THURSDAY, AUGUST 8, 1895.

THE STUDY OF INSECTS.

A Manual for the Study of Insects. By Prof. John Henry Comstock and Anna Botsford Comstock. Pp. 701. (Ithaca, N.Y.: Comstock, 1895.)

THE present work is very much on the same lines as Dr. Packard's well-known "Guide to the Study of Insects," though somewhat more popular, and dealing still more exclusively with North American entomology, of which, on the whole, it furnishes an admirable compendium. It is got up in a very attractive form, and is crowded with illustrations, the woodcuts being chiefly from engravings from nature by Mrs. Comstock.

The first chapter is devoted to a brief explanation of the principles of zoological classification and nomenclature, in the course of which we meet with a system of trinomial nomenclature for sub-species, or constant varieties, which has not hitherto been much patronised by entomologists. Thus, with reference to a common American swallow-tail, Prof. Comstock writes:

"This name, *Jasoniades glaucus*, is used when reference is made to the species as a whole. But if one wishes to refer to the black form alone, it is distinguished as *Jasoniades glaucus glaucus;* while the yellow form is distinguished as *Jasoniades glaucus turnus*."

Surely this is too complicated and clumsy a system for ordinary use!

The second chapter deals with "Insects and their near relatives," and includes a brief definition of the branch (or, as it is more commonly called in England, sub-kingdom) Arthropoda, and a table of the four classes *Crustacea*, *Arachnida*, *Myriapoda*, and *Hexapoda*, or insects. The *Crustacea* and *Myriapoda* are very briefly noticed, though a few typical forms of each are figured; but the *Arachnida* receive more attention, the orders and principal families, especially of the *Araneida*, being briefly discussed, with notices of their chief peculiarities and habits. As an illustration of the author's style in the more popular parts of his book, as well as embodying a curious phase of cannibalism, we may quote the following passage from p. 24:—

"Fig. 23 represents the large egg-sac of one of the cobweavers. This is made in the autumn, and contains at that season a large number of eggs—five hundred or more. These eggs hatch early in the winter; but no spiders emerge from the egg-sac until the following spring. If egg-sacs of this kind be opened at different times during the winter, as was done by Dr. Wilder, the spiders will be found to increase in size, but diminish in number as the season advances. In fact, a strange tragedy goes on within these egg-sacs; the stronger spiders calmly devour their weaker brethren, and in the spring, those which survive emerge sufficiently nourished to fight their battles in the outside world."

The remaining chapters are taken up with a sketch of the seventeen orders of insects admitted by Prof. Comstock, with special, and indeed almost exclusive, reference to the North American species. These chapters differ very much in length and importance, the space allotted to some of the smaller orders being barely a couple of pages, while the chapter on *Lepidoptera* alone occupies nearly a third of the volume.

The interest of the book is much enhanced by the illustrations; and in speaking of the *Membracidæ*, one of the families of *Homoptera*, Dr. Comstock observes: "Nature must have been in a joking mood when tree-hoppers were developed"; and the row of "odd fellows" at the foot of p. 154, where this observation occurs, fully bears out the remark.

But it must not be supposed that this book is too popular to appeal to serious students; far from it. Some of the smaller orders of insects are, indeed, passed over with but slight notice; but in the larger ones, we meet with elaborate descriptions of structure, and dichotomous tables of the principal families, which are afterwards discussed in greater detail, and in most cases one or more of the representative American species are figured, frequently with transformations.

Although, as a rule, America suffers more from insect pests than Europe, yet there seem to be exceptions which we should hardly anticipate. Thus Prof. Comstock informs us (p. 103) that "The earwigs are rare in the North-Eastern United States, but are more often found in the South and on the Pacific coast," and the native American cockroaches also are regarded by him (p. 106) as harmless, the destructive species, as in England, being all imported insects. Among these, he mentions the "Croton Bug," as he calls *Phyllodromia germanica*, as infesting "the vicinity of the pipes of the water-systems of many of our cities." In England, this species is particularly numerous in bakeries.

Under the *Fulgoridæ* (Lantern-flies), Prof. Comstock refers to "the fact that they are phosphorescent," apparently being unaware that the statement is very greatly doubted, though it is perhaps premature to say that it has been actually disproved.

A great many figures of neuration of *Lepidoptera* and other insects are given, all numbered according to a uniform system which Prof. Comstock has adopted from Redtenbacher, with modifications of his own, but which is unfortunately not fully explained in the work before us.

English names are given to most of the insects noticed, some of them being rather grotesque. Thus, at p. 274, we find a figure of "The Firstborn Geometer" (*Brephos infans*), with the explanation on the following page: "As this is probably the most primitive geometer occurring in our fauna, we suggest the popular name Firstborn for it." This is not the first occasion on which we have had occasion to animadvert on the introduction of crude speculations on the course of evolution, as if they were established or probable facts.

It is perhaps worth noticing that Prof. Comstock places the *Lepidoptera* between the *Myrmeleonidæ* and the *Diptera*. He has a peculiar classification of his own, which we have not space to indicate in detail; but he makes the *Hepialidæ* and *Micropterygidæ* a separate sub-order under the name of *Jugatæ*, and after it he places the *Frenatæ*, in which he includes all the remaining families, commencing with the *Megalopygidæ*, *Psychidæ*, *Cossidæ*, &c., and ending with the "super-family" *Saturniina*, the "families" *Lacosomidæ* and *Lasiocampidæ* (apparently not referred to any "super-family"), and the butterflies, including the "super-families" *Hesperiina* and *Papilionina*, in a reversed order, terminating with the Nymphalidæ, sub-family *Satyrinæ*. In the butterflies, Dr. Scudder has been chiefly followed.

The family *Papilionidæ* supplies us with an illustration that the book is only written primarily for American students; for the *Papilioninæ* are distinguished by the black ground-colour, the tail, and the five-branched radius of the fore-wings; and the *Parnassiinæ* by the white tail-less wings and four-branched radius, characters not universally exact, though amply sufficient to distinguish the North American forms.

A curious fact is noticed by Prof. Comstock with reference to the Garden Whites. He tells us that the native American species—*Pieris oleracea* and *Pontia protodice*—have both become greatly lessened in numbers by the increase of the imported European *Pieris rapæ*.

Another curious fact noticed by Prof. Comstock is that the dog-flea is the common flea of the United States, the true *Pulex irritans* being comparatively rare; while the importance of counter-checks in agricultural entomology is illustrated by the author's remark: "Nothing more wonderful has been accomplished in economic entomology than the subduing in California of the cottony-cushion scale by the introduction from Australia of a lady-bug, *Vedalia*, which feeds upon it."

We cordially commend Prof. Comstock's book to European, and especially to British, entomologists: for, although it is written mainly for American students, it contains much which entomologists of other nations will find both useful and instructive. W. F. K.

AGRICULTURE AND HORTICULTURE.

Agriculture, Practical and Scientific. By James Muir, M.R.A.C. Pp. 350. (London: Macmillan, 1895.)

Agriculture. By R. Hedger Wallace. (London and Edinburgh: W. and R. Chambers, 1895.)

The Horticulturist's Rule-Book. By L. H. Bailey. Third edition. (London and New York: Macmillan and Co., 1895.)

PROF. MUIR'S neat and presentable volume is the latest claimant upon the indulgence of the agricultural public, the number of readers—and what is more to the point, the number of students—amongst whom is undoubtedly steadily increasing. Commencing with a discussion of the plant, the author speedily falls back upon the soil as the staple of his discourse, though parenthetically he introduces a chapter on plant food in the soil. Then we get the inevitable section on the British geological formations, which has about as much relation to the living art of agriculture as a list of our kings and queens has to a true understanding of English history. Drainage, irrigation, and other processes for ameliorating the soil are next discussed, and then half a dozen chapters are devoted to the important subject of manures. Implements and machines are next briefly glanced at, and the remainder of the book is occupied by chapters on the chief crops of British agriculture. We believe that, well-worn as the theme is, there is still room for novelty in the treatment of agriculture as a book subject, but Prof. Muir does not appear to have hit upon it.

Live-stock constitute the backbone—the sheet-anchor—of British agriculture, and to omit all reference to this indispensable section of our greatest national industry in a book bearing the comprehensive title of the volume under notice, is a blemish upon the work. No one would ever infer from its name that the volume is silent upon the great subject of sheep husbandry, which has become so inextricably—and we may add so advantageously—interwoven with the arable farming of this country. Nor would any one expect, in a book on "Agriculture, Practical and Scientific," to find no allusion to the milk-pail and the cows that fill it, and no mention of the butter and cheese industries. The author recognises that agriculture embraces "the breeding, feeding, and management of all kinds of farm live-stock," but it is not till the reader begins perusing its pages, that he learns that the work "will not attempt to deal with" this part of the subject. In this matter, the author had nobody but himself to please, and all we venture to say is that the title of the volume should have fitted its contents. A work on "agriculture" that ignores live-stock might fairly be compared to a treatise on chemistry that made no mention of carbon.

The part of the work that is best done is that relating to crops, and had Prof. Muir chosen to confine himself to this branch of farming, he would not have acted unwisely. His skilful treatment of this section of the subject serves to revive the recollection of John Wilson's admirable work in the middle of the century. But the most important cropping of all—that of grass land—is inadequately treated, though it is abundantly evident, from the few pages allotted to this subject, that the author might usefully have given more space to it at the expense of one or two perfunctory chapters which would not have been missed. The processes of hay-making and ensilage are well described, yet here again the idea arises that the author felt he was approaching his limits, and the result is that he appears to exercise a restraint which we feel sure has operated to the disadvantage of the reader. A feature of the work that will be much appreciated is that it reproduces in a handy form many of the tabular statements that have from time to time been published in the *Journal* of the Royal Agricultural Society of England. Three dozen illustrations accompany the text, and those of seeds are particularly noteworthy for their fidelity.

Commending the book, then, for its trustworthy treatment of farm crops, we may notice one or two features that seem to call for criticism. The index is sometimes relied upon for the introduction of terms not given in the text. Thus, "nitrification" is indexed as dealt with at page 25, turning to which the reader finds the process described, but no name given to it, unless perchance the term "oxidation" is inadvertently used instead. Other similar cases occur. A highly important subject to farmers, the temperature of germination, is surely awarded scant treatment when it is dismissed in the brief paragraph: "The temperature most favourable to germination varies in the seeds of different plants." Such frequent recourse is made by the author to the work of Lawes and Gilbert, that it is regrettable he did not imitate the consistency with which they employ the term "nodules" to denote the outgrowths on the roots of papilionaceous plants. The repeated use of the word "tubercle" can only lead to confusion, especially now that, in connection with bovine and other tuberculosis, it is so frequently heard at agricultural gatherings. Several peculiarities in spelling, adhered to throughout the work, might in a new edition be brought into conformity with general usage: examples are afforded in *Telletia*, *Cecydomyia*, *Centorhynchus*, *Sitona*, *Chonopodium*, *Claviceps purpura*.

It is difficult to understand why the second of the volumes of which the titles head this notice has been prepared, unless it be to find favour with candidates in a certain specified examination, the syllabus of which, however, the author tells us, "has not been slavishly followed." The really valuable parts of the book have apparently been culled from the writings of five living agricultural authors whose names are mentioned in the preface, and who, if they turn over the pages of this compilation, can hardly fail to alight upon much that they have seen before. It is regrettable that the author did not cling to his guides throughout. He would not in that case have said of sainfoin: "In appearance the leaves resemble those of vetches, but the blossom is more like that of red clover." Apart from the worthlessness of such a statement as this, it cannot fail to raise a doubt as to whether the author has ever seen a field of sainfoin. Again, with reference to lucerne, we read: "Like sainfoin, it produces good crops for about ten years." Where, we would ask, is the district in which sainfoin stands for anything like this period? What is meant by the statement that "sainfoin is much harder than lucerne"? The germination of a seed is described as "the period parallel to the sucking of a young mammal"; and elsewhere we read, "nitrification goes on or acts more quickly under circumstances favourable for rapid growth, and in this respect is parallel to germination." Nothing, perhaps, indicates the character of the book more thoroughly than the page of illustrations entitled "Various Specimens of —— s Grass Seeds." We omit the name of the seedsman, who probably would be sorry to claim that a seed of rye-grass, for example, sold by him is different from all other rye-grass seed.

The 350 pages of the book are divided into no fewer than 70 chapters. *Inter alia* a treatise on chemistry is introduced, with figures of a spirit-lamp and test-tube. From a chapter on "Blossoms and their functions," we cull the following specimen of literary grace: "We are apt to look upon them merely as objects created to feast man's eye with their beauty, or his nose with their sweet scent." The language of the book is of an irritating style, which is constantly in evidence from the grammatical blunder at the close of the preface down to the final chapter, in which reference is made to what "the plant needs to live healthy." It is, however, only fair to add that, at the outset, the author writes: "It has been my endeavour to avoid errors."

The sub-title of Mr. L. H. Bailey's book—"A compendium of useful information for fruit-growers, truck-gardeners, florists, and others"—indicates its scope. In a score of chapters such subjects are dealt with as injurious insects, insecticides, plant diseases, fungicides, lawns, grafting, seeding, storing of fruits and vegetables, the weather, and many other matters of practical interest. It is stated in the preface: "The contents of the volume have been gleaned from many sources; and, whilst the compiler cannot assume the responsibility of the value of the many recipes and recommendations, he has exercised every care to select only those which he considers to be reliable." The result is a most valuable book, and though intended primarily for American readers, it will none the less constitute a useful reference manual for horticulturists in this country. We notice, with regard to potato disease, that it is recommended to spray the plants with Bordeaux mixture "upon the first indication of the blight." It would probably be better to follow the advice, recently published by the Irish Land Commission, to spray before the appearance of disease, and thus employ the application as a preventive rather than a remedial measure. It is when the reader meets with such a remark as the "marsh-marigold or so-called cowslip," that he must bear in mind the American origin of the book. There is probably no better work of its kind.

OUR BOOK SHELF.

Electrical Laboratory Notes and Forms. Arranged and prepared by Dr. J. A. Fleming, F.R.S. (London: The *Electrician* Printing and Publishing Co.)

It is now generally recognised that the best way to teach the rudiments of science is by the natural or kindergarten method, which aims at leading the young student to observe facts and phenomena for himself, and come to conclusions concerning them. The method is applied easily enough to very elementary practical work, and with the best results. In the case of elementary work in physics, all the student requires to be told is what to do, and he may be left to find the teaching of his results. For instance, it is only necessary to instruct him to find the weights of equal bulks of different liquids and solids, and the results of his experiments show him at once what relative density means. This principle of letting the results of experiments suggest conclusions is undoubtedly the right one for introductory courses of practical physics and chemistry; indeed, almost the only information that need be given to the students in the laboratory is how to set up their simple apparatus and what to do with it; nothing ought to be said about what they are going to prove, or the experiments lose their value of developing the faculties of acute observation and intelligent induction from the observed facts.

Advanced work in physics and chemistry offers difficulties to the extension of the scientific method of observation and induction. The time spent in the laboratories is far too short to enable students to rediscover the more intricate laws and relationships for themselves, however admirable the mental training of such researches may be; and if the instruments are all arranged so that it is only necessary to press a knob to make them act, and obtain a result, the value of the mechanical observations then made cannot be very great. The difficulty of applying the scientific method to physical laboratory work is brought out by the volume before us. The volume contains twenty elementary and twenty advanced exercises in electrical measurement. Each exercise consists of a six-page sheet, two pages of which are occupied with a condensed account of the theoretical and practical instructions for performing the particular experiment, while the remaining pages are ruled up in lettered columns, to be filled in by the student with the results of his observations. What the student does is really to test the accuracy of formulæ, mostly arrived at by theoretical considerations; the work is therefore purely deductive, and not inductive. Yet it is difficult to see how to make the work covered by these notes anything but deductive; certainly no better system of teaching practically the elements of electrical engineering has so far been developed.

By means of Dr. Fleming's notes and a little oral assistance now and then, the student will be able to perform instructive experiments, and will be taught to observe closely, and to record his results neatly. The method followed facilitates the work of the demonstrator and the student, and enables a large amount of practical work to be carried out in a comparatively short time.

Microbes and Disease Demons. By Dr. Berdoe. Pp. 93. (Swan Sonnenschein and Co., 1895.)

UNDER the above sensational title the writer discusses, or rather attacks, the anti-toxin treatment of diphtheria. It is difficult to understand what has prompted the production of so prejudiced and, we regret to say, unscientific comment upon this subject. We most emphatically take exception to such expressions as "scientific quackery," and others of a similar character, being applied to investigations of which, although the therapeutic value may be as yet a question of opinion, undoubtedly mark a new step forward in our endeavour to unravel the problems surrounding disease.

We have no intention of discussing Dr. Berdoe's views in detail, but we feel ourselves called upon to refer to one statement, because the writer has used it as a vantage ground for his most savage attack upon this method of treating diphtheria. We refer to the death in Brooklyn alleged to have resulted from the injection of some of the anti-toxin. Several pages are devoted to a detailed account of the incidents of the case, and Dr. Berdoe does not hesitate to designate it as "sudden death from anti-toxin." This, however, is not the view of the Brooklyn Health Department, or of authorities in the Bacteriological Laboratory of the New York City Board of Health, in both of which institutions the anti-toxin used was submitted to a very careful and exhaustive examination, and the official opinion given that it was not responsible for the death of the patient.

The case for or against the anti-toxin treatment of diphtheria is not one which should be approached from a party point of view, and such prejudiced, vaporous effusions as Dr. Berdoe has permitted himself to indulge in, will never take any part in deciding the question of its efficiency. To arrive at any such positive conclusion is of necessity a matter upon which time and experience can alone give the final verdict, and its discussion should only be entrusted to those who are capable of approaching the subject in a scientific and judicial spirit.

Men-gu-yu-mu-tsi; or, Memoirs of the Mongol Encampments. Translated from the Chinese by P. S. Popov, Russian General Consul at Peking. 580 pp. (*Memoirs of the Russian Geographical Society*, vol. xxiv.; Russian.) (St. Petersburg, 1895.)

THIS is the work of two Chinese men of science, Chjan-mu, or Shi-chjou, author of a history of Jinghiz khan's conquests, and Khe-tsyu-tao, author of several geographical works, of which the description of the northern borderlands is best known. It was published in China in 1867, and consists of two parts: a description of the different tribes and confederations into which the Mongols are divided, with short notes on the extent of the territories they occupy, and short historical notices—the whole covering only about 160 pages of the Russian edition—and a great number of most interesting foot-notes, which cover more than two-thirds of the volume, and contain a great variety of miscellaneous geographical and historical information.

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.*]

University of London Election.

I HAVE read the letters which Mr. Bennett, Mr. Thiselton-Dyer, and Prof. Ray Lankester have addressed you on the subject of the University of London, and much regret that my friends, whose opinion I value so much, take exception to one paragraph in my letter to Prof. Foster. I do not wish to seem to treat their views with any want of respect, and perhaps, therefore, you will allow me to send a few lines in reply.

They all criticise the sentence in which I state that I should endeavour to maintain the right of Convocation given in the Charter, which expressly provides that no alteration should be made in the constitution of the University without the assent of Convocation.

Prof. Ray Lankester says that "Sir John Lubbock has adopted and made himself the leader of this extraordinary and fantastic policy." Whether it is extraordinary and fantastic or not, is of course a matter of opinion, but, at any rate, it is the law at present.

I am satisfied that my constituents highly value this right, and I fail to understand how Mr. Thiselton-Dyer has been able to persuade himself that in endeavouring to maintain it I am taking a line "not courteous to Convocation," or have given "Convocation the severest slap in the face it has ever received."

Prof. Ray Lankester also says that I "have shown an unfavourable estimate of the intelligence" of my constituents. This is such an extraordinary version (not to say perversion) of what I said, that I trust you will allow me to quote my own words. What I said was—

"Feeling that Convocation ought to be consulted on a matter so vitally affecting the University, I should strongly urge, and would do my best to secure, that the scheme when arranged should be submitted to Convocation for their approval, to be signified as at a senatorial election, and would oppose the Bill unless this were conceded."

