society, June 11.—Prof. C. Lapworth, F.R.S., in the chair.—A descriptive outline of the plutonic complex of Central Anglesey, by Dr. Charles Callaway. The central complex of Anglesey was originally composed of diorite, felsite and granite. The gneiss and granitoid rock of the area, formerly regarded as sedimentary in origin, are now known to be plutonic masses.—Alpine valleys in relation to glaciers, by Prof. T. G. Bonney, F.R.S. The author discusses some hypotheses about the formation of Alpine valleys which have been advanced by Prof. W. M. Davis, but has left the Ticino Valley, on which the latter lays much stress, to Prof. Garwood, who has very lately visited it. Prof. Davis maintains that the upper and wider parts of Alpine valleys were excavated in pre-Glacial times, the lower and narrower portions during the Great Ice Age. The author tests this hypothesis by applying it first to the valley of the Visp, of the eastern arm of which, and of the "hanging valley" like a gigantic corrie, where Saas Fee is situated, he gives a description, pointing out that all parts are so connected that any separate explanation of their form is impossible. To obtain an idea of the condition of the Alps in Middle and Later Tertiary times, we may consider the effect of alterations of temperature, on the assumption (which, as he shows, is not likely to be seriously incorrect) that the altitude of the Alps during the greater part of their existence has remained unchanged. A rise of temperature of from 6° to 7° F. would have the same effect as lowering the district by 2000 feet; a rise of 10° would correspond with 3000 feet. In the latter case the Pennine chain about the headwaters of the Visp would be comparable with the range from Monte Leone to the Ofenhorn. With a rise of 14° glaciers would almost vanish from the Alps, for the snow-line would then be at 12,000 feet above sea-level. Thus glacial action in the Oligocene and Miocene ages would be a negligible quantity, and it would gradually become sensible during the Pliocene; but glaciers would not invade valleys now free from them until the temperature was some degrees lower than it is at present—in other words, can have only occupied these during a small portion of their existence. The author passes in review a number of other Alpine valleys, which lead to the same conclusion. He calls attention once more to the connection of cirques with valleys, to the impossibility of referring the former to glacial action, and to the unity exhibited by all parts of the Alpine valleys, touching upon some structural difficulties which Prof. Davis has been content to meet with hypotheses. Alpine valleys in all parts, as the author shows, indicate by their forms meteoric agencies other than glaciers, which can only have acted for a comparatively short time and have produced little more than superficial effects.—The origin of some "hanging valleys" in the Alps and Himalaya, by Prof. E. J. Garwood. Lateral valleys which enter the main valley marked by discordant grades in the Jongri district of the Sikhim Himalaya have been attributed by the author to Pleistocene elevation and super-erosion of the main valley by water. Similar valleys in the Val Ticino have recently been attributed to overdeepening of the main valley by ice. The author shows that there is no real proof of this, in fact the evidence seems strongly to point to fluviatile and not glacial erosion of the main valley. This is shown by the overlapping profiles and river-gorges situated both above and below some of these "hanging valleys," and by the fact that a greater relative amount of erosion has taken place towards the upper end of the main valley than at the lower, where the mouths of the "hanging valleys" are less elevated.