Why should this proposal appear to my friends as being, in Mr. Bennett's words, fatal to "all hopes of bringing our University into line with the requirements of the age"? The Commissioners will either propound a wise scheme or an unwise one. My critics believe that it will be wise. Why, then, should they assume that Convocation will reject it? At any rate it is an extraordinary reason for attacking me as a Member of Parliament, that I have faith in the good sense and sound judgment of my constituents.

JOHN LUBBOCK.

High Elms, July 30.

Metrical Relations of Plane Spaces of n Manifoldness.

PLANE spaces of n manifoldness are assumed to have the following properties:—

(1) Given a S_{n-1} (a plane space of $n-1$ manifoldness) and a point P outside the same, then a certain S_n will exist which contains both the S_{n-1} and P.

It follows therefore that a S_n is determined by $n+1$ of its points, unless these points have that special situation to each other by virtue of which they are contained in a plane space of minor manifoldness.

(2) If a plane space S_n contains $n+1$ points, which have not the special situation to each other above mentioned, then it will contain the plane space S_n, determined by these points.

It therefore appears that $n+1$ points determine a S_n uniquely.

Given a straight line L and any point P upon the same: through L any number of planes can be constructed, each of which contains a certain line L′ through P perpendicular to L. The aggregate of such lines L′, in a space S_n form a S_{n-1}, which has that special position towards L by virtue of which it is called perpendicular to L in P.

To prove this theorem, which certainly holds if $n = 2$ or 3, let us assume that it is true when $n = k$; then it will also be true when $n = k + 1$. Through P, in a space S_k which contains L and is contained by S_n, construct the S_{k-1} perpendicular to L. Any point not contained in the S_{k-1} and L determines a plane, which contains the perpendicular PQ to L. PQ and the S_{k-1} determine a space S_k, and the proposition is that any line through P in this S_k is perpendicular to L. Through PQ construct a plane space Σ_{k-1} in S_k perpendicular to L. It must exist, according to hypothesis. S_{k-1} cuts the S_k into two parts, because every straight line in S_k (as easily follows from the assumptions) has one point in common with the S_{k-1}, we therefore have no means of passing from one point of such straight line to its other points without passing the S_{k-1}. S_{k-1} and Σ_{k-1} cut the S_k therefore into four different parts, which have the cut of Σ_{k-1} and S_{k-1}, that is a certain S_{k-2}, in common. Let the four departments, into which the S_k is cut, be called A, B, C, D. A straight line through P, not contained by the S_{k-2}, will be situated (as it passes P, that is a point of the S_{k-2}) in two different departments; and if we change the situation of this line continuously, without passing either the S_{k-1} or the Σ_{k-1}, it will remain in the same two departments. The departments are therefore arranged by two. If a straight line through P, belonging to A, also belongs to B, then A and B shall be called opposite to each other. Let A, B and C, D be opposite to each other. We have no means whatever of distinguishing two opposite departments, unless we assume at the very least another arbitrary point, because every plane configuration through the S_{k-2}, extending into one department, equally extends into the opposite one. Whatever is true for the one department must therefore be true also for the opposite one.

Now construct any line L′ through P in the S_k. Let L′ belong to A and B. If L and L′ are not perpendicular, then the angle LL′ contained in A must be larger or smaller than the corresponding angle LL′ contained in B. Let L′ change its position continuously; if the angle LL′ contained in A would be always larger than the corresponding angle in B, this would amount to a permanent property of A distinguishing it from B, which it cannot possess. Therefore, whichever evolution L′ may perform from the S_{k-1} to the Σ_{k-1} in A (and B), it must have at least one intermediate situation in which L and L′ are perpendicular. The aggregate of such situations form a surface in A and B. Let $L', \ldots L'_{k-1}$ be $k-1$ lines contained in that surface; then the plane space of $k-1$ manifoldness containing these $k-1$ lines, must, according to the hypothesis, be perpendicular to L. The surface must therefore contain this plane space. If now we replace one of the two S_{k-1} or Σ_{k-1} by this space, the argument will still hold. However, near the two borderings plane spaces will finally approach, there will always be at least one intermediate plane perpendicular space, all of which are contained in the S_k. It is therefore nothing left but to concede that the S_k in question has the property established in the proposition.

Through any point P only one line L will pass, which is perpendicular to a space S. Assume indeed two such lines, which may have with S respectively Q and R in common. Then PQR would form a triangle, of which ∠ PQR as well as ∠ PRQ, according to the foregoing, will be = a right angle. This, however, is impossible, unless Q and R coincide.

A point and a plane space therefore determine a certain line, the perpendicular to that space through the point, a certain point—the one in which the line above mentioned cuts the space—and a magnitude, the distance of the two points above mentioned. This is always true, unless the point belongs to the space. Let the point approach the space. If the two points in question coincide, then the point will belong to the space. The conditions, therefore, that a point and a space are united, is (distance of point and space) = 0.

Let P move continuously so that its distance from a plane space S remains unaltered; P and S may determine a space Σ; then the aggregate of such points in Σ is another plane space. Let P and Q be two situations of P. Then all points of the line PQ have the same distance from S, as is easily seen to rest on Euclid's parallel axiom by means of parallelograms. The general proposition can, from this, be established by considerations analogous to the proof of our first theorem, independent of any new assumption. Two such spaces Σ and S are called parallel, and determine a certain magnitude, whose disappearance is the condition of coincidence of Σ and S.

Let Σ and S be parallel. Through any point A outside the same draw two lines, which cut both Σ and S, in B, C and B′, C′ respectively, then the lines ABB′ and ACC′ have a point in common, they are therefore in the same plane, BC and B′C′ must therefore either have a point in common, or be parallel. A point in common they have not, as they are contained in Σ and S, and these two have no point in common. It follows that

$$AB : AB' = AC : AC'.$$

We now add to our assumptions another one. $n+1$ points determine, as already stated, a plane space S_n, and besides a certain pyramid of n dimensions; of which we assume that it shall possess magnitude. Let the $n+1$ points be $A_1 \ldots A_{n+1}$. $A_2 \ldots A_{n+1}$ determine a certain space S_{n-1}. Draw any line through A_1. It cuts S_{n-1} in a point B. Choose A'_1 on this line so that $A_1B = BA'_1$. Then the two points A_1, A'_1 have an exactly symmetrical position to S_{n-1}. No property can be valid for the one which is not valid for the other (as long as no elements are introduced to disturb the symmetry). We cannot therefore assume that one of the two pyramids, determined respectively by A_1 and the $A_2 \ldots A_{n+1}$ or A'_1 and $A_2 \ldots A_{n+1}$, should be larger than the other. Now the *locus* of points A'_1 is, according to the foregoing, a parallel Σ_{n-1} to S_{n-1}. It follows: The magnitude of the pyramid is dependent (1) on n of its points (2) and the distance of the $n+1^{st}$ from the plane space determined by these n points.

What we have in mind, when we speak of the magnitude of a pyramid, will come out clearer when we give a theorem of addition. Let X be any point collinear with and intermediate between A_2 and A_3. Then we say:

The pyramid determined by A_2X and any other points + the pyramid determined by XA_3 and those other points = to the pyramid formed by A_2A_3 and the rest of the points.

This explanation, combined with the above, shows that the magnitude of a pyramid is equal to some constant multiple (say $\frac{1}{n}$) of the product of the magnitude of the pyramid $A_2 \ldots A_{n+1}$, and the distance of A_1 from the space fixed by the other points. We shall write this number $(A_1A_2 \ldots A_{n+1})$. (A_1A_2) is simply the distance of the two points, and according to a convention necessitated by considerations of continuity, we assume

$$(A_1A_2) + (A_2A_1) = 0.$$

Generally, if we transpose any two letters, the magnitude designated changes sign.

If A, B, C are three collinear points, and if we designate by the single letters A, B, C the distances from these points of any fixed point O on that line, then we have identically

$$(AB)C + (BC)A + (CA)B = 0.$$

This is an algebraical identity easily established. The same holds also when the single letters A, B, C are made to denote the distance of these points from any space Σ, which either is parallel to line ABC, or has with it a point in common, as is easily established by proportions.

If between three points of a line such an equation exists, this must be true also for $n+2$ points in a S_n. The proof of this by induction is perfectly easy. Let for instance A, B, C, D, be four points in a plane, and let Σ be any space, that has with it a line in common. Join CD; it may meet AB in E. Then we have some linear identity

$$aA + bB + cE = 0$$

where a, b, c denote constants independent from Σ, and also

$$dC + eD + fE = 0.$$

Eliminating E, we obtain some linear identity between

A, B, C, D.

In order to determine the constants, let us assume the space Σ (which is permitted) to be parallel to the plane ABCD; then we have if

$$aA + bB + cC + dD = 0$$
$$a + b + c + d = 0.$$

If we place Σ so that it cuts ABCD in CD, and if then we make $a = (BCD)$, c follows = (CDA). We therefore obtain

$$(BCD)A + (CDA)B + (DAB)C + (ABC)D = 0$$

and just so in the general case

$$(BCD \ldots L)A + (CD \ldots LA)B + (D \ldots LAB)C + \ldots = 0.$$

The use of the distances of points from variable plane spaces enables us to do away with fixed coordinate systems. The proof of projective theorems becomes perfectly lucid, while at each stage of the proceedings we are always able to give the geometrical significance of the constants employed. To give a few instances: Let $A_1 \ldots A_{n+1}$ be $n+1$ points in a plane space S_n. Let P be any other point. We then have one linear relation

$$a_1 A_1 + a_2 A_2 + \ldots + a_{n+1} A_{n+1} + pP = 0.$$

Assume outside the space any point Q. Construct the plane spaces $QA_1 \ldots A_n$, $QA_2 \ldots A_{n+1}$, $\ldots$ $n+1$ in all, and cut them by some line joining the residual point A_{n+1}, $A_1 \ldots$ respectively with a point R on the line QP. We thus obtain $n+1$ new points A^1_{n+1}, $A^1_1 \ldots$, which joined give a plane space Σ_n, that cuts S_n always in one and the same plane cut S_{n-1}, however we may choose Q and R, which is related to P and the configuration of the A in a peculiar manner.

To follow the different steps indicated, let us assume

$$pP = qQ + rR$$

(the three points are collinear); therefore

$$a_1 A_1 + a_2 A_2 + \ldots + qQ + rR = 0.$$

Joining R with A_1, we obtain a line that contains the point $\frac{a_1 A_1 + rR}{a_1 + r}$, which as

$$a_1 + a_2 + \ldots + q + r = 0$$

is also $= \frac{a_2 A_2 + \ldots + qQ}{a_2 + \ldots + q}$, that is contained in the plane space $A_2 A_3 \ldots Q$.

$$A^1_1 \text{ is therefore } = \frac{a_1 A_1 + rR}{a_1 + r}.$$

Just so

$$A^1_2 = \frac{a_2 A_2 + rR}{a_2 + R}.$$

. . . . .

The line $A^1_1 A^1_2$ contains the point

$$\frac{(a_1 + r)A^1_1 - (a_2 + r)A^1_2}{a_1 - a_2};$$

that is

$$\frac{a_1 A_1 - a_2 A_2}{a_1 - a_2},$$

which is collinear with A_1, A_2. The plane space S_{n-1} contains therefore all the $\frac{n \cdot n-1}{1 \cdot 2}$ points thus formed, and the proposition follows at once.

In a similar way it may be proved that, if two $(n+1)$ pyramids in a S_n are in perspective, the intersection of corresponding sides, $\frac{n+1 \cdot n}{1 \cdot 2}$ in all, are all contained in a S_{n-1}. We prove this simply for $n = 2$, which is sufficient to exhibit the general way of proceeding. Let A B C, $A^1 B^1 C^1$ be two triangles in perspective; let AA^1, BB^1, CC^1 have point P in common. Then we must have

$$\begin{aligned} P &= aA + a^1A^1 \\ &= bB + b^1B^1 \\ &= cC + c^1C^1. \end{aligned}$$

Join AB, A^1B^1. Their intersection, from

$$aA + a^1A^1 = bB + b^1B^1$$

follows

$$\frac{aA - bB}{a - b} = \frac{a^1A^1 - b^1B^1}{a^1 - b^1}.$$

Now $\frac{aA - bB}{a - b}$, $\frac{bB - cC}{b - c}$, $\frac{cC - aA}{c - a}$, are obviously collinear.

Two plane spaces in general do not determine one magnitude only. Take, for instance, two lines in space. They have a distance, and form an angle. If their distance or the sine of their angle is = 0, they will be coplanar. If both are = 0, they will coincide. We have two magnitudes, because the system of two lines in space has two degrees of degeneration (coplanarity and coincidence). This is also generally the case, because geometrical magnitudes are nothing but the most suitable invariants, whose evanescence is the necessary and sufficient condition for the degeneration of the system to which they belong.

If two plane spaces A, B determine only *one* magnitude, we designate the same by (AB). Let A be a straight line, for instance, and B a plane space which has one point in common with A. From any point of A, say P, draw the perpendicular to B. Join B with point Q, common to B and A. Then the sine of $\angle$ Q is the magnitude denoted by (AB). Let A be a plane, having in common with B a line. From any point P of the plane draw the perpendicular on B, say PB, and from this point B the perpendicular on the common line BQ. Then again sin ($\angle$ Q) = (A B), and thus generally. We determine the sign of the magnitude according to the rule

$$(AB) + (BA) = 0.$$

Let us now add another plane space C to the system A, B, such that both CA and CB determine only one magnitude. Then the whole system may determine an additional one, whose evanescence would signify that C belongs to the plane space fixed by A and B in conjunction, and is united with the space that A, B have in common. It is in fact the product of (AB) and the magnitude formed by C and the space AB, and will be written

$$(ABC)$$

In this way we proceed, obtaining the definition of a magnitude, which has the property that its evanescence is the necessary and sufficient condition for the degeneration of the system to which it belongs.

The magnitude in question may be formed in various ways, but the system being such that it can possess only one such magnitude, the different formations must always lead to one and the same result, with the exception of a constant factor. This factor must either be + 1, or else − 1, on account of the symmetrical way in which the magnitude is formed. If the system is one of straight lines through a point P, the magnitude in question has a special significance. Two triangles which have an angle in common, are in proportion as the product of the sides including this angle. Three lines in space which have a point in common and are not coplanar, form a corner. Cut a corner by two different planes. The two different pyramids are in proportion as the product of the three sides forming the corner. And so in general, as can be easily proved by induction. Therefore, if we have such a corner of n lines in a space S_n, and cut it by a space S_{n-1} the pyramid formed is = the product of the n sides extending from the vertex of the corner multiplied with a factor which is specific for the corner; and this latter factor is exactly the magnitude formed according to the rule given.

(It may happen that the formation of the magnitude, as given, leads to zero without giving a significant result. This is an indication that somewhere during the process one of the conditions of degeneration is fulfilled—for instance, when C belongs to the space AB. Then the process is the reciprocal one. We determine the magnitude formed by C and the space common to A and B. If that also is zero, then A, B, C belong to what is called a pencil. The simplest case of this kind is the system of three lines in a plane.)

Let A B C be three plane spaces belonging to a pencil; that is, let (ABC) = 0. Let D be any other plane space, which has an element with the pencil in common. Then we have again

$$(AB)C + (BC)A + (CA)B = 0,$$

where the single letters A, B, C in this identity denote the magnitude formed between each of these three spaces and the auxiliary one.

It will suffice to prove this for the case of three lines through a point P. Let Σ cut the pencil in a line S. Let A, B, C form with S the angles α, β, γ respectively, then the proposition amounts to

$$\sin(\alpha - \beta)\sin\gamma + \sin(\beta - \gamma)\sin\alpha + \sin(\gamma - \alpha)\sin\beta = 0,$$

which is nothing but the Ptolemäus theorem about four points in a circle.

Now again we may proceed to show, that between $n+2$ elements A_i, for which, to be short $(A_1 A_2 \ldots A_{n+2}) = 0$, a linear relation must exist $\Sigma a_i A_i = 0$, where the a_i are certain constants. Of course, if not also some of the minors are zero, such as $(A_1 A_2 \ldots A_{n+1})$, this will be the *only* relation that can thus exist. We can therefore determine the a_i, by giving Σ exceptional positions. The result is again

$$(A_1 A_2 \ldots A_{n+1}) A_{n+2} + (A_2 A_3 \ldots A_{n+1} A_{n+2}) A_1 + (A_3 \ldots A_{n+2} A_1) A_2 + \ldots = 0.$$

Let $A_3 \ldots A_{n+2}$ form the space S, and the magnitude (S) then, making Σ identical with S, we obtain

$$(A_2 S) \cdot (S) A_1 + (S A_1) \cdot (S) A_2 = 0.$$

But $(A_2 S) = -A_2$ for this special position of Σ, and $(S A_1) = A_1$, therefore the test applies, and the theorem must be correct.

For such systems A_i, as we have considered, all projective properties will be corresponding to each other, and all metrical properties at least as far as they are dependent upon the interpretation of the constants employed. EMANUEL LASKER.

Ilkley, July 9.

P.S.—The same holds true, with slight modifications, for the only curved space that contains no exceptional elements, that is the surface of a globe of *n* manifoldness.—E. L.

The Feigning of Death.

THE discussion, a few months since, of the feigning of death in reptiles (vols. li. pp. 107, 128, 223, and lii. p. 148), induced me to experiment on the Currant Moth, whose powers of "shamming" are so familiar. The moth was first seized by one wing, and it at once feigned death; thereupon I cut off its head with a pair of scissors, and the *animal continued to feign death.* I use the expression advisedly, for absolute immobility was maintained for some seconds, and then violent fluttering ensued, causing the animal to rush wildly about the table, but failing to lift it into the air. In this condition any impulse, such as touching or pinching, induced a repetition of "shamming." After a strong stimulus the shamming was prolonged, and indeed a direct connection was obvious between the strength of stimulus and the length of period of quiescence. This power of response to stimulus was maintained for two days, and then weak fluttering set in for some hours, followed by death. Our entire ignorance of the physiology of the nervous system of insects renders it difficult to draw complete conclusions from these phenomena; nevertheless, it is difficult to conceive that volition can persist for forty-eight hours in a decapitated animal. We are forced then to conclude that here, at any rate, death-feigning is a purely reflex phenomenon, and that the sensory stimulus received by the surface of the body causes inhibitory impulses to arise reflexly from the ganglia of the central nerve chain, and prevent all movement of the locomotor muscles. In confirmation of this, it may be mentioned that denuding the wing of its scales over any area caused a marked diminution of sensitiveness over the area so treated. Since all stages between sensory hairs and ordinary scales occur in Lepidoptera, it is not unreasonable to assume that the scales still function as tactile end-organs, in spite of their modification subserving decorative purposes. OSWALD H. LATTER.

Charterhouse, Godalming, July 31.

Halley's Chart of Magnetic Declinations.

IN NATURE for May 23 and 30, 1895, are interesting communications from Dr. Bauer and Mr. Ward in reference to Halley's old chart of magnetic declinations.

I have a copy of this chart not referred to by either of these gentlemen.

It is bound in vol. i. of "Miscellanea Curiosa." This work was edited by Halley; it consists of three volumes, containing, in the main, reprints of papers read before the Royal Society. Vol. i. was published in 1705, and was printed by J. B., for Jeffery Wale and John Senex.

The chart is $7\frac{1}{2}$ inches high and 13 inches long, and embraces just the circumference of the earth.

The title in the upper left-hand corner reads: "A new and correct Sea Chart of the Whole World, showing the Variations of ye compass as they were found Año 1700 with a view of the General and Coasting Trade Winds and Monsoons or shifting Trade Winds by the Direction of Capt. Edm. Halley."

In the lower left-hand corner is the note: "Capt. Halley's map of the World in two large sheets is sold by R. Mount and T. Page on Great Tower Hill, London."

The name "I. Harris, delin. & scu." is in the lower right-hand corner of the chart. CHARLES L. CLARKE.

New York, July 27.

THE ERUPTION OF VESUVIUS, JULY 3, 1895.

THIS recent disturbance at Vesuvius is interesting in several ways, and at one time had all the appearance of developing into as grand a display as that of 1872.

The last eruptive cycle of Vesuvius commenced on June 7, 1891, when I had the good fortune to be but a few hundred yards distant at the time the main bursting of the rift took place. The details of that eruption, with illustrations, can be referred to in my articles and reports.[1] We may briefly state that cycle as follows: the splitting of the whole of the great cone of Vesuvius by a radial rift which extended beyond the base for some distance across the Atrio del Cavallo. At the first moment a little lava issued from the upper part of the rift, but after a few hours all came from its lowest extremity in the Atrio, and continued to flow with practically no interruption for a period of nearly three years, or, more correctly, from June 7, 1891, to February 7, 1894. During that period no great quantity was given forth at any one time, so that no stream could attain much length before cooling. Though the amount emitted during that period is enormous, and if vesicularised into pumice and scoria would, I think, quite equal Monte Nuovo in volume. The consequence of this is, that a great and pure lava cone was built up in the Atrio, of low inclination (14°), and adding much to obliterate that interesting and characteristic feature of the volcano. Coincident with the formation of the rift, the central cone rapidly crumbled in, until a deep crater was formed which eventually attained over 150 m.

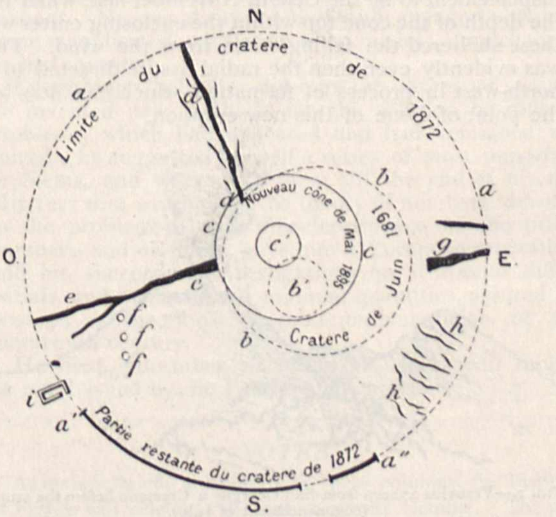

FIG. 1.—Diagram showing the actual state of Vesuvius, from a drawing by M. A. Bourdariat, after an earlier plan of mine (*La Nature*, June 8, 1895). (*a*) Limit of the crater edge of 1872; the part represented by a dotted line is that covered by more recent lavas of different dates. The parts *a'* and *a''* are still uncovered. (*b*) Crater of June 1891. (*b'*) Active vent of the 1891 crater. (*c*) New cone in process of formation (May 1895). (*c'*) Active vent of the cone on May 12, 1895. (*d*) Rift and vapour mouth of June 7, 1891. (*e*) Fissure emitting acid vapours on crater plain formed in the 1872 crater. (*f*) Very old hot-air passages and fumaroles. (*g*) Fissure of May, 1889. (*h*) Numerous fissures on the south-east edge of the crater plain. (*i*) Guides' shelter.

in depth and diameter. It was at its greatest dimensions in February 1894, when the lava stopped issuing by the lateral outlet, and therefore commenced to rise in the chimney. The immediate result of that stoppage was that the formation of a cone was soon commenced at the bottom of the crater by the ejection of lava cakes. The growth of this new cone of eruption was so rapid that, when I visited and photographed the interior of the 1891 crater in November last, this was not above 60 or 70 m. deep, and the cone of eruption was rapidly increasing in height within it.

My friend M. Alex. Bourdariat has carefully observed the

[1] "Il Vesuvio," *Corriere di Napoli*, June 10, 1891. "L'Eruption du Vésuve," *L'Italie*, Rome, June 13, 1891; *Le Figaro*, Paris, June 17, 1891. "The Eruption of Vesuvius," *Mediterranean Naturalist*, Malta, July 1 and August 1, 1891. "Lettre sur l'Eruption du Vésuve," *L'Italie*, Rome, July 18, 1891. "L'Eruption du Vésuve, visites d'exploration au Volcan," *La Nature*, August 8, 1891 (illustrated). "The Eruption of Vesuvius," NATURE, vol. xliv. pp. 160–161, 320–322, and 362 (illustrated). "Report British Association," 1891–92–93–94. "L'Eruzione del Vesuvio," *Rassegna delle Scienze Geologiche*, vol. i. Rome, 1891 (illustrated).

phenomena of the volcano during the early months of the present year, and has recorded the changes in *La Nature*, June 8 (Fig. 1). It appears from his interesting description that in January of this year the apex of the cone of eruption overtopped the edge of the 1891 crater. Lava even flowed out in the crescentic depression between eruptive cone and crater ring. This was followed by a little repose of some days, to be succeeded by powerful ejections of lava cakes to a considerable height (80 to 100 m.), which rapidly added to the growth of the eruptive cone. In May, this new cone was from 15 to 20 m. above the 1891 crater, and at the commencement of July was considerably more, as is shown by Fig. 2, taken from San Giorgio a Cremano, as the others—and also notes—by Mrs. T. R. Guppy.[1] This sketch shows that on the day preceding the eruption, central activity with cone-forming stage was very active, attaining the fifth degree on my scale.

M. Bourdariat's plan of the summit of the great cone, constructed on one of mine of earlier date, shows the axis of the new eruptive cone is not concentric, but to the north-west of the 1891 crater. This he attributed to the wind, no doubt one of the causes at work, but I had seen such displacement to be the case in November last, when from the depth of the cone top within the enclosing crater walls these sheltered the falling cakes from the wind. There was evidently even then the radial fissure directed to the north-west in process of formation, which has now been the point of issue of this new eruption.

FIG. 2.—Vesuvius as seen from San Georgio a Cremano before the eruption (commencement of July).

The first indication of the final splitting of the great cone was at midnight, when the crater became quiet. In half an hour—that is, on July 3 at 12.30 o'clock—when the guardian of the upper railway station of Mr. G. M. Cook's railroad, which is but a very short distance from the rift, was awakened by a strong shock of earthquake that produced some slight cracks in the masonry foundation of the building. The shocks, though slighter, continued during the night. At eight the stronger shocks were again repeated, and the activity, which had recommenced at the chimney, had again ceased. This was due to the filling of the fissure as it extended outwards by the lava, the level of the surface of which naturally sunk. When this takes place, support is removed from the inner sides of the chimney in the cone, which crumbles in and chokes the vent. The whole top of the mountain had by this time become fissured, in consequence of which, at nine o'clock, seven or eight large blocks of rock, besides a quantity of small ones, were detached from the top of the cone, crashed and ploughed down its side, leaving a scar described as looking like a mud stream, and marked by a number of pits at equal distances, due to the bounding of some of these boulders. This scar is seen in Fig. 3, close by the side of the right of the new lava stream. Mr. Treiber, Mr. Cook's engineer, calculates one of these blocks to be at least 20 c.m. The point of detachment and the resulting scar was by the side of the upper part of the new fissure, but a little to the south-west, and the traces left by the rolling masses are parallel to it.

[1] I have on several occasions had to thank Mrs. Guppy for notes and sketches that, often at considerable trouble, she has placed at my disposal. They are of much value, as she has observed and knows all the changes of the mountain during the many years she has resided in Naples.

At 10.18, the radial dyke reached the surface of the great cone and formed an eruptive mouth on a level with and to the north of the upper railway station, from which a copious outflow of lava took place, running down the cone, as seen in the figure below.

At 10.30, about 70 m. lower down, a fresh eruptive mouth was opened, and is well seen in Fig. 3, having an oblique

FIG. 3.—Vesuvius as seen on July 3, at 10 a.m.

crateriform appearance, as in the case of the upper one, and on other similar occasions a jet of steam, that constitutes the excavating agent, was converted into a blackish column by the lapillæ, sand, and dust dislodged and carried up with it from the side of the mountain. There is certainly some discrepancy in Mr. Treiber's report, for Mrs. Guppy's sketch, made at ten o'clock, shows this lower *bocca* already in existence. Her sketch likewise exhibits the progress of truncation of the central eruptive cone by the formation within it of a crater. Such a crater is entirely due to the crumbling in of the edges and their fall down the chimney, as no explosions were going on by the top part of the main chimney. Lava continued to pour forth from the lower end of the lower crateret, and probably from a part of the radial fissure that reached the surface below it, but which of course is hidden by the flowing lava. The stream reached the bottom of the great cone at the junction of the Atrio del Cavallo and the Piano di Genista, and then extended towards the upper end of the ridge of the Lion's Paw, or I Canteroni, where was once the old Crocelle. Here it soon formed a fine stream 60 m. in breadth. Besides the two main craterets, already

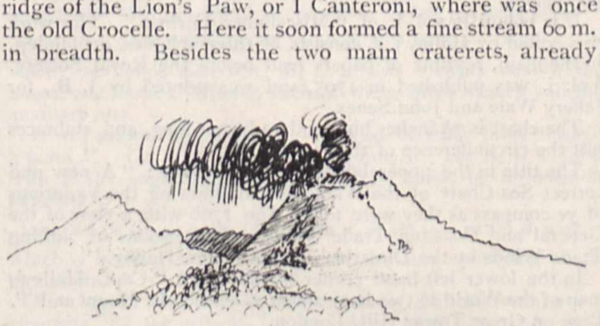

FIG. 4.—Vesuvius as seen on July 5, at 10 a.m.

described, two minor ones also were formed on the same line of rift.

On July 4, the craterets quieted down, little lava flowed, so that during twenty-four hours the face of the stream only advanced 12 m. This corresponded with a slight return of activity at the main chimney, so as to relieve the accumulating vapour tension of the lava below, which the mountain will not resist for long.

The ejections were, of course, of the *accessory* type—that is, not *essential* to the eruption, but simply the remnants of the crumbled-in portion of the eruptive cone. Each puff had its characteristic black colour, due to the quantity of *accessory* sand and dust.

At 22 o'clock, the upper crateret gave out a little vapour and a little lava, but again became quiet. At 23 o'clock, the lower crateret showed new cracks around about it, with the escape of vapour.

During the night, between the 4th and 5th, the lava again increased, so that it is reported the next morning to be advancing at the rate of 25 m. per hour. It had turned to the west, and flowed down on the south side of the Lion's Paw, or the Observatory ridge, and had divided into two main streams, which subsequently subdivided into minor ones that radiated in different directions.

On July 5, the explosions at the central crater were powerful, so as to form from time to time pine-shaped vapour plumes over the volcano. At others, the vapour was bent over the Atrio by the sirocco wind, so as to spread a shower of dust and sand right across that depression. One of these is well indicated in Fig. 4.

So far no damage has been done except to a private carriage road that crosses the Piano di Ginista to the lower railway station. No cultivated land has been reached. The lava is, however, on a steep slope, and is flowing in the direction of the valley called the Cupa Pallarino, over the edge of which a magnificent cascade of incandescent rock was formed in 1872.

The eruption is quite identical in all its details with the usual antecedent ones, resulting from the formation and extension outwards of radial dykes. Many of such eruptions I have described in these pages and elsewhere, and fully explained their mechanism, production, growth and closure.

Three results may happen: (1) The radial sheet of rock may cool and seal the rift so that the volcano will soon return to the cone-forming stage, as seems to be indicated by the appearance of pasty lava cakes amongst the ejecta on July 5. (2) The fissure may enlarge and extend downward with the outflow of lava, as in 1872, with the formation of a much larger central crater. (3) It may follow the more usual course, as its immediate predecessor, and give issue to a small but almost continuous outflow of lava during months or years.

H. J. JOHNSTON-LAVIS.

P. L. CHEBYSHEV (TCHEBICHEFF).

THE death of Prof. Chebyshev has hardly been noticed in the English papers; and even in Russia, except for a short sketch in the University *Bulletin*, and in a speech of Prof. Markoff's with reference to him, which is reported in the *Bulletin de l'Académie impériale des Sciences de St. Pétersbourg*, no biographical notice has appeared of this celebrated mathematician.

Paphnyty Levovitch Chebyshev was born on May 14, 1821, at Akatovo, in the government of Kaluga; and after being educated privately, entered Moscow University; he completed the usual courses, and took his Bachelor degree. In 1846 he received his Master's degree at the same university for his "Essay on the elementary analysis of the theory of probability," and in the following year commenced a series of lectures as assistant lecturer in Petersburg University. He received the Doctor's degree in 1849 for his well-known "Theory of Comparison," which contained a model exposition of the formation of the theory of numbers, and clearly proved the strength of his mathematical genius. In 1852 Chebyshev was promoted to an extra professorship, and in 1860 to a regular professorship. During 1853–59 he was elected successively assistant, extra, and ordinary tutor in the Academy of Sciences. He remained a professor, doing active work of the most valuable kind, thirty-five years, during the course of which, at various times, he lectured on every branch of pure mathematics, and during one period—in 1849–51—on practical mechanics.

In his numerous writings Chebyshev left a very great deal to the reader's imagination, often giving deductions simply without proofs, but in his lectures he never left a point without the fullest explanation; and his lectures are distinguished not only for elegance and accuracy, but for their extraordinary simpleness; the already-mentioned "Theory of Comparison" may serve as a good example, as well as his proof of Bernoulli's theorem, which is now given in all works on the theory of probability.

The professorial services of Chebyshev had a great significance to the Petersburg University. He placed the teaching of mathematics on a firm basis, and formed an independent school of thought. All the present staff of mathematical teachers in the Petersburg University, except a very few of quite the youngest, are his pupils and follow in his footsteps. His moral influence did not, therefore, cease when he resigned his professorship in 1882. The Council of the University elected him an honorary member, and his pupils kept up the habit of going to him on certain days to have lively discussions on various scientific subjects, in which his indomitable energy acted on his hearers in the most animating manner. He was always to be found engaged either on some complicated calculation or on models of mechanism he had invented.

Everything Chebyshev did bore the impress of genius; he invented new methods for the solution of difficult problems, which had appeared and had remained unsolved; he suggested himself a series of most important problems, and worked at them till the end of his life. His very first writings on the theory of numbers, devoted to the problem of the inter-dependence of the prime numbers, and on limits, gave him a European reputation, and his succeeding investigations on irrational differentials, and maximal and minimal quantities, assured his position as the most original mathematician of the nineteenth century.

He died November 26, 1894; his works will shortly be republished by the Petersburg University.

NOTES.

As already briefly announced in these columns, the Institute of France will celebrate its centenary next October. The programme of the *fêtes* which have been organised in connection with that event has just been sent to the Members and Correspondants of the Institute, the intention being that the centenary shall be marked by a reunion of all the men of light and leading who belong to the Institute. On the afternoon of October 23, there will be a reception in the Palais de l'Institut of the Foreign Associates and Correspondants and of French Correspondants, and in the evening the Minister of Public Instruction will hold a reception. On October 24, a meeting will be held in the Great Hall of the Sorbonne, at which the President of the Republic will attend. Discourses will be delivered by the President of the Institute, the Minister of Public Instruction, and M. Jules Simon. A banquet, to which all the Associates and Correspondants are invited, will take place on the evening of the same day. On October 25, there will be a special performance at the Comédie Française, and a reception will be held by the French President. The celebration will be concluded on October 26, by a visit to the Château de Chantilly. It will be seen from this that the hundredth anniversary of the foundation of the Institute of France will be celebrated in a manner worthy of the high position which the Institute holds among the world's societies of science, art, and literature.

THE seventh session of the Australasian Association for the Advancement of Science will be held in Sydney, from January 3 to 10, 1897, under the presidency of Prof. A. Liversidge, F.R.S. The Presidents and Secretaries of the Sections are as follows: Astronomy, Mathematics, and Physics: President, Mr. R. L. J. Ellery, C.M.G., F.R.S.; Secretaries, Prof. R. Threlfall and Mr. J. Arthur Pollock. Chemistry: President, Mr. T. C. Cloud; Secretary, Mr. W. M. Hamlet. Geology and Mineralogy: President, Captain F. W. Hutton, F.R.S.; Secretaries, Prof. T. W. E. David and Mr. E. F. Pittman. Biology: President, Prof. T. J. Parker, F.R.S.; Secretaries, Prof. W. A. Haswell and Mr. J. H. Maiden. Geography: Secretary, Mr. H. S. W. Crummer. Ethnology and Anthropology: President, Mr. A. W. Howitt; Secretary, Dr. John Fraser. Economic Science and Agriculture: President, Mr. R. M. Johnston; Secretaries, Prof. Walter Scott and Mr. F. B. Guthrie. Engineering and Architecture: President, Mr. H. C. Stanley; Secretary, J. W. Grimshaw. Sanitary Science and Hygiene: President, Hon. Allan Campbell; Secretary, Dr. J. Ashburton Thompson. Mental Science and Education: President, Mr. John Shirley; Secretary, Prof. Francis Anderson. Communications and papers for the meeting, or inquiries, may be addressed to the Permanent Hon. Secretary, The Chemical Laboratory, The University, Sydney, N.S.W.

IT is announced that the Hodgkins prize of ten thousand dollars has been awarded by the Smithsonian Institution, in equal proportions, to Lord Rayleigh and Prof. Ramsay, in recognition of their discovery of argon.

WE regret to notice the death of Mr. Joseph Thomson, whose explorations in Africa have added so much to our knowledge of that continent. He was only thirty-six years of age.

Science announces the following appointments:—Prof. William J. Hussey, of Illinois, to succeed Prof. Barnard as Astronomer at the Lick Observatory; Dr. J. Allen Gilbert to be Assistant Professor of Psychology at the University of Iowa; Mr. J. H. Tyrrell to be Professor of Geology and Mineralogy in the University of Toronto.

REUTER'S correspondent at Newfoundland, writing under date of July 23, says:—The steamer *Kite*, having on board the members of the Peary Relief Expedition, took her departure a few days ago for Bowdoin Bay, Inglefield Gulf. Her return can hardly be looked for before October 1.

MR. CECIL H. SMITH, of the Department of Greek and Roman Antiquities in the British Museum, has been appointed director of the British School at Athens for the next two years, in succession to Mr. Ernest Gardner, who has held the office since 1887. The Trustees of the British Museum have, with the concurrence of the Treasury, given Mr. Smith special leave of absence for the purpose.

THE annual meeting of the Society of Chemical Industry was held in Yorkshire College, Leeds, last week. In his presidential address, Dr. T. E. Thorpe, F.R.S., described some of the important advances made in technological chemistry during recent years, and especially dwelt upon the methods used for the enrichment of coal gas; the manufacture of glycerine from waste soap lyes; the manufacture of edible fats; the improvements on the chemical side of photography; and the chemistry of textiles. The following new officers were elected:—President, Mr. Tyrer; Vice-Presidents, Mr. T. Fairley, Mr. Boverton Redwood, Sir H. E. Roscoe, Dr. T. E. Thorpe. Members of Council, Prof. Le Neve Foster, Mr. Douglas Herman, Mr. C. C. Hutchinson, Mr. Ivan Levinstein, Mr. J. S. McArthur, Sir Robert Pullar. Treasurer, Mr. E. Rider Cook. Foreign Secretary, Dr. Ludwig Mond. It was decided to hold the next annual meeting of the Society in London.

BEDFORD COLLEGE (for Women) has taken what appears to us to be an important and commendable step in establishing a separate and scientific course of instruction in hygiene. This subject, which is becoming every day of more consideration, has generally been taught in a somewhat disconnected manner, as an adjunct to be attached anywhere, rather than as a distinct study; at Bedford College it is now to take its place as a special subject. Students will be required to devote themselves for a session or more solely to this and allied branches of science, namely, physiology, bacteriology, chemistry, and physics, practically as well as theoretically, and thus they will have the opportunity, by following a connected system of teaching, of really understanding the meaning and practical bearings of the subject. Many appointments as sanitary inspectors, health mistresses in schools, and teachers of hygiene, being now open to women, the subject seems to offer considerable inducement to those who have an aptitude and liking for scientific work, to devote themselves to this study.