Zoological Society, June 3.—Dr. Henry Woodward, F.R.S., vice-president, in the chair.—Mr. Lydekker exhibited the mounted head of a male Siberian wapiti, and made remarks on the various forms of the wapiti met with in northern Asia.—Mr. G. A. Boulenger, F.R.S., exhibited a strap made of the skin of the okapi (*Okapia johnstoni*), which had been received in Belgium from the Mangbetta country (lat. 30° N., long. 28° E.) in December, 1899, a year previous to the arrival in this country of the two bandoliers upon which the name *Equus johnstoni* had been founded.—Dr. Forsyth Major exhibited a reduced photograph of the skin of a female okapi (*Okapia johnstoni*), recently received by the Congo State Museum at Brussels, together with the skeleton of a male. Dr. Forsyth Major also made some remarks on this material, which had been handed over to him for publication.—Mr. E. J. Bles exhibited and made remarks upon some living tadpoles of the Cape clawed frog (*Xenopus laevis*). This species had bred in the Society's Gardens, and the event had formed the subject of a paper in the Society's *Proceedings* by Mr. F. E. Beddard (*cf. P.Z.S.* 1894, p. 101), but Mr. Bles was able to supply some additional particulars.—Mr. Lydekker described the head and skin of a wild sheep from the Thian Shan, recently presented by Mr. St. George Littledale to the British Museum, as belonging to a new subspecies, which he proposed to call *Ovis sairensis littledalei*. He also exhibited and described a specimen of the sheep named by Severtzoff *Ovis borealis*, which had been brought home by Mr. Talbot Clifton from the Yana Valley.—A communication was read from Dr. R. Broom containing an account of the differences exhibited in the skulls of Dicynodonts from the Karroo deposits of South Africa. The author was of opinion that these differences, in many cases, were not specific, but were due to sex, and, consequently, that many of the specimens which had received specific rank really belonged to the same form.—Mr. F. E. Beddard, F.R.S., read a paper on the gonad ducts and nephridia of the annelid worm Eudrilus, in which supplementary facts to those already ascertained by previous authors concerning these organs were adduced.—Dr. C. I. Forsyth Major read a paper on the pigmy hippopotamus from the Pleistocene of Cyprus, in which he described the fossil remains of *Hippopotamus minutus*, Blainv., exhibited by the author at the meeting of the Society on April 15. The characteristic features of this primitive hippopotamus were pointed out, and reasons were given for the assumption that the type-specimens of the species, Cuvier's *Petit Hippopotame fossile*, supposed to have been found near Dax in the Landes, had been brought over from Cyprus.—Mr. Hamilton H. Druce contributed a paper containing remarks on several species of butterflies of the family Lycænidæ from Australia, especially in reference to those described by Herr Semper. He also read descriptions of several apparently new species of the same family from the Eastern Islands and from Africa.—Mr. R. I. Pocock read a paper which dealt with the habits of the littoral spiders belonging to the genus Desis. The seven known species were enumerated, and one of them was described as new, under the name *Desis kenyonae*.—Mr. H. R. Hogg contributed a paper which contained additional information concerning the Australian spiders of the suborder Mygalomorphæ. Out of a collection of forty specimens (comprising examples of eleven species and nine genera) received by the author, no less than nine species and five genera had proved to be new, and were described in this paper.

EDINBURGH.

Royal Society, June 2.—Dr. Ferguson in the chair.—Prof. Metzler communicated a paper on some identities connected with alternants and with elliptic functions, in which it was shown that an identity established by Cayley and discussed by Muir, and believed by them to be of general validity, was not true in a particular set of cases.—Prof. A. Smith read a paper on amorphous sulphur and its relation to the freezing point of liquid sulphur. He showed that the freezing point, which in books is stated to be very variable within certain limits, was determined by the amount of amorphous sulphur present. When the amount of amorphous sulphur present was plotted against the freezing point an almost perfect straight line was obtained, indicating 119·25 as the freezing point of liquid sulphur quite free from the amorphous form, although practically that had never been obtained. Taking this value and estimating the depressions of the freezing point due to the presence of the amorphous sulphur, he calculated the molecular depression by means of van 't Hoff's formula and finally found 7·6 as the estimated molecular weight of amorphous sulphur—a value which under the difficulties of the experiment was a good approximation to 8.—Dr. W. Peddie, in a paper on the use of quaternions in the theory of screws, &c., showed how by a new interpretation of the scalar and vector parts of a quaternion a screw could be completely symbolised, and the whole theory developed in a compact and systematic way. The direction of the axis of the screw was determined by the direction of the vector part of the quaternion, and the scalar part of the quaternion represented the associated translation, the pitch being the ratio of the scalar to the tensor of the vector part. Any quaternion so regarded represented a screw through the origin; but the same quaternion could be made to represent a screw with axis not passing through the origin by breaking up the vector part into two portions, one of which represented the displacement, while the other represented the axis and with the scalar gave the pitch.—Dr. Hugh Marshall contributed a short paper on the dissociation of the compound of iodine and

thiourea, in which it was shown that in aqueous solutions of the compound there appears to be a complex balanced action of the kind represented by the equations

$$2CSN_2H_4 + I_2 \rightleftharpoons (CSN_2H_4)_2I_2 \rightleftharpoons (CSN_2H_4)_2^{\cdot\cdot} + 2I'.$$

The addition, to such a solution, of any substance which diminishes the ionisation results in increased dissociation, as shown by the increased intensity of the colour of the solution.

PARIS.