MEN of science often have occasion to regret that they do not live in the glorious age when tidal evolution shall have so reduced the spin of this world of ours that there will be forty-eight hours in a day. To be able to devote twice the present amount of time to observation would indeed be a boon to the busy investigator, and the man who shows how to do it, places his fellow workers under a deep obligation to him. Yet that is what Dr. Gowers, F.R.S., did in an inaugural address delivered before a general meeting of the Society of Medical Phonographers last week. Here is his argument: "Science rests on observation, which without immediate record is of little value; not only is memory inadequate, but record at once reveals unsuspected imperfections in observation. Compared with longhand, shorthand permits, in a given time, twice the amount of record, while leaving twice the time for observation." Shorthand requires no better recommendation than this to the notice of students of science, and we are glad to know that the Society of which Dr. Gowers is president, though only started last December, has now 165 members. In the daily work of the practitioner, which is peculiar in being a form of personal science, record is very important. For most practitioners, however, record is practically impossible in longhand, while shorthand offers them the desired means. But this is not only the case with medical men; it is always important that observations, however trivial or strange, should be committed to writing. We are, therefore, a little surprised that the Society should, so far as the name is concerned, be only one of Medical Phonographers. Its objects appear to be broad enough to justify the name being changed to the Society of Scientific Phonographers, and a further argument for the more comprehensive designation is that many scientific workers outside the ranks of the medical profession have already become members.

AN interesting point in connection with the sand filtration of water has been recently brought to light by Dr. Kurth, of Bremen. It has frequently been pointed out that the thickness of the layer of fine sand in filtering beds cannot be reduced beyond certain limits without endangering the bacterial quality of the filtrate. Making more detailed examinations of the particular bacteria present in the effluent from a filter in which the depth of filtering material had been interfered with, Dr. Kurth found that the rise in the number of bacteria was almost entirely due to the presence in large quantity of one particular microbe, of which, however, no trace could be found in the raw water with which the filter was being fed. On one occasion there were as many as 900 in 1 c.c. present of this special microbe, whilst all the bacteria together in the raw water did not amount to more than 760 in 1 c.c. In this instance, therefore, the objectionable rise in the number of bacteria present in the filtrate did not necessarily indicate that the efficiency of the filter in dealing with the raw water was in fault, but rather that the disturbance of the sand had dislodged certain microbes present in the filtering material. It would appear, therefore, of interest to obtain in cases where the filtrate is unsatisfactory some particulars of the microbes present in the effluent, and determine in what relation they stand to the raw water microbes.

THE question of the audibility of fog-horn signals at sea seems destined to occupy a great deal of attention in naval circles. Some time ago we gave a description of the American experiments, which went to prove that round each siren there is a zone, about 1½ nautical miles broad, within which fog-signals cannot be heard, although they are distinctly heard outside that zone. These observations cannot now be treated with the incredulity they at first met with, since other experiments have confirmed them. A series of such experiments are described in *Hansa*. In one of these, the vessel steamed with the wind straight towards the light-ship from a distance of 4½ nautical miles. At a distance of 2¾ miles the sound became faintly audible, and suddenly increased in loudness at 2½ miles, retaining the same intensity up to two miles distance. From 1¾ to 1½ miles the note was scarcely audible, but then it immediately increased to such an extent that it appeared to originate in the immediate neighbourhood of the vessel. The steamer at this point reversed its course, and the fluctuation over this part of the course was found to be the same, except that it was even more strongly marked. Reversing again, the vessel steamed over this distance a third time, and again the sound disappeared at 1½ miles and reappeared again, so loud that it sounded as if the fog-horn was only two cables' lengths off. Then, at half a mile, the sound disappeared entirely, to reappear at quarter of a mile from the light-ship, after which it gradually and steadily increased in intensity until the latter was reached. It is time that this question, which is of great practical importance, should be systematically investigated.

THE second annual report of the Iowa Geological Survey, dealing with the work done during 1893, has just come to hand. The Survey was organised just three years ago, and it has carried out some very valuable investigations during its comparatively short existence. The coal deposits of Iowa have received special attention since the organisation of the Survey, and one volume descriptive of them was issued last year. But these deposits are far too extensive to be discussed in a single volume. We have it on the authority of Dr. C. R. Keyes, the Assistant State Geologist, that the area of the coal measures in Iowa is somewhat over twenty thousand square miles, and that isolated carboniferous outliers, and the region bordering the productive coal measures, which must be gone over in tracing the limits of the formation, occupy fully five thousand square miles or more. With reference to the beds of gypsum at Fort Dodge, Dr. Keyes says the area covered by the gypsum contains, approximately, twenty-seven square miles, and that, at the lowest estimate, the mass of gypsum which is found available in the region is not less than sixty millions of tons. Much valuable data with reference to these deposits are given in the report, and also information in regard to the building stones, clays, and other useful mineral substances in Iowa. Though the Survey has primarily a utilitarian point of view, it is clear from the report that the more scientific side of geology is not neglected. Prof. W. H. Norton contributes to the report a paper on the thickness of the Palæozoic strata in North-Western Iowa, based upon records of a number of borings for artesian and other deep wells. He also gives the results of a study of Devonian and Carboniferous outliers in Eastern Iowa. The report is illustrated by thirty-four figures in the text, and thirty-six plates; the most striking of the latter belong to a paper by Dr. Keyes, on glacial scorings in Iowa. Two new localities showing exceptionally fine effects of glacial action were found near the city of Burlington in 1893. One of them is near Kingston, on the top of a bluff overlooking the Mississippi river, and judging from the reproduction of a photograph, it furnishes a very remarkable example of a glaciated surface. Prof. Calvin, the State Geologist, is to be congratulated upon the work carried on under his direction. The Survey has lately lost Dr. Keyes, who has become State Geologist of Missouri, his place being filled by Mr. H. F. Bain.

THE fifty-sixth annual meeting of the Royal Botanic Society will be held in the Gardens, Regent's Park, on Saturday afternoon next, the 10th inst., at one o'clock.

A DAINTY catalogue, in which many rare and valuable geographical works are described, has been issued by Mr. Bernard Quaritch. The catalogue should be seen by all interested in geographical literature.

WE learn from the *Journal of Botany* that the herbarium of the British Museum has recently acquired a very fine collection of Hepaticæ made by Herr F. Stephani. It numbers about 10,000 specimens, and includes types of 1100 new species described by Herr Stephani.

THE *Proceedings* of the Liverpool Naturalists' Field Club for 1894 contain a record of a large amount of scientific work done in the way of botanical excursions in Lancashire, Cheshire, and North Wales; a list of carboniferous fossils found within twenty miles of Liverpool; and reports of papers read at the evening meetings. The total number of animals and plants that has been recorded as occurring in the district, both living and extinct, is given as 5735.

THE August number of the *Quarterly Journal of the Geological Society* contains a paper, by Dr. J. W. Gregory, on the Palæontology and Physical Geology of the West Indies. Among the other papers we notice the following:—Prof. J. B. Harrison and Mr. A. J. Jukes-Brown, on the chemical composition of oceanic deposits; Mr. H. M. Bernard, on the systematic position of the Trilobites; Prof. W. J. Sollas, on the mode of flow of a viscous fluid; Dr. C. S. Du Riche Preller, on fluvio-glacial and inter-glacial deposits in Switzerland; and Mr. E. T. Newton, on fossil human remains from Palæolithic gravels at Galley Hill, Kent.

THE Royal College of Belen, Havana, has just published its magnetical and meteorological observations for the year 1890. This institution has regularly issued reports since 1862, and the continuous instrumental curves, which accompany the tables, have furnished valuable information for the investigation of West India hurricanes. Since 1872, one of the late Padre Secchi's well-known and expensive meteorographs has been regularly at work at Havana, and is said to give very satisfactory results. We note that an attempt is made each month to connect the magnetical with the atmospherical disturbances.

WE have received from the Jesuit College of Oña, province of Burgos, a pamphlet containing meteorological observations made twice daily, with monthly and yearly results for the years 1883–1894. The Observatory is 1900 feet above sea-level, and is rather sheltered; but the summary of the climate of that part of Spain by Prof. Valladares, and the observations of cirrus clouds and their connection with atmospheric disturbances, are valuable contributions to meteorological science. During the twelve years in question, the extreme shade temperatures varied from 1°·3 to 100°, the annual mean being 51°·8, and the average yearly rainfall was 22 inches.

M. CASIMIR DE CANDOLLE contributes to the *Archives des Sciences Physiques et Naturelles* an important paper on the latent life of seeds. From a series of experiments, chiefly on seeds of wheat, oat, and fennel, he concludes that dormant seeds pass through a period of completely suspended animation, in which all the functions of the protoplasm are quiescent, but from which they revive when again placed in conditions suitable for germination. The immunity from injury appears to depend on the protoplasm of the seed passing into a completely inert state, in which it is incapable of either respiring or assimilating, before exposure to the unfavourable conditions. The period of suspended animation may extend over an indefinite time, probably through a long series of years, and the seeds may during this period be subjected to very low temperatures without destroying their vitality. Those above mentioned were exposed, in a refrigerator, as many as 118 times in succession, to a sudden cooling to temperatures varying between -30° and -53° C., without injurious effects. On the other hand, seeds of the sensitive plant and of *Lobelia Erinus* succumbed, for the most part, to similar treatment. These statements have an important bearing on the question of the retention of their vitality by buried seeds.

The additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus*) from India, presented by Mrs. Herman Schlesenger; a Rhesus Monkey (*Macacus rhesus*) from India, presented by Miss Folhurst; a Macaque Monkey (*Macacus cynomolgus*) from India, three Slow Lorises (*Nycticebus tardigradus*) from Sumatra, presented by Mr. Stanley S. Flower; a Geoffroy's Marmoset (*Midos geoffroii*) from Panama, presented by Miss Mina Sangiorgi; a Green Monkey (*Cercopithecus callitrichus*) from West Africa, presented by Mdlle. Eugénie Grobel; a Barbary Ape (*Macacus inuus*) from North Africa, presented by Mr. Edwin Fletcher; two Crested Porcupines (*Hystrix cristata*), two Cape Zorillas (*Ictonyx zorilla*) from South Africa, presented by Mr. J. E. Matcham: a Ducorp's Cockatoo (*Cocatua ducorpsi*) from the Solomon Islands, presented by Mrs. Dexter; a Nightjar (*Caprimulgus europæus*), European, presented by Mr. T. West Carnie; two Robben Island Snakes (*Coronella phocarum*) from South Africa, presented by Mr. Barry McMillam; a ——— Chameleon (*Chamæleon basiliscus*) from Egypt, presented by Mr. J. Buchanan; a Brown Capuchin (*Cebus fatuellus*) from Guiana, a Black-backed Jackal (*Canis mesomelas*) from South Africa, six Ring-tailed Coatis (*Nasua rufa*) from South America, deposited; a Red River Hog (*Potamochœrus penicillatus*) from West Africa, a Sooty Phalanger (*Phalangista fuliginosa*) from Australia; a De Filippi's Meadow Starling (*Sturnella defilippi*) from La Plata, purchased; two Mandarin Ducks (*Æx galericulata*), seven Summer Ducks (*Æx sponsa*), three Chilian Pintails (*Dafila spinicauda*), bred in the Gardens.

OUR ASTRONOMICAL COLUMN.

The Rotation of Venus.—Notwithstanding the persistence with which the planet Venus has been telescopically observed, the period of rotation is still undetermined with anything like certainty. Schröter believed the time of rotation to be 23h. 21m.; and this period, or thereabouts, was pretty generally adopted until the announcement by Schiaparelli, in 1890, that the time of rotation was probably equal to that of the planet's revolution round the sun, that is, about 225 days. This conclusion was based on the rigidity of the markings at different hours of the day and for weeks together. Observations by M. Perrotin and Dr. Terby tend to strengthen the conclusion arrived at by Schiaparelli. On the other hand, M. Niesten observed the planet between 1881 and 1890, and found that a period of 23 hours satisfied his observations; while M. Trouvelot, from nearly twenty years' work, concluded that the rotation period was about 24 hours. In this divided state of opinion, therefore, it is evident that much remains to be done before any satisfactory conclusion can be drawn.

During the present year, Mr. Brenner, of the Manora Observatory, has observed the planet as frequently as possible since April 17 (*Ast. Nach.* 3300). His first observations of a bright and a dark spot near the north pole led him to agree with Schiaparelli, but further observations have changed his opinion, and he now believes the period to be about 24 hours. On July 2 he announced that a marking near the southern cusp had been visible since June 9, but became invisible about 4 p.m. each day, while a well-marked streak appeared about 8 p.m. Other marks also appeared and disappeared in a manner inconsistent with a rotation period of more than 24 hours. One of the most important of the markings, though noted quite independently, appears to be identical with one observed by Mr. Stanley Williams eleven years ago; in a communication to Mr. Brenner, Mr. Williams states: "In 1884 I managed to secure about one hundred sketches of the markings on Venus. These mostly favour a rotation of about 24 hours; but there was one strongly-marked indentation near the southern horn, which remained visible continuously for about a month. It was prolonged on the disc by a narrow and unusually dark and definite streak (for Venus)." Mr. Brenner has since claimed to have proved with certainty that Venus rotates in about 24 hours; some of the markings return regularly at the same hour of the day, and are invisible at other times, when the definition is equally good; and it is even possible to observe the appearance and advancing of the most conspicuous streak.

Geodetical Observations.—Dr. Geelmuyden, of Christiania, has recently published the results of a comparison between the astronomical and geodetical determinations made in the course of a triangulation of Norway. The stations selected for observation lie between 59° and 64° lat., and the astronomical work connected with the investigation was conducted under the direction of the late Prof. Fearnley, extending as far back as 1868. The observations refer to measurements made at eleven stations, of which nine have both the azimuth and latitude determined, and two the difference of longitude.

As origin for the geodetical survey, the geographical coordinates of Dragonkollen, a station on the Swedish border, have been chosen, partly because its position is particularly well determined, but principally on the ground that its situation points to the existence of a very small local attraction. Assuming that for this station a vertical line coincides with the normal of Bessel's ellipsoid, Dr. Geelmuyden has computed, with the data already collected in the course of the geodetic survey, the deviations of the plumb-line for the other stations, in which both the azimuth and the latitude have been determined. The results are shown in the following table:—

Station.	Difference of azimuth.	Difference of latitude.	Deviation of vertical.
Jonsknuden	+ 8″·55	− 1″·31	5″·17
Gausta	− 6·23	—	—
Husbergöen	− 0·72	+0·54	0·68
Christiania	− 3·87	+1·79	2·87
Högevarde	− 13·00	—	—
Hostbjörkampen	+ 6·40	+4·68	5·88
Næverfjeld	+ 4·49	+6·62	7·06
Gien	− 10·72	− 2·65	6·20
Graakallen	− 7·71	− 6·98	7·98
Norberghaug	− 6·70	+0·67	3·36

The deviations of the plumb-line here shown, agree on the whole with what might be expected from the conformation of the surface and the contiguity of neighbouring mountains. For example, the westerly deviation of Gien can be explained by the attraction of Dovrefjeld. An exception is, however, met in the case of Norberghaug, where an easterly rather than a westerly deviation would have been expected. A map is attached, in which is shown both the position of the several stations and the direction of the deviation of the plumb-line.

THE INSTITUTION OF MECHANICAL ENGINEERS.

The annual summer meeting of the Institution of Mechanical Engineers was held in Glasgow last week, under the chairmanship of the President of the Institution, Prof. Alexander B. W. Kennedy, F.R.S. A strong local committee had been organised under the chairmanship of Sir Renny Watson, Prof.

Archibald Barr being Secretary, and very complete arrangements had been made for the instruction and entertainment of members taking part in the meeting. In a great engineering centre there can be no lack of objects of interest to afford excursions for a meeting of this Institution, and the organising committee had taken full advantage of the facilities put at their disposal by owners of works who had liberally thrown them open to members.

The meeting commenced on Tuesday, July 30, and was brought to a conclusion on the Friday following. The mornings of the two first days were devoted to the reading of papers, of which the following is a list:—

Hydraulic stoking machinery and labour-saving appliances in modern gas works, by Andrew S. Biggart.

Notes on modern steel-work machinery, by James Riley.

Recent engineering improvements of the Clyde Navigation, by James Deas, Engineer of the Clyde Navigation.

Notes on hydraulic power supply in towns: Glasgow, Manchester, Buenos Ayres, &c., by Edward B. Ellington.

Papers on telemeters and range-finders for naval and other purposes, by Profs. Barr and Stroud, and on the electric lighting of Edinburgh, by Henry R. J. Burstall, were also on the agenda, but had to be adjourned until the next meeting.

On members assembling in the Institute of Fine Arts, they were welcomed by the Lord Provost of Glasgow, Sir James Bell, and the usual formal business having been disposed of, the first paper was taken, namely, that of Mr. Biggart, on gas works machinery. In this the author described an extensive hydraulic plant which has recently been laid down at the Dawsholm Gas Works in Glasgow. The apparatus is designed to supersede hand labour in the charging of retorts, and clearing them of the residual coke when the gas has been abstracted from the fuel. The usual method of performing these operations by hand must be known to most people. The coal having been broken to suitable size by hand, is placed in the retort by means of a long half-round scoop or trough. This is pushed into the retort and then turned over, the coal then being spilled and spread evenly throughout the length of the retort. This is very laborious work, and moreover the smoke and dust accompanying it are very injurious. It is, however, less trying than the discharging of the retorts, an operation which consists of raking out a mass of coke almost at a white heat. It will be easily understood, even by those not personally acquainted with gas works, that labour of this nature does not tend to the advancement of the labourer, for though good wages are paid they are apt to be spent in ways not all that could be desired. The introduction of machinery to supersede this somewhat demoralising work is therefore a distinct boon to the workman as well as the proprietors of gas works, and thus, indirectly, the users of gas; in fact, it is the oft-told tale of intelligent work being required to produce machines which take the place of the unthinking labourer. That is very nearly the whole history of the elevation of the working classes. In the machinery described by Mr. Biggart, and illustrated by wall-cartoons displayed at the meeting, the coal is broken by a machine having rolls with powerful steel claws which draw in the coal and break it to pieces of the required size. The coal is conveyed by means of buckets travelling on chains; these scoop it up and take it to the machine or to the required spot after it is broken. The charging machine consists first of a steel frame mounted on a carriage which runs on rails laid on the platform in front of the battery of retorts. Attached to the frame is a hopper, and from this a given quantity of coal is allowed to fall in front of a "pusher-plate." The function of the latter is to thrust the coal into the retort, the necessary forward motion being obtained by means of a hydraulic ram. A second ram is used to withdraw the pusher. About six or seven pushes are required to place the coal in a retort, the quantity that has to be placed at the far end naturally going in first. The arrangement of the mechanism is such that the coal is practically level in the retort, a fact which the gas manager looks on as important. There are many very ingenious devices incorporated in the design of this machine, which we have described in so elementary a manner, but to make them clear we should require somewhat elaborate illustrations. All charging operations are performed by means of a single lever. Having charged one retort, the machine is run along the lines of rail to the next retort, and so on through the whole range.

Having described the main outline of the charging machine, the action of the drawing machine hardly needs explanation, the two being so like in principle. In both the mechanism for raising the pusher or rake, respectively from the coal or coke so as to clear them, is very ingeniously devised, compared to hand labour. The saving in time and labour is considerable, as the machine will charge forty-eight retorts in an hour under favourable conditions. Not half the number of men are required in the retort-house; and it is said that the saving which this represents, averages about a shilling per ton of coal carbonised. As, roughly, about 8,000,000 tons of coal are annually used for gas-making in this country, it will be seen that the universal use of these machines should lead to a saving of £400,000 every year, to say nothing of relieving the working classes of exhausting and by no means elevating labour. It is, however, worthy of note, as indicative of the spirit of the age, that it was strikes, or the fear of strikes, that led to the more general introduction of these labour-saving appliances.

In the long discussion that followed the reading of the paper, the most notable point was the testimony of experienced persons as to the success of these machines.

Mr. James Riley's paper, on modern steel works machinery, was a valuable contribution to the published knowledge on this subject. Mr. Riley has taken a prominent position in the manufacture of mild steel from the time the material was introduced commercially, and he therefore speaks with authority. He was connected with the now almost classic Landore Works under Sir William Siemens, but it was as head of the Steel Company of Scotland that he made his name most widely known; indeed, there is no one to whom naval architects and ship constructors owe more than to the author of the paper for what has been done in the development of the steel-plate industry. Mr. Riley has recently found a new field for his energies, and it was largely in the description of the plant which he has been fitting up, that his paper dealt.

Some of the most impressive examples of the mechanical engineer's art are to be found in the modern steel works of this country. Massive cogging-mills, which will roll down an ingot of ten tons of steel, almost at a white heat, into slabs; hydraulic shears which crop off the ends of these slabs, cutting through a thickness of 12 inches and a width of 5 feet of glowing steel; the enormously powerful hydraulic forging presses—the casting for the cylinder alone, in an instance mentioned by Mr. Riley, weighing 64 tons; the plate mills, rail mills, hot saws, the live rollers and hydraulic turning gear, which deal with many ton ingots of steel as if they were but playthings; all these form an exemplification of artificial force hardly surpassed. The paper in question gave descriptions in detail of the most recent examples of these machines, which it would be of interest to repeat; but the difficulty of making the forms of construction clear without the diagrams shown on the walls, will compel us again to confine ourselves to mere outline. In a cogging mill described and illustrated, slabs up to 60 inches wide could be produced, and these are rolled on their edges by vertical rolls, the ordinary horizontal rolls being used for rolling on the flat. Ingots and slabs are taken to and from the mill by special carriages actuated by hydraulic rams. Hydraulic slab shears, described in the paper, have a centre cylinder of 31 inches in diameter, and two side ones 22 inches each; the work being held down by hydraulic power whilst being sheared. The accumulator pressure is one ton per square inch. The table has two hydraulic cylinders, by which it is raised or lowered. Steam slab cutting shears and plate mills are also described. The author advocates the use of three-high plate mills in place of the more usual reversing mill. A three-high mill runs continuously, the work being passed forward between the bottom and middle roll, and back between the top and middle roll. The frequent reversing of the engine driving the rolls, thus done away with, is naturally a source of loss. Hydraulic power has also been adopted for working plate shears, the mechanism employed for actuating the blades being of the nature of a toggle arm worked from a crank shaft by levers.

A long discussion followed the reading of this paper, in which the desirability of rolling plates from the ingot, without previous cogging, was considered very fully. In America this practice is largely, indeed all but universally, followed; but the general opinion of the high authorities who spoke, appeared to be that in England, owing to the diversity of sizes of plates required, cogging into slabs was a necessary part of plate rolling. It is possible, however, that by properly apportioning mills to the description of work required, the intermediate process may in time become less universal in this country. That, however, remains to be seen, and one must remember how difficult it is to shake trade customs, however much they may stand in the way of advancement in manufacturing processes.

Mr. Deas' paper on Clyde navigation improvements was another excellent contribution to the proceedings of the Institution, although perhaps rather of the nature of a civil than a mechanical engineering paper. We use the term "civil engineering" in its restricted but more generally accepted sense. The Clyde is probably the most artificial tidal river in the world. What man has done for the Clyde, and what the Clyde has done for Glasgow, every one has heard. Mr. Deas carries the details of the narrative a step further, showing how he built up good and enduring quay walls where the nature of the ground rendered the task one of the greatest difficulty. The most striking feature was the series of hollow concrete cylinders, sunk into the natural sand or gravel to form a foundation for the quay walls. The method of sinking was ingenious, and to those interested in these matters a perusal of the paper will be of great interest, both in regard to this and many other points.

Mr. Ellington's paper was one of great interest, as, indeed, were all the memoirs read at this meeting. The author has taken the foremost position in the introduction of the distribution of hydraulic power from a central station. The first example on a large scale was the installation at Hull, which was laid down in 1877. This was followed, after an interval of seven years, by the London scheme, which has now reached large dimensions, not far from ten million gallons of water being pumped per week at a pressure of 750 lbs. to the square inch; the mains extending over the most important parts of the metropolis. Since then the system has been applied in Liverpool, Melbourne, Birmingham, Sydney, and Antwerp; the latter city using over three million gallons per week. The latest examples are Manchester and Glasgow, where the pressure has been increased to 1120 lbs. to the square inch. It was the Glasgow scheme that Mr. Ellington chiefly described. These works have been carried out under the supervision of Mr. Corbet Woodall, acting for the Corporation. The engine-house is laid out to contain six sets of triple compound engines of 200-horse power each. There are two accumulators having rams 18 inches in diameter, and 23 feet stroke; each is loaded to 127 tons. The capacity is 57,500 gallons per hour at the standard pressure of 1120 lbs. to the square inch. The water supply is taken from the Corporation mains; in London Thames water is used. The mains are 7 inches in diameter, there being gutta-percha packing rings at the joints.

Speaking of the efficiency of the system, the author founded his remarks chiefly on his experience in London, and it was found that the average for ten years was 0·9243. The efficiency is determined by the fraction representing the ratio of the quantity of water registered by consumers' meters to the quantity pumped at the central stations. In Liverpool a still better coefficient is obtained, the efficiency being 0·9555. A Parkinson meter is used by the author; this is very like a gas meter. The Kent positive low-pressure meter is largely used in London.

Perhaps the most interesting part of Mr. Ellington's paper was that in which he compared the cost of hydraulic power supply and electric supply. The results were largely in favour of the water system, and were certainly somewhat surprising to many. In making this comparison data were taken from the records of the London Hydraulic Power Company and of the Westminster Electric Supply Corporation. In making the comparison 1000 gallons of water at 750 lbs. per square inch is taken as equivalent to 6·518 Board of Trade units of electricity. The analysis showed that the station cost of hydraulic power is 5·172*d.* per thousand gallons pumped at a pressure of 750 lbs. per square inch. The corresponding cost of an equivalent amount of electric energy, reduced to the same hydraulic standard, is 9·014*d.* per thousand gallons; on an electrical standard of Board of Trade units of 0·793*d.* and 1·383*d.* for hydraulic and electrical energy respectively. It was a curious coincidence that, in making this comparison, the capital outlay, output, quantity sold, and average price obtained were nearly the same; it was only in cost of production that the divergence was remarkable. A further point that came out in the discussion was that the dividends paid by the two companies respectively were not greatly different. The author could come to no other conclusion on the figures than that, from some cause not hitherto explained, hydraulic power is much less costly to produce than electricity. Prof. Kennedy, who occupied the chair, and who is so largely responsible for the distribution of electrical energy, could find no fault with Mr. Ellington's figures; but we believe the matter is likely to become the subject of further investigation.

We do not propose dealing with the many excursions that were made, and which included visits to a large number of shipyards, engine works, iron and steel works, as well as the large Corporation undertakings, such as the gas and water works, To describe these at all adequately would require a volume rather than an article. It will suffice to say here that these excursions were well attended, and the meeting was highly successful generally.

THE INTERNATIONAL GEOGRAPHICAL CONGRESS.

THE closing meeting of the International Geographical Congress took place on Saturday morning (August 3), and there seemed to be no dissentients from the opinion that in all its departments the Congress has been a great success. In particular, the meeting is to be congratulated on accomplishing much important work, and combining therewith a large amount of entertainment and social intercourse, without unduly taxing the energies of its members. While there was no reason to expect, in a scientific body like the Congress, any serious complication of interests, it is specially satisfactory to recognise the spirit which showed itself in all the sittings from day to day, and found its most definite expression in the graceful and courteous speech in which General Greely seconded the proposal that the Congress accept the invitation of the German delegates to hold the next meeting in Berlin. The Congress has not as yet met in Germany, and it was felt that a large number of members would have great difficulty in attending a meeting at Washington, although a visit to the United States offered many inducements to accept the cordial invitation which came from that country.

At the close of its proceedings the Congress gave deliverance on a number of important questions which we may take as representing the general views of geographical experts on matters of special moment in that branch of science. With regard to Africa it was agreed that it is desirable to bring to the notice of the Geographical Societies interested in Africa the advantages to be gained:—

(1) By the execution of accurate topographical surveys, based on a sufficient triangulation, of the districts in Africa suitable for colonisation by Europeans.

(2) By encouraging travellers to sketch areas rather than mere routes.

(3) By the formation and publication of a list of all the places in unsurveyed Africa, which have been accurately determined by astronomical observations, with explanations of the methods employed.

(4) By the accurate determination of the position of many of the most important places in unsurveyed Africa, for which operation the lines of telegraph already erected, or in course of erection, afford so great facilities.

Resolutions were passed as to the collection and cataloguing of cartographic materials, and urging that all maps should bear the date of their publication, and the report of an influential commission appointed at Berne to consider a proposed map of the world on a scale of 1 : 1,000,000 was adopted in a form embodying a resolution that:—

(1) The Commission has received the Report of the Berne Committee, and feels grateful for the work done by it.

(2) The Commission declares that the production of a map of the earth to be exceedingly desirable.

(3) A scale of 1 : 1,000,000 is recommended as being more especially suited for that purpose.

(4) The Commission recommends that each sheet of the map be bounded by arcs of parallels and of meridians. A poly-conical projection is the only one which is deserving of consideration. Each sheet of the map is to embrace 4 degrees of latitude and 6 degrees of longitude, up to 60 degrees north, and 12 degrees of longitude beyond that parallel.

(5) The Commission recommends unanimously that the meridian of Greenwich and the metre be accepted for this map.

(6) The Commission recommends governments, institutions, and societies, who may publish maps, to acccept the scale recommended.

(7) The Commission lays down its mandate, and recommends

that the Executive Committee of the Congress be charged with the duty of carrying on its work, and be authorised to co-opt for this purpose scientific men representing various countries.

Support was given to the proposal for further international surveys in the North Atlantic, the North Sea, and the Baltic, by the adoption of a resolution, drawn up by a special Committee—"That the Congress recognises the scientific and economic importance of the results of recent research in the Baltic, the North Sea, and the North Atlantic, especially with regard to fishing interests, and records its opinion that the survey of these areas should be continued and extended by the co-operation of the different nationalities concerned on the lines of the scheme presented to the Congress by Prof. Pettersson."

The recommendation of the Education Committee was adopted, to the effect that—"The attention ot this International Congress having been drawn by the British members to the educational efforts being made by the British Geographical Societies, the Congress desires to express its hearty sympathy with such efforts, and to place on record its opinion that in every country provision should be made for higher education in geography, either in the universities or otherwise."

Other resolutions were also carried, expressing the approval of the principle of State printed registration of literature, as the true foundation of national and international bibliography, urging the need of some agreement as to the writing of place-names, and acknowledging the scientific necessity of an international system of stations for the observation of earthquakes.

Besides the above, a number of resolutions were adopted in the course of the daily deliberations, of which the following is, perhaps, the most important of all the decisions of the Congress.

The resolution refers to the Exploration of the Antarctic regions, concerning which the Congress recorded its opinion that this is the greatest piece of geographical exploration still to be undertaken, and in view of the additions to knowledge in almost every branch of science which would result from such a scientific exploration, the Congress recommended that the several scientific societies throughout the world should urge in whatever way seemed to them most effective, that this work shall be undertaken before the close of the century.

The following is a summary of the proceedings ot the Congress during the week. Previous meetings were reported in our last issue.

The general session on Monday (July 29) opened with a paper on Antarctic Exploration by Geheimrath Prof. Dr. G. Neumayer, and a discussion followed, in which the President, Sir Joseph Hooker—the only survivor of Sir James Clark Ross's Antarctic Expedition of 1843—Dr. John Murray, Sir George Baden-Powell, Mr. Arundell, M. de Lapparent, General Greely, and Prof. Guido Cora took part; and a committee was appointed to draft the resolution already quoted. The Congress then turned its attention to the Arctic regions, papers being presented by Admiral A. H. Markham, General Greely, Herr S. A. Andrée, and M. E. Payart. Herr Andrée's project for reaching the North Pole by means of balloons was somewhat severely criticised, but the author was confident of being able to meet all the difficulties suggested, and announced that he had already obtained the funds necessary for his expedition. A paper on Russian researches on a sea route to Siberia was afterwards read by Lieut.-Colonel de Shokalsky.

In the afternoon, General Annenkoff and Mr. J. Y. Buchanan presided over Section B, which dealt with papers relating to physical geography. M. le Comte de Bizemont presented a paper by M. G. Lennier on the modifications of the coasts of Normandy, and Prince Roland Bonaparte gave an account of researches on the periodic variations in French glaciers. After these were discussed, papers on the decimal division of time and angles, on the centesimal division of the right angle, on standard time, and on a system of symbolic hour zones, were read by M. le Dr. J. de Rey Pailhade, M. Louis Fabry (presented by M. Jacques Léotard), M. Bouthillier de Beaumont (presented by M. le Comte de Bizemont), and Prof. d'Italo Frassi, and a further discussion followed.

Section C, presided over by M. le Colonel Bassot and Colonel Sir Henry Thuillier, concerned itself with geodesy, and important papers were read on the geodetic operations of the Indian Survey, by General J. T. Walker, C.B., F.R.S., late Surveyor-General of India; the desirability of a geodetic connection between the surveys of Russia and India, by Colonel T. H. Holdich, C.B. (read by Colonel Sir John Ardagh); the general levelling of France, by M. Charles Lallemand, Directeur du Service du nivellement général; the rise and progress of cartography in the Colony of the Cape of Good Hope, by A. de Smidt, late Surveyor-General of that colony; and on the geodetic survey of South Africa, by Dr. David Gill, F.R.S., Astronomer-General for Cape of Good Hope (communicated by Mr. A. de Smidt).

In the course of discussion the need of surveys of the Nile Valley in connection with the South African triangulation was emphasised.

On Tuesday, July 30, the general meeting was chiefly occupied with reports, and the discussion of resolutions already referred to. Section B was devoted to oceanography, under the presidency of Dr. John Murray. Mr. J. Y. Buchanan gave a retrospect of oceanography during the last twenty years, and read a paper, by the Prince of Monaco, on the work of the yacht *Princess Alice*. A paper on ocean currents and the methods of their observation, by Captain A. S. Thomson, was laid on the table; and Prof. W. Libbey, of Princeton, gave an account of some valuable researches on the relations of the Gulf Stream and the Labrador current. Prof. Libbey's investigations have afforded some remarkable results bearing on the migrations of fish on the eastern seaboard of the United States, and they form an interesting contribution to the study of certain problems in marine zoology. A paper by Prof. J. Thoulet, suggesting that geographical societies in towns situated near the coast should interest themselves in the oceanography of neighbouring seas, was laid on the table.

Section C, presided over by Prof. H. Cordier and Prof. J. J. Rein, discussed geographical orthography and definitions. Papers were read on the orthography of place-names by Mr. G. G. Chisholm; on geographical place-names in Europe and the East, by Dr. James Burgess; and on the transliteration and pronunciation of place-names, by Dr. Giuseppe Ricchieri.

Popular interest in the Congress probably reached its highest point at the general meeting on Wednesday (July 31), when the proceedings related exclusively to Africa and its development. Sir John Kirk read a paper on the suitability of tropical Africa for development by white races or under their superintendence, dealing with the possibilities of colonisation proper, the establishment of European settlements in places permitting of temporary residence, and the means whereby the native races may themselves be taught to aid in the development of the country. Count von Pfeil laid down the conditions of success in colonising tropical Africa, which he said were chiefly a thorough knowledge of the character of the country it was proposed to colonise, of tropical hygiene, and of the art of making the native take an active share in the work. Mr. Silva White's paper dealt with the problem from various points of view, the author concluding that tropical Africa is on the whole unsuitable for European colonisation, and that it is capable of only a limited degree of development as compared with other and still undeveloped regions of the world. Mr. H. M. Stanley, Mr. E. G. Ravenstein, M. Lionel Décle, and Slatin Pasha also presented communications to the meeting, and a discussion followed. General Chapman read a paper on the mapping of Africa, and a proposal was referred to a committee whose report includes the resolution given above. A paper on a crestographic map of Africa was read by Mr. Silva White, and another by M. Victor de Ternant, on French Africa, was laid on the table.

Only one of the sections met (Section C). The Presidents were Dr. A. Gregoriev and Prof. Libbey. Oceanographical papers were communicated by Prof. Otto Pettersson and Mr. H. N. Dickson, dealing with recent research in the North Sea. Prof. Pettersson submitted a scheme for an extension of the same work, and a committee was appointed to draw up the resolution afterwards adopted by the Congress. A paper on limnology as a branch of geography was then read by Prof. Forel, and after remarks by Prof. Anuchin, Prof. Halbfass, Prof. Penck, Prof. Libbey, and M. de Krapotkine, Dr. H. R. Mill asked that his paper on "Limnology in the British Islands" be held as read. Señor F. A. Pezet gave an account of the counter-current "El Niño" on the coast of Northern Peru.

The general meeting of Thursday (August 1) opened with a return to the subject of Antarctic exploration. Mr. C. E. Borchgrevink, who had been unable to reach London in time for the meeting on Monday, read a paper on his voyage in the *Antarctic* to Victoria Land. Prof. C. M.

Kan read a paper on Western New Guinea, and future exploration in Australia was discussed by Mr. David Lindsay. A memoir on the Niger lakes, by M. Paul Vuillot, was laid on the table, and one on explorations in Madagascar, by M. E. F. Gautier, was communicated in abstract. In the absence of M. Maistre, who was to have read a paper on the hydrographic system of the Shari and Logone, Señor Don Torres Campos gave an account of the climatology of the Portuguese and Spanish colonies on the west coast of Africa.

Section B—Presidents, M. Levasseur and Mr. Ravenstein—received the following papers:—On the construction of a terrestrial globe on the scale of 1 : 100,000, by Prof. E. Reclus; on the construction of globes, by Signor Césare Pomba; the life and geographical works of Cassini de Thury, by M. Ludovic Drapeyron; an ethnographical map of Europe, by Herr V. von Haardt.

Prof. de Lapparent, Dr. John Murray, and Prof. Penck presided over Section C, where Prof. Palacky read a paper on the geographical element in evolution; Dr. E. Naumann, one on the fundamental lines of Anatolia and Central Asia; Dr. S. Passarge, a third on laterite and red earth in Africa and India; and Mr. Henry G. Bryant, a fourth on the most northern Eskimos. The last paper described observations made in North and South Greenland during the Peary Relief Expeditions.

On Friday (August 2) the President communicated a paper to the general meeting, by Baron A. E. Nordenskiöld, on ancient charts and sailing directions. Prof. Hermann Wagner read a paper on the origin of the mediæval Italian nautical charts, which gave some interesting results as to the length of the mediæval nautical mile. Mr. Yule Oldham dealt with the place of mediæval manuscript maps in the study of the history of geographical discovery, and, in the course of remarks on this paper, Mr. Batalha-Reis announced the discovery of an authentic fifteenth century portrait of Prince Henry the Navigator, at Lisbon. The Congress received a number of presentations, and discussed various proposals and resolutions.

Section B—Presidents, Señor Don Torres Campos and M. le Prof. Levasseur—dealt with spæliology (or the science of caverns) and mountain structure. A paper on the method of investigating caverns, by M. E. A. Martel, was read; M. F. Schrader described new instruments and methods used in surveying the Pyrenees; and Prof. Rein gave an account of observations in the Spanish Sierra Nevada.

Dr. E. Naumann occupied the chair in Section C, in which Prof. Penck read an important paper on the morphology and terminology of land forms, and communications were received from Mr. Batalha-Reis on the definition of geography, and Prof. Gerland on earthquake observations.

On Saturday only a general meeting was held. General Annenkoff read a paper on the importance of geography in connection with the present agricultural and economical crisis, and the rest of the time was occupied with resolutions and reports. The President dissolved the Congress in a short concluding address, and bid the foreign visitors a hearty farewell.

After such well-filled days the Congress wisely devoted most of its evenings to recreation. Only two exceptions were made. On Monday night Prof. Libbey showed by the lantern a large number of photographs made in the north of Greenland; and on Thursday Dr. H. R. Mill gave a demonstration in the form of a lecture on the English lakes.

THE BRITISH MEDICAL ASSOCIATION.