Academy of Sciences, June 23.—M. Bouquet de la Grye in the chair.—New researches on batteries founded on the reciprocal action of two liquids, by M. Berthelot. The smallest amount of hydrogen visible in a voltameter of special form after one minute was determined for pressures of 760 and 5 mm., in the latter case 0·000014 mgr. This sensitive voltameter was then applied to the determination of the minimum electromotive force required to produce visible decomposition, and to measure the effects produced by liquid batteries.—The properties of a certain anomaly which is capable of replacing the anomalies already known in the calculation of the disturbances of the minor planets, by M. O. Callandreau.—The influence of the photographic magnitude of stars upon the scale of reduction of a negative, by M. Prosper Henry. Instead of comparing the results obtained by eye and photographically as has been proposed by Gill, a purely photographic method is here suggested. A portion of the sky is photographed upon a given plate first with a short exposure and then with prolonged exposure, the pointer micrometer having been slightly displaced between the two exposures. The results of the application of this method with the large objective of the Paris Observatory are now given.—The extension of the kathode hypothesis to nebulæ, by M. H. Deslandres. The light emitted by nebulæ has been attributed by Arrhenius to electrified particles, by Nordman to Hertzian waves, but the author regards both these explanations as inadmissible, since, for the same reason, the earth's atmosphere at night should glow with an equal lustre. The kathodic hypothesis appears to offer a better explanation.—On algebraic continued fractions, by M. R. de Montessus de Ballore.—Researches on actino-electric phenomena, by M. Albert Nodon. When light rays or ultra-violet rays are thrown upon a thin conducting plate they give rise, on the dark face of this plate, to radiations analogous to X-rays. They differ from kathode rays, since they easily pass through metals and black paper, and appear to possess properties intermediate between X-rays and radium rays.—On a phenomenon observed on an excitor, the spheres of which are connected to a Ruhmkorff coil, by M. H. Bordier.—The effect of self-induction on the ultra-violet portion of spark spectra, by M. Eugène Néculcéa.—On the heats of dilution of sodium sulphate, by M. Albert Colson.—The chlorinating properties of a mixture of hydrochloric acid and oxygen, by M. Camille Matignon. Gold, tellurium and platinum are attacked by a mixture of oxygen and pyrochloric acid at temperatures much below the temperature of reaction between hydrogen chloride and oxygen. The mixture may in certain cases replace chlorine.—On the acidity of pyrophosphoric acid, by M. H. Giran. By a study of the heats of neutralisation and heats of solution of the sodium pyrophosphates, the conclusion is drawn that pyrophosphoric acid is a tetrabasic acid, the acid value of each of the hydroxyl groups being identical.—The displacement of strong bases by ammoniacal copper oxide, by M. Bouzat.—On the phenyl migration of phenylethylene and its derivatives, by M. M. Tiffeneau. Evidence is given showing that in several instances the migration of the phenyl group is probable.—Study of the action of selenyl chloride upon erythritol, by MM. C. Chabrié and R. Jacob.—On dibenzoylhydrazobenzene, by M. P. Freundler. MM. Biehringer and Busch have recently described a new mode of decomposition of diazo-compounds by means of copper powder, in which dibenzoyl-hydrazobenzene is stated to be formed. It is here shown that the compound really formed in this reaction is benzanilide, the benzoyl derivative of hydrazobenzene possessing entirely different properties.—Acyl derivatives of isopyromucic acid: the acetate, benzoate and pyromucate of isopyromucyl, by M. G. Chavanne.—Chemical analysis of *Piper Famechoni* or Kissi pepper, by M. A. Barillé.—On the phenomena of migration in ligneous plants, by M. G. André.—On the composition of ewe's milk, by MM. Trillat and Forestier.—On the estimation of organic nitrogen in water, by M. H. Causse.—Analysis of the mode of action of lecithins upon the animal organism, by MM. A. Desgrez and Aly Zaky.—Orthogonal skiagrams of the thorax; their use for the localisation of anomalies and for the measurement of organs, by M. H. Guilléminot.—The physiological secretion of the pancreas, by MM. C. Delezenne and A. Frouin.—Physiology of the heart in some colonies of compound Ascidians, by M. Antoine Pizon.—On the idea of depth applied to African metalliferous layers, by M. L. de Launay.—On the presence of Carboniferous strata in Tidikelt, Sahara, by M. G. B. M. Flamand.—Reproduction of some Palæolithic figures drawn on the walls of the grotto of Font-de-Gaume (Dordogne), by MM. Capitan and Breuil. Four reproductions are given, three of the bison and one of reindeer.—On the colouring matter used in the figures described in the previous paper, by M. Henri Moissan. The colours are ochres formed of the oxides of iron and manganese.—The cyclone at Javaugues (Haute-Loire), on June 3, 1902, by M. Bernard Brunhes.

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