THE sixty-third annual meeting of the British Medical Association, held in London last week, was the largest in the history of the Association, and one of the greatest assemblies of medical men ever known. Twenty-two years ago the Association held its annual meeting in London, but whereas at that time the membership was only 1500, the number now exceeds 16,000. A large number of foreign medical men were present at the meeting, among them being Prof. Stokvis, Dr. W. W. Keen, Dr. Apostoli, Prof. Mosso, Dr. Fraenckel, Dr. Farkas, Prof. Pozzi, Dr. Ottolinghi, Prof. Lazarewitch, Prof. von Ranke, Prof. Baginsky, Dr. Hermann Biggs, Dr. Ball, Dr. Koster, Prof. Gayet, Dr. Meyer, Prof. Panas, Prof. Fuchs, Prof. Bowditch, Dr. L. A. Nékám, Prof. Baumler, Prof. Martin, Dr. Cushine, Prof. Cordès, Prof. Hamburgher, Prof. Marinesco, and Prof. Geikie. Sir T. Russell Reynolds therefore presided over an assembly international in its main aims, and representing an Association as remarkable in its growth as it is high in its standing. It is only possible here to give a few extracts from some of the addresses and refer briefly to a part of the general work of the sections. For these reports we are indebted to the *British Medical Journal*, the organ of the Association. Sir T. Russell Reynolds took for the object of his address "the most striking fact of modern physiological, pathological, and therapeutical research, viz. the power of living things for both good and evil in the conservation of health and in the prevention or cure of disease." In the course of his remarks he said:—"The most important fact with regard to recent microbiological research is the gradually-increasing appreciation of the fact that these lower forms of life exert, not necessarily mischievous, but, indeed, benignant influences on the human body, and that although the mode of their operation is not fully explained they take part in healthy processes, assisting normal functions, nay, indeed, it would seem sometimes producing them and warding off the malign effects of other influences to which we are habitually exposed. These bodies, to which we are indebted for this aid, operate partly by their chemic action and partly by what we must call a vital process, and by their cultivation outside the human body and their modification by passing through other organisms, can be made to exert a malign or a beneficial agency on man. It seems even in the range of possibility that at some time not very distant some other than 'the ancient mariner' may apply to them the far-reaching words of Coleridge, and exclaim—

> O happy living things! no tongue
> Their beauty might declare;
> * * * * *
> Sure my kind saint took pity on me,
> And I blessed them unaware.

"The third great revelation of the last twenty years is the wonderful protective and curative power of these living products. This, in a very wide sense, is not new. Of all the most powerful agents of destruction, the most violent have been derived from 'living' things; they are to be found in the animal and vegetable worlds, not in the mineral. In their most terrible malignity—such as in snake-bite, glanders, or hydrophobia—these need no human skill for their development; they are prepared in the laboratory of nature, and, alas! are only too ready to our hand. Next to these come the poisons of stinging things, and, after them, the more slowly operating and less deadly animal infections; some with indeed beneficial influence, as 'vaccinia'; others with local effects on the skin, but not often great disturbance of the general health.

"The vegetable kingdom can produce potent poisons, such as belladonna berries, aconite root and leaves, poppy juice, and the ignatian bean; but in order to render these more deadly the hand of man has to come in and prepare nicotine, strychnine, morphine, and the like; just as it may produce, from the mineral or quasi-mineral world, such potent agents as hydrocyanic acid, concentrated acids, and other dealers of destruction.

"The interest in these facts lies in the modern mode for their utilisation. The great potency of living products has led to very fanciful notions in therapeutics; and there have been those who, to cure diseases of organs, have given portions of the same but healthy organs of animals or of man or other animals. Again, the idea has been pronounced that even excreta were useful drugs, and that the diseased organs of man might effect a cure of those supposed to be afflicted in like manner.

"Curious as some of these details are, they are of real interest to us only as they lead up, through inoculation for small-pox, to our own Edward Jenner's discovery of vaccination, and then, through the researches of Pasteur, Lister, and Brown-Séquard, to our present state and plane of knowledge. It would seem now that there is scarcely any limit to what may be expected in the cure or prevention of disease; and the most striking of all phenomena is, to my mind, the probability of rendering an animal immune by the introduction into its organism of a healthy constituent of the body of another. This, if fully confirmed, will be the greatest veritable triumph of therapeutic and preventive medicine, instituted and guided by extended inquiry into comparative anatomy, physiology, and pathology. As in the human race or species there exist, as is well known, what may be termed 'idiosyncrasies'—by which is simply meant that as a matter of fact some people, and some people's families, escape epidemic diseases, whereas they are especially prone to take others to which they may be exposed—so in the great economy of Nature certain groups of animals have been shown to exhibit no capacity for 'taking,' or for even being 'inoculated' with the poisons to which others are exposed, and from which they suffer, and that severely. It would seem, therefore, that use may be made of these animals, more or less naturally immune from certain maladies, and that their immunity may be partially conferred on man.

"Quite recently a communication of the greatest importance has been made on the rendering of animals immune against the venom of the cobra and other snakes, and on the antidotal properties of blood serum of immunised animals. This subject has occupied attention during the last six years, and we must all look forward with expectancy and hope to the possible and probable diminution of a great national and imperial calamity.

"The outcome of what I have been saying is this: that the scattered fragments of knowledge and 'guesses at truth' of many years have been gathered into a focus during the past twenty-five years; that the vegetable life, extracting from the mineral world the materials it needs for growth and production of powerful agencies for good in the form of food and medicines, and for evil in the form of poisons, has given itself up to the growth of animal life, with its much more complex organs, and for cure of ills once thought beyond the reach of human aid; but that, thanks to man's scientific ardour and industry, it has again shown itself to be our servant, our helper, and our protector.

"These are not dreams of the study, they are facts of the laboratory and of daily life; and in using that word 'life' again, I must endeavour to emphasise still more forcibly upon you my urgent belief that it is to living agencies and their employment that we must look for help in the care of infancy, the conduct of education—moral, mental, and physical—the training up of character as well as of limbs; that it is the guidance of living functions, in the choice of living occupations, be they either of hard work or of amusement. It is to these we must appeal if we would see the *mens sana in corpore sano;* and then it will be to these that we may confidently look for help when the inroads of age or of disease are at hand, often to cure us of our trouble; or, if not, to give us rest and peace.

"It would be absurd in me, now and here, to attempt to say in what this potency of life exists. It is enough for us to recognise its existence, rejoice in its marvellous energy, and anticipate still more from our investigations of its modes of action, but I cannot help feeling that, however far we go in our research into the arcana of nature, one of our ablest neurologists, who has gone very far, is right when he says: 'Search while you may with eyes, however aided and however earnest, that which we call "life," eludes our search and resists our efforts. We must be content with what knowledge we can gain, secure or insecure, and while using it as best we may, should realise in all humility how much there is we cannot know, and yet we cannot doubt.'"

An address in medicine was delivered by Sir William Broadbent, who traced the growth of the art and science of medicine. He pointed out that of the infancy of medicine properly speaking nothing is known.

Individual acts of healing are related in the Old Testament, and the treatment of wounds is described by Homer; the Chinese from remote antiquity had a system of medicine, and medicine has a place in the *Vedas;* but in the works of Hippocrates, who was born about 460 B.C., the earliest medical literature which has been handed down, the theory and practice of the art of healing is shown in a considerably advanced stage of development. The development of medicine from that time was sketched by Sir W. Broadbent in an admirable address, and the great advances made during the present century in the many departments of his subject were touched upon. In one of the sections, the excellence and defects of modern therapeutics were passed in review as follows:—

"We have still to ask, What is the bearing of all these advances of knowledge on therapeutics, which, after all, is the object of our lives?

"Until the last few years it has not been easy to answer this question by instances of any very extensive applications of physiology to the treatment of disease, and morbid anatomy was at one time a stumbling-block in the way of therapeutic effort. The pathologist, pointing to an excavated lung or cirrhosed liver, would ask the physician what he could expect to do with drugs against such conditions. But that stage has passed away, and I will not mock your intelligence by other illustrations beyond those just given of therapeutic applications of physiological and pathological knowledge, or by arguing that all knowledge of normal processes aids in the comprehension of morbid processes, and that we are in a better position to combat disease when we thoroughly understand its causation and initiation, and follow mentally its development, course, and tendencies.

"Given the faculty of observation, the insight which penetrates the meaning of the phenomena, the analytical and synthetical powers by which a diagnosis is constructed, the ready adaptation of means to a well-defined end, and the firmness of character required to deal with the frailties of human nature, and the best physiologist will make the best pathologist and the best pathologist the best physician.

"As regards the remedies at our command, they are only too numerous. Recourse to a great variety of drugs is fatal to exact knowledge of their effects and to precision in their use, but new ones are added every day for the benefit chiefly of those who do not know how to employ the old ones. There have, however, been recent acquisitions of extreme value, heavily discounted, unfortunately, in the case of some by the mischief done through their indiscriminate use: the antiseptic group, the chloral sulphonal group, the salicylates and salicine, the phenacetins and antipyrin class, coca and cocaine. What makes some of these, moreover, far more important and interesting is the fact that their physiological action has been inferred from their chemical constitution.

"A fact which brings practical therapeutics into near relation with physiology and pathology is that the active principles of all drugs are isolated, their chemical composition is ascertained, and their physiological action investigated. Pharmacology, in effect, has become a branch of experimental physiology, and the immediate effect of remedies is known with a completeness and accuracy heretofore undreamt of. All this is working towards a more intelligent employment of drugs, and leads towards the goal of all the efforts to bring therapeutics within the circle of the sciences. This goal is that we should know not only the effects of remedies, but how these effects are produced. This is in the last resort a question of chemistry. As I have said before, all vital actions are attended with molecular or chemical changes; are, from one point of view, chemical action, and come under the laws of the correlation of force and conservation of energy; so, therefore, are the physiological and therapeutical action of drugs, and obviously the key to the latter is to be found in the chemistry of vital processes. Therapeutics, to become scientific, is only waiting for answers to the questions which she puts to chemistry. Why are sodium salts so much more abundant than potassium salts in the blood, and why are the former almost confined to the liquor sanguinis, and the latter to the corpuscles? We must assume that albuminoid proteids have an affinity for sodium, and the globulins for potassium. With the answer to this is bound up the secret of the necessity of sodium, potassium, and calcium salts to anabolic and catabolic operations, in which they take no traceable part, and of the presence of iron in the blood corpuscles.

"Why, again, in the case of substances apparently so similar as potassium and sodium salts will the former, if injected into a vein, even in small quantity, paralyse the heart and destroy life, while we see pints of normal saline solution thrown into the circulation with none but good results? How does prussic acid —the simplest in composition and constitution of all organic substances—prove fatal with such fearful promptitude by its presence in infinitesimal proportion in the blood? How again does morphine suspend the activity of the nerve centres? Chemists must admit that the poisonous effects of prussic acid and morphine can only be due to some molecular change in these substances; they know that if the deadly cyanogen is so tied up that its component atoms cannot fly apart it is innocuous, and that a very slight change in the chemical constitution of the morphine molecule entirely alters its effect; it is an almost irresistible inference from the doctrine of conservation of energy that the change in the molecule, say of the morphine, must be equal and opposite to the molecular change in the nerve cells which it arrests. It seems to me, therefore, that we have in the chemical constitution of the morphine molecule a clue to the character of the chemical change by which nerve action takes place and to the quantivalence of nerve energy.

"What then is our position to-day in respect of the three points which we have been following—the recognition of disease, the knowledge of remedies, and the ideas which govern the employment of remedies in the treatment of disease?

"The basis of therapeutics is diagnosis, the grasp of the actual condition underlying the symptoms or phenomena, and the greater our command of powerful remedies and the more precise our knowledge of their effects and of the mode in which these effects are produced, the more important does accuracy in diagnosis become.

"A diagnosis, to be real, implies not only the recognition of the disease which may be present and an accurate appreciation of the morbid changes which may have taken place in various organs. It embraces a knowledge of the nature and intensity of the pathological processes which have been and are in operation, and of the causes which set them going, and also of the results to which they tend. A further element, moreover, enters into the consideration; an estimate, by the aspect of the patient, by the pulse and temperature, and by other subjective and objective indications, of the impression made on the system, and of the resistance which it is capable of to the lethal tendencies of the disease.

"Year by year we see improvement in this respect; not only that hospital physicians and teachers endeavour to carry diagnosis to a greater pitch of accuracy and a higher point of refinement than ever before, but that the entire body of medical men are trained by improved education and systematic clinical teaching to appreciate and to practise careful diagnosis in their daily work.

"Diagnosis, we may say, has reached an extraordinary degree of advancement. There are, no doubt, still new fields to conquer, but in the recognition of diseases, local and general, there is not much which seriously concerns the human race which remains to be done. The same degree of knowledge, however, does not extend to morbid processes. Our comprehension of the significance and essential character of inflammation is by no means complete and satisfactory. The part which fever plays and the place which it holds among the phenomena of disease is far from being fully understood. It cannot have been intended by nature for the destruction of the subject, and we can see distinctly that in some cases it forms part of the defensive operations; possibly, indeed, its general tendency is defensive, by promoting the production of phagocytes, or possibly a certain elevation of the temperature may be fatal to maleficent organisms which have taken possession of the blood or tissues. We are not certain, indeed, whether in pyrexia the heat-producing oxidation in the structures receives its stimulus from, or takes place at the bidding of, the nervous centres, or, on the other hand, is due to enfeeblement of the restraint which they normally exercise over it, or whether it defies control by the thermo-taxic nervous centres."

An address in surgery was delivered by Mr. Jonathan Hutchinson, who gave a brief retrospect of the surgery of the past, interspersed with a few comments as to what may be hoped for the future.

Prof. Schäfer delivered an address in Physiology, taking for his subject "Internal Secretions." After describing various glands and secretions and their method of interaction, he said: The general results to which we are led point very strongly in favour of the notion that internal secretions are yielded both by the ductless glands and by what are usually known as the true secreting glands, and it is obvious that such internal secretions may be of no less importance than the better-recognised functions of the external secreting glands. That a failure of one or other of these internal secretions has to be definitely reckoned with by the physician there can be no doubt whatever, while at the same time the therapeutist will be able to avail himself of the active principles which the internally secreting organs afford, and in certain cases to use their extracts in place of the hitherto more commonly employed vegetable medicaments.

The work of the different sections covered a wide range, and much of it relates purely to medical practice. It will be sufficient, therefore, for us to indicate by the following summary the general character of a few of the more important papers and discussions reported in the *British Medical Journal.*

SECTION OF MEDICINE.

The President, Dr. Pavy, opened the proceedings in this Section by an address, in which he described the progress in medicine due to the discovery of the casual relationship existing betweeen micro-organisms and certain diseases, enlarging upon the immense effect that this had had upon the question of treatment, and upon the control that could be exercised upon the spread of infectious diseases. He briefly touched upon the serum treatment of diphtheria. Dr. Sidney Martin then introduced the discussion on diphtheria and its treatment by the antitoxin. Dr. Martin commenced by stating that there had always been two schools of therapeutists with regard to the treatment of diphtheria, the one trying to discover some local application which would loosen or remove membrane in the throat, and the other to provide a remedy that would act upon the general symptoms of the disease. The want of success in the past made it essential, in his opinion, to examine most carefully into any new method of treatment suggested, and to submit it to a most rigid scientific inquiry before accepting it. The antitoxin treatment, he stated, had been studied with the greatest care, and its recommendation was based upon the results of a consideration of the pathology of the disease.

Prof. von Ranke (Munich) stated that whilst in 1892 he had in his hospital a mortality of 56·2 per cent., in 1893 of 46 per cent., and in 1894 up to September 24, when he had commenced the serum treatment, one of 57 per cent., since that time his death-rate had been reduced to 17·7 per cent. He further considered that not only was the reduced death-rate due to the injection of antitoxin, but that the course of the disease was favourably influenced in the most striking manner. Prof. Baginsky, of the Empress Frederick Hospital, Berlin, though not speaking with the high enthusiasm of Dr. Ranke, yet gave equally startling figures, stating that whilst the mortality in the four years previous to 1895 had been on the average 41 per cent. under the old system of treatment, during the last year, under the serum treatment, it had been reduced to 15·6 per cent. Dr. Sims Woodhead spoke briefly upon the importance of using large doses of serum, and concluded by quoting some Paris statistics which were highly favourable. Dr. Hermann Biggs (New York) then gave a most interesting account of the immunising effect of the serum, quoting figures to show that in almost all cases the immunising power of the serum extends to a period of thirty days. He further stated that out of 800 healthy children who had received injections, he had not seen a single case in which any harm had resulted from the treatment.

SECTION OF SURGERY.

Sir William MacCormac, President of the Section of Surgery, took for the subject of his address "Some Points of Interest in Connection with the Surgery of War." He came to the following conclusion:—

"It would appear probable that in a future war many of the wounds produced by the new projectile will be surgically less severe, and prove amenable to effective surgical treatment. Probably also the number of severe injuries will be very great when we consider the enormous range of the new weapon and the penetrating power of the projectile, which enables it to traverse the bodies of two or three individuals in line, including bones, and to inflict serious or fatal wounds at a distance of 3000 or 4000 yards. It is impossible to say what the proportion between these two is likely to be. At near ranges the explosive effects will be much the same as before; but at long range the narrow bullet track, the small external wounds, which often approach the subcutaneous in character, and the moderate degree of comminution and fissuring of the bone will be surgically advantageous. These will form the bulk of the gunshot injuries of the future, for it would seem impossible with magazine quick-firing rifles to maintain a contest at close quarters without speedy mutual annihilation.

"We may take it for granted that the number of wounded, in proportion to the numbers engaged and actually under fire, will be greater than before. The supply of ammunition will be larger, the facility for its discharge greater, and smokeless powder will increase accuracy of aim.

"I think we are justified in believing, although there is high authority for a contrary opinion, that the next great war will be more destructive to human life, 'bloodier,' in fact, than any of its predecessors; and that the number of injuries, and in many cases the severity of the injury, will be largely increased. But very many cases will remain less severe in character, more capable of successful treatment, and less likely to entail future disablement, while improved sanitation and antiseptic methods will enormously increase the proportion of recoveries.

"It is the unceasing effort of modern surgery to provide antiseptic protection in an effective form in time of war; and I may be permitted to recall that the medical organisation during our last war in Egypt was so complete in this respect that not a single case of infective wound disease occurred during the whole campaign.

"As a temporary dressing, some form of antiseptic occlusion will prove most generally applicable. The small wounds of entrance and exit render this plan comparatively easy of application, and the chances of septic infection will be diminished by the less frequent necessity for probing or searching for a lodged projectile, and, indeed, the ascertained presence of the bullet is no sufficient indication *per se* to attempt its removal. The eye, rather than the hand, is the best thing to employ at a first dressing station, as Fischer has well said.

"If only asepticity can be ensured—and this is the great difficulty —we may expect a large measure of success to follow the treatment of wounds of the soft parts, many forms of fracture—notably also wounds of the joints, and very especially wounds of the lung."

SECTION OF PUBLIC MEDICINE.

The proceedings in this Section were opened by Mr. Ernest Hart, who delivered an address on "Public Health Legislation and the Needs of India." Mr. Hart strongly criticised the whole system of the sanitary service and the medical service of India, and held that it needs to be overhauled and reconstituted.

"What is urgently needed," he said, "is a Royal Commission or strong Departmental Committee to inquire into the whole matter, and to institute a radical change. For at present India is decimated by preventable diseases; the health of our troops is ruined by the same causes. With us lies the reproach of nursing and fostering cholera in what is called its endemic home—a purely ignorant and silly phrase. Until some great change is made in the whole system of the present administration, the great sanitary needs of India will never be met."

SECTION OF PHARMACOLOGY AND THERAPEUTICS.

In this Section, under the presidency of Sir William Roberts, there was a discussion on Sero-Therapeutics, embracing the application of serum treatment, not only to the acute infective disorders, but also to the cure of bites from venomous serpents. In his introductory remarks the President drew attention to a hitherto much neglected alkaloid of opium, generally known as "narcotine," but more properly termed "anarcotine," from the complete absence of narcotic properties. A large amount of evidence was available which seemed to show that this alkaloid has very valuable antiperiodic powers, which, should further investigation corroborate, will render it a valuable remedy in certain cases of malaria in which quinine entirely fails. The discussion on Sero-therapeutics was opened by Dr. Klein in a paper on the nature of Antitoxin. He drew attention particularly to the differences in action between a protective serum obtained from animals immunised by injections of filtered diphtheria toxin, and by those treated with living cultures of the diphtheria bacillus. He had found that while the first had an extremely high neutralising power on the chemical poison separated from the bacilli, it had not nearly so marked an immunising power. On the other hand, an antitoxin prepared with the aid of living cultures, while it was less active than the other in neutralising toxins, was far more efficacious as an immunising agent. He also gave brief hints on the advantage of using a dried serum in place of the usual liquid form, and stated that the use of the former was far less likely to be followed by the appearance of rashes and other complications.

OTHER SECTIONS.

Dr. Mickle, President of the Section of Psychology, delivered an address on the abnormalities occurring in the form and arrangement of brain convolutions. The Section of Physiology was opened by Dr. Ferrier with an address on the relations of physiology and medicine. In the Section of Anatomy and Histology, Mr. Henry Morris, in his presidential address, gave a brief history of the rise of artistic illustration in its relation to anatomical teaching.

The presidential address in the Section of Pathology and Bacteriology was delivered by Dr. Samuel Wilks, F.R.S. In the course of his remarks he drew attention to the fact that every pathological process is accompanied by a corresponding reparative process, and lamented that sufficient regard had not been paid to the distinction between these constructive and destructive processes. To study these for the sake of discovering the several influences exerted in the production of each is of great practical import; and a consideration of them also shows that pathology is governed by the same laws as those which exist in every other department of nature, and therefore must take its place on an equivalent footing with the other sciences.

Mr. H. Power, the President of the Section of Ophthalmology, remarked on the work that had been done by the founders of ophthalmology in the past, and the gradual formation of a scientific branch of medicine, of which the methods of diagnosis and treatment were fortunate in being founded on pure science. Owing to its intimate relations with the other branches of medicine and surgery there was no danger of its separating from the parent stem and becoming barren; at the same time he advocated a sounder education in the sciences on which ophthalmology was established, such as mathematics and physics, being required of all candidates for ophthalmic posts in hospitals.

BACTERIOLOGICAL EXHIBITS.

A collection of exhibits brought together to illustrate points of general pathological interest was on view during the meeting. Bacteriological exhibits made up one of the departments of the temporary museum thus formed. Dr. Cautley exhibited cultures and coverglass preparations of an organism found in seven out of eight cases of the affection usually termed influenza cold. It was of special interest and importance as showing, first, that the disease in question is microbial in origin, thus explaining the frequency with which such colds affect all the members of a household; secondly, that it possesses a certain relationship to epidemic influenza. The biological characteristics indicated that the organism is allied to the organism of epidemic influenza. Morphologically the organism presented a further point of interest, many club-shaped forms, similar to those of the diphtheria bacillus, appearing in the specimens. Some excellent photographs of the specimens accompanied the exhibit, and were taken by Mr. E. C. Bousfield.

The cultivations from the laboratories of the Conjoint Board of the Royal College of Physicians, London, and of the Royal College of Surgeons, England, were permanently fixed by formic aldehyde. This substance arrests the growth almost at once, and after the lapse of two or three days kills the bacilli. Various organisms in culture illustrated this method, and showed its applicability to museum and other specimens.

Drs. MacFadyen and Hewlett exhibited from the Bacteriological Department of the British Institute of Preventive Medicine a complete series of cultures of the most important micro-organisms, and Mr. Joseph Lunt exhibited living cultures of various water organisms isolated from drinking water, sewage, air, &c., together with some interesting instances of enzymes filtered from both cultures of various organisms, possessing liquefying and other properties similar to those possessed by the parent organisms.

Dr. Klein showed a large number of photographic lantern slides representing nearly all known pathogenic bacteria, and, amongst others, duplicates of Mr. Bousfield's work for the influenza and cholera reports, the latter especially showing vibrios with their flagella with wonderful clearness.

SCIENCE IN THE MAGAZINES.

FOUR short papers on Huxley appear in the *Fortnightly Review*. The Hon. G. C. Brodrick, Warden of Merton College, Oxford, records some personal reminiscences of the man whose loss is so keenly felt. It appears that about thirty-seven years ago, when a Linacre Professorship of Physiology, coupled with Human and Comparative Anatomy, was founded, Huxley meditated becoming a candidate for the chair. Before the election took place, however, he made up his mind not to seek the office, which was awarded to the late Prof. Rolleston. The reason he assigned was that his opinions were too little in harmony with those prevalent at Oxford. This opinion he again gave, but with diminished emphasis, when he was asked, twenty years later, to accept the chair, upon the death of Prof. Rolleston. His work for the advancement of anthropology forms the subject of a note by Prof. E. B. Tylor. "Close upon the end of his life," says Prof. Tylor, "Huxley did his best to promote the scheme to make anthropology at Oxford an examination subject for an Honours degree in Natural Science. Writing to me, he said, "If I know anything about the matter, anthropology is good as knowledge, and good as discipline.' But Convocation thought he did not, 'know anything about the matter,' and threw out the proposed statute." Huxley's career as biologist is sketched by "A Student of Science." The following is worth quoting from that contribution. "It was characteristic of the Professor's general mental attitude that mere novelty never affrighted him. When Ramsay propounded his theory of the excavation of lake basins by glacial action, Huxley supported it, even against the opposition of Lyell and Falconer. Suppose St. Paul's Cathedral removed from its present site to any part of the North Sea, the English Channel, or the Irish Sea, and the whole dome would be clear out of water. Place it, on the other hand, on the flow of Loch Lomond, and the largest ship in the British Navy might float safely over the golden ball, for the Loch has a maximum depth of 630 feet. Sir Andrew Ramsay's theory explains a striking fact like this, and affords undoubtedly a rational explanation of many similar phenomena." The fourth of the papers treats of Huxley as philosopher, and is by Mr. W. L. Courtney, the editor of the *Fortnightly*. Under the title "The Spectroscope in Recent Chemistry," Mr. R. A. Gregory contributes to the same review a brief history of the discovery of argon and helium, and discusses the many interesting points raised by the advent of those two new terrestrial elements, especially with reference to their spectra. It is worthy of contemplation that, so far as instrumental possibilities go, both argon and helium could have been discovered spectroscopically many years ago, and Lord Rayleigh would have been saved his years of tantalising experimentation. And yet there are some who think that the spectroscope will not help much more in the extension of natural knowledge!

The evolution of the orator and poet, actor and dramatist, is traced by Mr. Herbert Spencer in his fourth paper on "Professional Institutions," which appears in the *Contemporary*. First in his story of development comes the orator, who proclaimed the great deeds of a victorious chief during the triumphal reception; then was evolved, through natural selection, the poet, who, with picturesque phrases and figures of speech, gave rhythm to the laudatory speeches. Gradually the orator or poet joined with his speeches mimetic representations of the achievements of the living or the apotheosised ruler, or else they were simultaneously given by some other celebrant. So the actor was produced, and as more complex incidents came to be illustrated by speech and action, it was necessary for one to arrange the parts to be played, and thus the dramatist was developed. In support of this very natural sequence, Mr. Spencer adduces a variety of evidence supplied by uncivilised races and by early civilised races. Another paper in the *Contemporary* consists of extracts from Mr. E. A. Fitzgerald's journal of his ascents of virgin peaks in the New Zealand Alps. Five new peaks were ascended, namely, Sealy, Silberhorn, Tasman, Haidinger, and Sefton, the Matterhorn of the range. He also discovered a pass which has received his name, and across which the range has now been traversed to the west coast. Several attempts had previously been made to find such a route, but unsuccessfully. Mr. Fitzgerald's paper will therefore not only be read with interest by lovers of Alpine adventure, but will also be valued by the geographer.

The story of Antarctic exploration is told in *Macmillan's Magazine*, and the movement for further researches in those higher southern latitudes is given support. It will be remembered that the efforts made by the Royal Geographical Society, in connection with a committee of the Royal Society, to induce the Government to fit out an expedition for exploring in the Antarctic Ocean, were not successful. Notwithstanding this, the writer of the article expresses the general opinion when he says: "When it is undertaken at all it is desirable that the next Antarctic expedition should be a national one. Private enterprise, which has been splendidly active of late in the way of Arctic discovery, would scarcely be equal to all the demands of extensive and thorough Antarctic exploration."

A passing notice must suffice for the remaining articles of more or less scientific interest in the magazines and reviews received. A brief sketch of the characteristics of Sonya Kovalevsky is given in the *Century*, and one of the concluding sentences reads: "Notwithstanding her solid contributions to applied mathematics, she originated nothing; she merely developed the ideas of her teachers." A number of elementary facts with reference to the transporting power of water and the deposit of sediment, are stated by Mr. W. H. Wheeler in *Longman's Magazine*. The *National* contains an article, by Mr. J. L. Macdonald, on fruit-farming in California, which is worth the attention of agriculturists. In the *Quarterly Review*, roses and rose cultivation are surveyed, though more from an historical than a scientific point of view. An *Edinburgh Reviewer* discusses organic variation and animal coloration, basing his remarks upon Mr. Bateson's "Materials for the Study of Variation" and Mr. F. E. Beddard's "Animal Coloration." In *Good Words* we find an illustrated article by Dr. Bowdler Sharpe, on curious nests of birds, and a paper on the Earl of Rosse and his great telescope, by Sir Robert Ball. *Chambers's Journal* contains, among other instructive articles, one on the U.S. North Atlantic Pilot Chart, and another on "Taka Joli," a new substitute for yeast. Finally we have to acknowledge the receipt of *Scribner's Magazine*, the *Sunday Magazine*, and the *Humanitarian*.

PHOTOMETRIC STANDARDS.

THE following Report of the Committee appointed by the Board of Trade, in December 1891, "to inquire into and report to them upon the subject of the standards to be used for testing the illuminating power of coal gas," has just been published as a Parliamentary paper.

"(1) It was intimated to us, by a letter from the Secretary to the Board, that the method at present in use for measuring the illuminative value of coal gas has been objected to, alike by the Metropolitan Gas Referees and the London County Council, as being of an unsatisfactory nature; that the London Gas Companies are alive to the defects in the present system; and that legislation is admittedly necessary for the purpose of substituting a more trustworthy standard for that now in existence; but that, in view of the difference in opinion as to what the substituted standard should be, the President of the Board deemed it advisable that, before his support was given to any legislation, the whole question should be considered by a Committee that would command the confidence of the various interests affected.

"(2) The method at present in use for measuring the illuminative value of coal gas consists in comparing the light of the gas, when burning from a particular burner at a specified rate, with the light of a sperm candle burning also at a specified rate, which last is taken as a standard. We have satisfied ourselves, from considerations set forth in the Appendix to this Report, that the flame of a sperm candle does not furnish a satisfactory standard, by reason of the amount of light which it affords varying over a wide range, under conditions as to the manufacture of the candle, as to its mode of use, and as to adventitious circumstances attending its use, which, as a whole, it is not possible to regulate and define.

"(3) Though recognising, however, that the sperm candle flame does not furnish a satisfactory standard, we nevertheless consider it advisable that, in official documents and reports, the quantity of light yielded by coal gas burned under specified conditions should continue to be expressed as heretofore, in terms of candle-light, the actual comparison, however, being made between the gas-light and some well-defined and constant light ascertained to be equal in quantity to, or a definite multiple of, the average light given by the standard sperm candle.

"(4) We have further come to the conclusion that, in the present state of experience and knowledge, the source of the light to be used as a standard by gas-testers generally must be produced by the process of combustion, and be in the nature of a flame.

"(5) We find that the one-candle-light flame proposed by Mr. A. Vernon Harcourt as giving a standard light, and commonly known as the 'Harcourt pentane air-gas flame,' when used under the conditions defined, does constitute a very exact standard, capable of being reproduced at any time without variation of illuminative value.

"(6) We have satisfied ourselves that the light given by Mr. Harcourt's above-mentioned pentane air-gas flame as defined, in respect to the conditions of its production, in the Appendix, is a true representative of the average light furnished by the sperm candle flame constituting the present standard. Since 1879, when the pentane air-gas flame was first introduced, many series of experiments have been made by different observers, in which the light of the proposed standard has been compared with the light of the standard sperm candle flame, with the result that in those series of experiments in which the height of the pentane air-gas flame was adjusted strictly according to the directions given in the Appendix, the light afforded by this flame was found to agree exactly with the mean result afforded by the standard candle flame. In other series of experiments, indeed, in which a slight variation was made in the mode of adjusting the height of the pentane air-gas flame, some discrepancies in the direct results furnished by the comparison of its light with that of the standard candle flame were observed; but in these several series of experiments also, when the necessary correction, called for by the difference in the mode of adjustment resorted to, was made, the light of the pentane air-gas flame was found to accord closely with the mean result afforded by the standard candle flame.

"(7) Inasmuch, however, as there is a practical advantage in comparing directly the light of such a coal-gas flame as is usually tested (being, that is, of about a sixteen-candle-light value), with a light approximating somewhat in value thereto, we have further submitted to careful examination the flame of the ten-candle-light pentane argand proposed as a standard by Mr. W. J. Dibdin in 1886. This flame is produced by burning a mixture of air and pentane vapour from a suitable argand burner, provided with an opaque screen by which the light from the upper portion of the flame is cut off. The screen being set at a definite height, it was found by Mr. Dibdin that, owing to a compensating action affecting the lower or exposed portion of the flame, the luminosity of this portion of the flame remains constant even under considerable variations, whether in the total height of the flame or in the proportion of pentane vapour to air in the mixture burnt. With a view to simplify the construction of the argand burner furnishing a cut-off flame of this constant luminosity, we have tried various changes in the form of the cone and in the division of the air supply to the flame, but in every case have found the original burner, as supplied by Mr. Sugg for the purpose, to give more satisfactory results than the modified forms.

"(8) The amount of light emitted by the portion of the Dibdin argand pentane-air flame that is used in photometry, being dependent on the distance above the steatite ring of a screen by which the upper part of the flame is cut off, we have come to the conclusion that when the bottom of the screen is fixed at a height of 2·15 inches (54·6 mm.) above the top of the steatite ring, the amount of light emitted by the lower portion of the flame is substantially equal to ten times the average light of a standard sperm candle flame, or to ten times the light of Mr. Harcourt's one-candle-light pentane air-gas flame.

"(9) We have further satisfied ourselves that any number of Dibdin argand burners may be produced, having the form and dimensions set forth in the Appendix; and that these several burners, when used in the manner there defined, may be depended on to furnish a flame giving, when duly screened on the top, ten times the average amount of light given by a standard sperm candle.

"(10) We therefore recommend that the pentane-air flame furnished by a Dibdin argand burner, having the form and dimensions set forth in the Appendix, and used in the manner there defined, be accepted as giving the light of ten standard candles, and that this flame be authorised and prescribed for official use in testing the illuminating power of the gas supplied by the London Gas Companies.

"(11) We further recommend that sealed specimens of the burner, the carburetter, and the pentane for use therewith, duly certified by the Gas Referees, be deposited with the Board of Trade, and also in such places and in the care of such persons as the Board may direct, to be available for the purpose of comparison, in the event of any question arising as to whether the pentane-air flame of some particular burner does or does not afford the same amount of light as that now proposed for adoption as a standard.

"(12) With a view to making some provision for future possible improvements and requirements, we further recommend that the Gas Referees be authorised, should they at any time see fit, to approve and certify for use in gas-testing any other flame based upon the 10-candle standard defined above, which they may consider suitable for the purpose, whether produced in a like or unlike way, and whether having the same or a different multiple value; such other flame, however, not to be used for gas-testing unless approved by the Board of Trade, and unless the Gas Companies give their consent to its adoption as a standard.

"(13) We further recommend that the illuminating power of coal gas shall continue to be recorded as heretofore in terms of the light given by a specified number of cubic feet (to wit, 5 cubic feet) burnt per hour from the standard London argand burner, but that, in testing the illuminating power of the gas, the requirement that the gas shall actually be consumed at this rate be rescinded, so as to allow the Gas Referees to sanction a mode of testing in which the gas shall be burned from the standard London argand burner at whatever rate is found requisite in order that it may give a light equal to that of the prescribed number of candles, and in which the illuminative value of the gas shall be calculated as being inversely as the rate at which such gas had to be burned during the testing so as to give this amount of light."

The Report is signed by Prof. William Odling, F.R.S. (Chairman), Mr. W. J. Dibdin, Dr. E. Frankland, F.R.S., Dr. A. Vernon Harcourt, F.R.S., Mr. George Livesey, Dr. William Pole, Mr. George Rose-Innes, Prof. A. W. Rücker, F.R.S., Dr. W. J. Russell, F.R.S., Mr. G. C. Trewby, and (subject to the omission from (13), line 7, of the words "the Gas Referees to sanction") by Mr. H. E. Jones. Prof. Vivian B. Lewes was the Secretary of the Committee.

SCIENTIFIC EDUCATION IN AMERICA.

UPON the occasion of the laying of the corner-stone of a new building for a Museum for Dartmouth College, Hanover, U.S., Prof. A. S. Bickmore recently delivered an address, in the course of which he dealt with the methods of scientific instruction in America. The College was originally designed to elevate the Indian race in America, hence its location at Hanover, New Hampshire, in 1770. It was named after Lord Dartmouth, who took a deep interest in the aborigines of the New World, and who was the principal benefactor of the school established for their education.

We extract the following from the report of Prof. Bickmore's address in the *New York Times*:—

"The present is pre-eminently an educational age, and the princely gift from one of our alma mater's loyal sons for the purpose of endowing a 'professorship of palæontology, archæology, ethnology, and kindred subjects, and for the erection of a building for preserving and exhibiting specimens illustrating the aforesaid branches,' is in perfect harmony with the judgment of the leading educators of our times, namely, that the greatest benefit it is our privilege to confer upon coming generations is to provide ever-increasing means for their mental improvement.

"As we meet to-day to lay the corner-stone of the noble edifice so generously provided for by the late Dr. Ralph Butterfield, and to celebrate the commencement of a structure which will add so largely to the educational facilities of this college, I invite you to consider with me, as a subject suggested by this occasion, 'The Place in Modern Education of the Natural Sciences and their Museums.'

"In a period which will ever be famous in history for the great donations that are being constantly made by our private citizens for the public good, it is worthy of our careful consideration that the most munificent gifts are almost exclusively for the purpose of promoting education. In the United States where even the existence of 'a Government for the people and by the people' must ever rest upon the intelligence and the integrity of each individual citizen, it is not a matter of desirability, but simply one of necessity, that the promotion of public instruction shall ever be a question of paramount importance.

AMERICAN SYSTEM OF TEACHING.

"Our American system of instruction may be rapidly summarised. First and lowest is the kindergarten, which may be regarded as still in its experimental stage, but which is certainly destined to become one of our most effective methods of mental training. Next come the public schools, supported by taxation, with their primary and grammar grades, and the high schools and private academies. Above these are the colleges, with their ever-increasing series of elective studies; and then the universities, with their special schools of science, medicine, law, and theology; and finally, the great post-graduate institutions, composed of entirely distinct corporations for the creation of great museums of science and art, and the accumulation of exhaustive libraries.

"As nearly as it is possible to ascertain, we have been expending twice as much per individual for public education as England, but as she increases her grants for that purpose, our provision must be enlarged in the same ratio, and especially ought we to introduce the latest and most improved methods for imparting instruction.

"The National Educational Association, at its meeting at Saratoga in 1892, appointed a committee, with President Eliot at its head, to suggest improvements in the studies of our secondary schools, and in their report those educators state their opinion that 'the study of both plants and animals should begin in the lowest grade, or even in the kindergarten, and that such studies, with geography subsequently added, ought to count in an examination for college.' Indeed we find the latter study already in the curriculum of Harvard University. In 1882, just ten years before President Eliot's committee was appointed, we began to seek to render our Museum of Natural History in New York City an aid to the instruction given in our public schools, by placing in each of them a small cabinet of the rocks, corals, shells, insects, and birds of our own country, We also organised for the teachers a series of illustrated lectures, describing the collections on exhibition in our halls, and picturing the regions from which they came. Our first audience consisted of twenty-five teachers and three officers of our Board of Education. Last year, under the auspices of the State Superintendent of Public Instruction, we spoke directly at the museum, and indirectly by the repetition of our lectures elsewhere, to 103,000 of our educators and other citizens, and now, through a provision made by the last Legislature, our visual instruction will be repeated in the public schools of every city in our State, and in all the villages having a population of 5000 and upward, so that during the coming year we shall reach 800,000 pupils, besides large audiences of adults on the public holidays. The measure of success that has attended our labours has been largely due, first, to our belief that it is the duty and the privilege of every educational institution of every grade to try to render a distinct benefit to each class of the citizens, wherever it may be located, and, secondly, to the illustrative method employed based on the maxim that 'the eye is the royal avenue to the mind.'

"To the question, what kind of a collection in natural history should be desired for each of these grades of instruction, we would reply that it should exactly correspond to the curriculum of study adopted by that grade. A college museum should possess a full series of the animals, plants, and minerals of the State in which it is situated, with typical specimens of the orders of these natural kingdoms from other States and other Continents; and also a library that will enable its teachers to keep up with the general progress of their departments. Even this simple plan may be made to absorb more money than most of our colleges are likely to acquire for such purposes during many generations, on account of the unfortunate tendency in these times for many a friend of education to found a new institution which may bear his name.

"In this presence I hardly need to add that every student should be encouraged to improve his leisure hours in taking long walks through all the region surrounding his place of study, in order to make his own observations and his own deductions upon the physical geography and geology of the places visited. His vacations may in this way become quite as important as the same length of term time. If during these travels he will gather minerals, fossils, or make a small cabinet of botanical specimens or insects, he will not only gain important information, but will have discovered the true mode of gaining by healthy exercise in the open air that relaxation which is a necessary condition to the best results in the recitation room; and whatever may be his subsequent occupation, thankful indeed will he be that he commenced so early to learn how to forget the overwhelming cares of a busy life, and that therefore he is able once more to commune with nature as restfully as he did in his college days.

"A university which has courses of post-graduate studies added to its college curriculum may follow the same plan, and also provide the means for original research along those lines in which its professors may be eminent authorities. However, experience has taught us that when one enthusiastic instructor dies and another takes his place, the new occupant of the professorial chair usually has already given his leisure time to some one of the thousand groups of the animal kingdom entirely different from those studied by his predecessor, and the books and specimens he finds already gathered will prove of little value to him for the pursuit of his own favourite branch of our science.

MUSEUMS AS EDUCATORS.

"A museum of natural history developed by a distinct corporation may advance education in two different ways—firstly, by the exhibitions of its collections and by illustrated lectures; and, secondly, by securing such exhaustive series of specimens and the books treating of them as to render it possible for original research to be carried on in many or most of the orders of the animal kingdom. Such organisations could favourably utilise an unlimited amount of funds, and even partly to fulfil their mission must absorb enormous sums. They can, therefore, only be created in our great and wealthy cities, and in them only by a happy and enthusiastic co-operation of their State and Municipal Governments, supplemented by large gifts from their wealthiest and most generous citizens. Our museum in Central Park is becoming such an institution for instruction and investigation. The city has provided a site of eighteen acres and $2,500,000 for that part of the structure already erected and under contract. Our specimens and books, the gifts of private citizens, amount to about $2,000,000 more, and yet we have completed less than one-fifth of our proposed edifice. The Art Museum has even a larger property and as comprehensive a plan, and now the Lenox and Astor Libraries, and the Tilden gift are happily united, and together form a third stone in the arch of this central university for the highest culture. So that, while we visit London to admire its group of noble institutions at South Kensington, we are at the same time founding in our new land a similar series on a greater scale, and erecting buildings and accumulating collections at a rate not witnessed on the other side of the sea; but the extensive ground plan upon which we are building the Museum of Natural History embodies the views of the late Sir Richard Owen, the ablest investigator in our science of the present century.

"In such a museum the specimens of minerals, rocks, and even fossils may be nearly perfect in themselves or fairly representative of the formations from which they were taken, but it should be remembered that in the usual mode of exhibition of animals and plants we necessarily lose the charm of their environment. Thus the song-thrush, which in life fills these northern valleys with the magical music of its liquid notes, when mounted and placed in a case is not only mute but uninteresting. The humming birds, in all their array of brilliant gems, to be known must be seen alive, darting to and fro amid the fragrant and richly-coloured flowers which supply their food in the tropical lands where the stately palm-trees wave their graceful fronds. The albatross, as usually mounted, with its wings tamely folded, hardly suggests the noble bird that skims gleefully over the crests of mountainous waves, while the storms are raging in the 'Roaring Forties' of the southern ocean. The chamois can only be appreciated when it is seen aloft on some projecting crag of the Alps, and the Rocky Mountain goat when, after long climbing, we find it surrounded by the splintered peaks of the Selkirks high up on the borders of eternal ice.

"To remedy these defects such a progressive thinker as Sir William Flower wisely proposes an entire change in the present style of taxidermy, and our experience in New York has been that our cases of American birds in their native haunts are among the most attractive as well as instructive displays in our halls. In our illustrated lectures we exhibit on one screen the Rocky Mountain sheep, while we picture on another screen beside it the grand mountain of the Holy Cross, where this rare animal formerly roamed.

"Zoology has attained a prominent place in this country largely through that great investigator and instructor, Prof. Lewis Agassiz, whose marvellous store of knowledge was equalled only by his devotion to his favourite study.

"But while science should be pursued for science's sake, yet we must not under-estimate the value of the technical sciences which take the results of original research and transform them so that they may confer an immediate and practical benefit upon the whole world. It is in this great department of modern education—the applied sciences—that the American people are pre-eminently successful, and in the coming contest for the supremacy among all nations, ours is destined to maintain a commanding place through our untiring industry, inventive genius, and peculiar adaptability to meet new conditions."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

PROF. J. W. JUDD, C.B., F.R.S., has been appointed Dean of the Royal College of Science, in succession to the late Prof. Huxley.

THE following list of Royal scholarships, medals, and prizes awarded last month in connection with the Royal College of Science, London, has just been issued by the Department of Science and Art. Royal scholarships:—First year's Royal scholarships, Ernest Smith, George Marks Russell, Frank Fisher, Norton Baron; second year's Royal scholarships, Robert Sowter, Joe Crowther. Medals and prizes:—"Edward Forbes" medal and prize of books for Biology, William George Freeman; "Murchison" medal and prize of books for Geology, John Caspell; "Tyndall" prize of books for Physics, Part I., William Herbert White; "De la Beche" medal for Mining, Robert William Pringle; "Bessemer" medal and prize of books for Metallurgy, John Collet Moulden; "Frank Hatton" prize of books for Chemistry, William Longshaw. Prizes of books given by the Department of Science and Art:—Mechanics, Cecil Alwyne Selpram Baxter; Astronomical Physics, Ernest Edward Leslie Dixon, William Herbert White; Practical Chemistry, Henry William Hutchin; Mining, Robert William Pringle; Principles of Agriculture, William Williams.

THE University of Pennsylvania has issued an appeal (says *Science*) asking for an endowment fund of £1,000,000 to meet the immediate requirements of the University. Mr. Thomas McKean has given without restrictions a sum of £10,000 in addition to the £10,000 given a few months ago. A contribution of £2000 has also been received from Mr. Richard F. Loper. It is stated that this is the thirteenth contribution of a similar kind that has been received. We learn from the same source that the University of Cincinnati has received a gift of £9000 from Mr. Henry Hanna, to be used in the erection of a wing in the new University building.

SOCIETIES AND ACADEMIES.

DUBLIN.

Royal Dublin Society, April 24.—Prof. J. Mallet Purser in the chair. The following communications were read:—Dr. E. J. M'Weeney on a temporary variation in the quality of the Vartry water. [This is the water-supply of the city of Dublin.]—Dr. David Hepburn (of Edinburgh), on the papillary ridges on the hands and feet of monkeys and men. The material for this paper was supplied by the anthropological laboratory of Trinity College, Dublin, and the paper was communicated by Prof. D. J. Cunningham, F.R.S.—Mr. Walter E. Adeney, on the course and nature of fermentative changes in natural and polluted waters, and in artificial solutions, as indicated by the composition of the gases in solution.

May 22.—Mr. Thomas Preston in the chair.—The following communications were presented:—Prof Emerson Reynolds, F.R.S., note on the spectrum of argon.—Mr. W. E. Adeney, on the chemical examination of organic matters in river water.—Mr. Richard J. Moss, on the preparation of helium.—Mr. Moss also exhibited a simple form of apparatus for the distillation of mercury in vacuo; and Dr. W. Frazer showed some photographs of the natives of Formosa.

June 26.—Dr. J. Joly, F.R.S., in the chair.—The following papers were read:—Mr. Thomas Preston, on the rectilinear propagation of light.—Dr. J. Joly, on photography in natural colours.—Sir J. William Dawson, F.R.S., note on a paper on "Eozoonal structure of the ejected blocks of Monte Somma," by Dr. H. J. Johnston-Lavis and Dr. J. W. Gregory, and reply to the note by the last-named authors.—Dr. G. Johnstone Stoney, F.R.S., criticism of the kinetic theory of gases regarded as illustrating nature.—Dr. E. J. M'Weeney, further observations on the Vartry water.—Dr. M. Weeney exhibited cultivations of *Phoma Betæ*, a fungus that produces a disease of the mangold wurzel.

PARIS.

Academy of Sciences, July 29.—M. Marey in the chair.—On the presence of water vapour in the atmosphere of the planet Mars, by M. J. Janssen. Mr. W. W. Campbell has recently asserted that the atmosphere of Mars does not contain water vapour, and has requested further details concerning the author's observations, from which the presence of water vapour had been supposed to be proved. These details are now supplied; the author particularly points out that his Etna observations were carried out under exceptionally favourable conditions, and that the definite and convincing evidence they afforded was confirmed by observations carried out at Palermo and at Marseilles.—On groups of substitutions of the same order and degree, by M. Levavasseur.—On algebraical surfaces admitting of a continuous group of internal birational transformations, by MM. G. Castelnuovo and F. Enriques.—On algebraical machines, by M. Léonardo Torres.—Vibrations of the tuning-fork in a magnetic field, by M. Maurain.—New photographs of lightning flashes, by M. N. Piltschikoff. Several types of lightning flash are defined, and the dimensions are given for certain flashes; for instance, a photograph taken during a storm at Odessa on June 13, shows a luminous band 0·75 mm. wide, caused by a flash at a greater distance than 10 kilometres; the actual width of the flash was therefore more than 62 metres. A new voltaic cell, by M. Morisot. The cell consists of a carbon pole immersed in 1 : 4 sulphuric acid saturated with potassium bichromate and a zinc pole within a porous cell containing concentrated caustic soda solution (sp. gr. 1·25), this cell being separated from the depolarising acid solution by a second larger porous cell containing dilute caustic soda (sp. gr. 1·05). The E.M.F. of this cell is to begin with 2·5 volts, and remains above 2·4 volts during at least ten hours of uninterrupted action, and with variable external resistance remains constant. The intermediate bath of dilute alkali diminishes the action across the porous diaphragm between the soda and the sulphuric and chromic acids without materially increasing the resistance. The zinc is less attacked than with an acid bath, and may readily be brought into good condition after long use by a short immersion in acid.—Action of aniline on mercurous iodide, by M. Maurice François. The aniline decomposes the mercurous iodide with the formation of the substance diphenylmercurodiammonium iodide $(C_6H_5NH_2)_2HgI_2$, and metallic mercury. The reaction is incomplete and exactly similar to the action of water on bismuth sulphate or mercuric sulphate. The boiling saturated aniline solution dissolves mercurous iodide and redeposits it on cooling in the crystalline form.—Action of nitric peroxide on campholenic acid, by MM. A. Behal and Blaise.—On the products of the condensation of isovaleric aldehyde, by M. L. Kohn.—On the estimation of boric acid, by MM. H. Jay and Dupasquier. The boric acid is distilled over into soda by the aid of methyl alcohol used continuously and the residual soda determined by titration.—On the elimination of lime among those affected with rickets, by M. Oechsner de Coninck.—On the utility of injections of oxyspartëine before anæsthesia by means of chloroform, by MM. P. Langlois and G. Maurange. The injection, an hour before the operation, of 4 to 5 cgr. of spartëine or 3 to 4 cgr. of oxyspartëine, together with 1 cgr. of morphine, gave rapid narcosis easily maintained with little chloroform and a regular pulse, energetic even when the respiration became superficial.—Influence of toxines on progeny, by M. A. Charrin. Bacterial poisons derived from the mother, like those introduced otherwise into the system, retard the growth of infants by rendering assimilation less perfect.—On the structure of the ectoderm and of the nervous system of parasitic Plathelminthes (Trématodes et Cestodes), by M. Léon Jammes.—Contributions to the embryogeny of simple Ascidians, by M. Antoine Pizon.—On the composition of the monazite sands of Carolina, by M. Boudouard.—Discovery of gigantic remains of fossil elephants, made by M. Le Blanc, in "la ballastière de Tilloux (Charente)," by M. Marcellin Boule.

BERLIN.

Physical Society, June 14.—Prof. du Bois Reymond, President, in the chair.—Dr. F. Kurlbaum gave an account of his determination of the unit of light made in conjunction with Prof. Lummer. The unit was based on the light emitted by white-hot platinum foil. Since the radiant energy varies with the temperature, it was necessary to keep the latter constant for a prolonged period, and to be able to re-establish it at any time. This result was arrived at bolometrically by measuring the ratio of the total radiant energy from the glowing foil to the radiation taking place across an absorbing medium. This ratio is dependent upon the temperature of the radiating body, and provides a trustworthy measure of its temperature. It was necessary to find some covering for the bolometer which should absorb all rays as uniformly as possible; after many experiments a layer of platinum black was found most suitable for this purpose. The absorbing medium employed consisted of a thin layer of water in a quartz cell. The energy radiated from the heated foil passed through a diaphragm of known aperture, whose temperature was the same as that of the bolometer. The errors in determining the unit of light amounted to one per cent., due chiefly to the air currents on the surface of the foil. The unit can now be established at any time in the Imperial Physico-technical Institute (Berlin); but in order to facilitate its accurate establishment at any other place, experiments are being made to determine the temperature of the glowing foil from ratio of the radiation over the range of the visible spectrum.

June 28.—Prof. von Bezold, President, in the chair.—Dr. Raps exhibited and described some new electric meters constructed by Siemens and Halske, which by the use of constant magnets provide an accurate measure for technical purposes, and are uninfluenced by ordinary variations of temperature. Dr. du Bois described experiments made by Dr. E. T. Jones on magnetic lifting-power. He had already showed that Maxwell's formula holds good for a field whose strength is up to 500 C.G.S., and now passed on to fields of greater strength. In the last set of experiments electro-magnets were employed with a sectional surface of an iron bar passed through the armatures. A magnetic lifting power of 52 kilogrammes per square centimetre of surface was thus for the first time obtained, and Maxwell's formula was found to hold good up to this maximal value; the error was at most five per cent., due as yet to insufficient introduction of corrections. Stephan's formula did not in any way correspond with the results of the above experiments. It further appeared that a lifting power of 150 kilogrammes per square centimetre should be obtainable.

AMSTERDAM.

Royal Academy of Sciences, June 29.—Prof. Van der Waals in the chair.—Prof. Martin presented a work, written by him, and entitled "Die Fossilien von Java." Basing his arguments on the presence of these fossils, the author showed that in Java there are found Upper Miocene, Pliocene and Quaternary sediments. When the distribution of these formations is considered, it appears that in general the newer strata have been formed on the outer side of the older ones, and there can be no doubt that since the time of the Upper Miocene formation a continuous and very slow elevation of the coast ("negativ strandverschiebung") took place, in consequence of which the Upper Miocene, Pliocene and Quaternary sediments of the coast were laid dry. That this shifting of the coast was very considerable, is proved by the Njaliendoeng fossils, found 910 m. above the level of the sea, and this fact further tallies with what is known about Sumatra, where in the "Padangsche Bovenlanden" Neogene sediments have been found up to a height of 1088 m. Not long ago the author showed that during the Quaternary period a considerable movement took place in the eastern part of the archipelago, and numerous facts show that the whole of the Indian archipelago was subjected to this. The author further remarked that he had received interesting fossils from Western Borneo. Among them are: *Perisphinctes* (Waag.), *Protocardia*, and *Corbula*. All these fossils have been found in strata that were formerly known as "ancient schists," which, however, on account of the above-mentioned fossils, can only be reckoned to belong to the Mesozoic period; more particularly they ought to be classed either with the Jurassic or with the Cretaceous formation. In accordance with the present state of our knowledge it is highly probable that the fossils in question have been taken from Jurassic formations. It appears, then, that Mesozoic strata have a very wide distribution in the Indian archipelago.—Prof. Beyerinck read a paper on *Cynips calycis*. The *Cynips calycis* gall-nut, very common in Austria-Hungary on *Quercus pedunculata*, is appreciated in commerce as a first-rate tanning material. In the Netherlands two or three small localities are known where this gall is to be found.—The dehydration, rehydration and re-dehydration of colloidal silicic acid, by Prof. van Bemmelen.—Prof. Stokvis presented some pamphlets by himself and some of his pupils, and, with reference to Dr. Langemeyer's dissertation, discussed the influence of the use of sugar upon muscular labour. From experiments, made with the ergograph, it is deduced that it has not yet in any way been proved that sugar has a favourable influence upon muscular labour.—At the request of Dr. C. A. Lobry de Bruyn, Prof. Franchimont communicated that free hydrazine had been prepared by the former in two ways: 1° from N_2H_4HCl with sodium methylate in a methyl alcoholic solution, and 2° by heating the hydrate to 100° with barium oxide. Free hydrazine is a somewhat thick fluid with the smell of the hydrate. It boils without decomposition at 113°·5 and a pressure of 761 m.m., and at 56° if the pressure is 71 m.m. When cooled, it becomes solid, and then melts again at 2°; its density at 23° is 1·0075 and does not, therefore, differ much from that of the hydrate (boiling at 119°). In ordinary air it forms strong vapours and is easily oxidised by oxygen with the formation of nitrogen. In the air it will burn, but not explode, like hydroxylamine, and consequently it is much more stable.—Prof. Kamerlingh Onnes communicated measurements on the capillarity of liquid gases, made by Dr. Verschaffelt in the Leyden laboratory. Carbonic acid and nitrous oxide obey the law of corresponding states; their capillary equation has an exponent approaching the theoretical value given by Van der Waals, and they are not associated fluids.—Prof. Van der Waals presented a paper intended for the report of the meeting, and entitled: "On the critical circumstances of a mixture," being a sequel to what was communicated in the meeting of the section held in May.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Bouches a Feu: E. Hennebert (Paris, Gauthier-Villars).—Balistique Extérieure: E. Vallier (Paris, Gauthier-Villars).—Geological Survey of Canada, Annual Report, new series, Vol. 6 (Ottawa).—Science Readers, Book iv.: V. T. Murché (Macmillan).—A Text-book of the Principles of Physics: Dr. A. Daniell, 3rd edition (Macmillan).—Pan-Gnosticism: N. Winter (Transatlantic Publishing Company).—A Handbook to the Flora of Ceylon: Dr. H. Trimen, Part 3 and plates (Dulau).

PAMPHLETS.—Geogenetische Beiträge: Dr. O. Kuntze (Leipzig, Gressner).—Sobre Peces de Agua Dulce: C. Berg (Buenos Aires, Alsina).—The Grimsby Trawl Fishery, &c.: E. W. L. Holt (Plymouth).

SERIALS.—Journal of the Institution of Electrical Engineers, July (Spon).—Quarterly Journal of the Geological Society, August (Longmans).—Fortnightly Review, August (Chapman).—Macmillan's Magazine, August (Macmillan).—Scribner's Magazine, August (Low).—Verhandlungen des Naturhistorischen Vereins, &c., Einundfünfzigster Jahrg., Sechste Folge, 1 Jahrg., Zweite Hälfte (Bonn).—Bulletins de la Société D'Anthropologie de Paris, tome vi. 4e serie (Paris, Masson).—Geological Magazine, August (Dulau).—Geographical Magazine, August (Stanford).—Transactions and Proceedings of the New Zealand Institute, 1894, Vol. xxvii. (Wellington, Costall).—Science Progress, August (Scientific Press, Ltd.).

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