THURSDAY, MAY 30, 1901.

A NEW TREATISE ON PHYSICS.

A Treatise on Physics. By Prof. Andrew Gray, F.R.S. Vol. i. Pp. xxiii+688. (London: J. and A. Churchill, 1901.) Price 15*s*.

A BRIEF abstract of the contents of this book will suffice to show at once the enormous amount of information it contains and the labour which has been expended on its production. Its aim is "to provide a treatise on physics which may serve for those who, beginning at the elements of the subject, wish to have in one book an account of theoretical and experimental physics which may be sufficient for most practical purposes of scientific and technical education." Accordingly, the first volume contains nearly 700 pages devoted to dynamics and the properties of matter.

The book commences with an account of the fundamental units of measurement. Then comes a long chapter of nearly 100 pages given to kinematics; this is followed by chapters on dynamics, work and energy; after this we have statics of solids and fluids, gravitational attraction, astronomical dynamics, and the tides. The theory of elasticity fills some 70 pages, to be followed by 30 pages on capillarity, while the book closes with a very short section on measurements and instruments. As a book of reference, a kind of encyclopædia of physics, the work will be most useful; whether a student who is really beginning the subject would profit by the attempt to peruse it is perhaps open to doubt. For such a student the whole is too condensed; the range of subjects enumerated above is ordinarily dealt with in some six or eight different books, and though there is much force in Prof. Gray's protest against "the division of a great subject like physics into isolated compartments," yet most beginners will find that the subjects dealt with need a fuller treatment than Prof. Gray can give them, at least so far as their elementary parts are concerned.

It should be noted that the book contains no examples for the student to work out. Now while at Cambridge the practice of setting problems may be carried too far, most teachers will agree that it is only by practice in working examples that the fundamental laws of a subject such as dynamics can be driven home to an ordinary student. An engineer has to apply his mathematics to the questions which are brought before him for solution in his practice. The problems of the examination room differ, no doubt, in a marked degree from those which occur in real life, but a man who has been trained to their solution has a better chance of success when he is faced by some practical difficulty to which he must apply his mathematics than one whose training has consisted solely in studying the book work of his subject. However considerations such as these deal with the general scheme of the work, they do not touch the question, how the scheme has been carried out.

In looking at a new book on dynamics the reader turns naturally to the sections dealing with the laws of motion, and here the treatment might, we think, be clearer.

The ideas of inertia, mass, momentum, force, are not easily grasped by a beginner. Prof. Gray commences by the consideration of stress, the mutual action between two bodies whose relative motions are undergoing change; he then goes on to Newton's first law, in which the word "force" is introduced; it would be well to explain that the "impressed forces" of the law constitute one aspect of the stress which has been discussed just previously, indeed it may perhaps be questioned whether it is desirable to introduce the term stress at all in this connection. Strictly, a stress is measured by the force applied per unit of area; it has the dimensions of force divided by the square of a length, and we might more strictly call the mutual action between a falling body and the earth a force rather than a stress.

We then have a section on inertia or mass, and here Prof. Gray does not seem quite happy in his treatment. We are told that we get the idea of inertia from the observation "that different bodies have, when placed in what we are justified by experience in regarding *as the same circumstances*, different accelerations." Then we are to take the inertia of a body "as a measure of the quantity of matter in the body or, as it is called, the body's mass, and we shall see (§ 144) that the comparison of masses thus obtained must agree with that carried out by weighing." Again, the inertias of two bodies are compared by comparing the accelerations produced by applying to each in turn for one second a spring with a given stretch; the inertias are said to be inversely as the accelerations. Thus inertia is used throughout as equivalent to mass or quantity of matter, and practically the second law of motion, which, however, is not introduced until a later stage, is assumed; the spring with a given stretch exerts a definite force, and this force is equal to the product of the inertia and acceleration.

Such a treatment is open to criticism; for one thing the experiment suggested is an almost impossible one to perform; it is better either to start from some such statement as that whenever two bodies are moving under conditions in which each is free from all action, except that which arises from the second body, all the circumstances of the motion are consistent with the supposition that the ratio of the two accelerations is a constant, and to define this constant as the reciprocal of the ratio of the masses.

If it be objected, as perhaps it fairly may be, that the conditions assumed are never realised, we may have recourse to experiments with an apparatus such as Prof. Hicks's ballistic balance, in which two bodies swinging as pendulums are allowed to impinge directly in such a way that they are both brought to rest; experiments with this show at once that the ratio of the two velocities with which the bodies are moving at the moment of impact is a constant so long as the bodies remain unchanged. We define the ratio of the masses of the bodies as the reciprocal of this constant, and thus we obtain a means of comparing masses without the introduction of the idea of force; moreover, it is easy to pass naturally from this to the idea of mass defined as measuring the quantity of matter in the body.

Thus, having obtained a knowledge of mass and velocity, we can introduce the idea of force as the time rate of change of momentum, using Newton's second law to define and measure force.

Prof. Gray is careful to explain that he does not look

upon force as a cause of motion. Thus, § 138, when dealing with a simple pendulum, he writes: "The idea that F, T" (certain quantities appearing in his equations) "on the left denote forces in the sense of causes of motion and that the expression on the right are effects is a fallacy." He does, however, permit himself to speak of stresses as causing motion; it would surely be better to avoid the idea of causation entirely; it is doubtful if anything is gained by the distinction between "stress," as used by Prof. Gray, and "force." The term stress does, it is true, call attention to the fact that the action it denotes is a mutual one between two or more bodies, and this is wanting in the term force. Still, is is difficult to be consistent in the matter; thus, § 146, in dealing with Atwood's machine, we read, "putting T for the mass-acceleration *due* to the force applied to either mass"—the italics are not in the original. When once it has been explained that forces are measured by mass-accelerations, might we not write more simply and with equal effect the words, putting T for the tension of the string?

Observation shows us that in many cases the mass-acceleration of a particle is a constant; if we know the value of this constant from the conditions of the problem we can, having given the initial conditions, determine the motion; we say, for brevity, that the particle is moving under a constant force. In other cases, it has been observed that the mass-acceleration is a known function of the position of the particle relative to other particles. This function can often be calculated without any knowlegde of the velocity or acceleration of the particle; thus, if there be a second particle at a distance r from the first, each will have a mass-acceleration towards the other equal to mm'/r^2 where m and m' are the masses of the two particles. This is the force under which either particle moves. Having given this force, by equating it to the mass-acceleration, and solving the equations we can determine the motion. Thus the resolution of any problem of motion of a particle falls into three parts: (1) We determine from the conditions the mass-acceleration in each of three rectangular directions; (2) We equate these to the analytical expression giving these mass-accelerations in terms of the coordinates of the particle and their differential coefficients with respect to the time; (3) We solve the resulting equations.

We may consistently employ the name force for the quantities determined under (1), and indeed may speak of them as the forces impressed on the particle without implying that they are the cause of the motion. This is done in the later sections of the chapter. One other criticism occurs in connection with the sections of the book immediately under review. Prof. Gray writes, § 134, "The word weight is used in two senses, in the sense of the quantity of matter in a body, and sometimes, though perhaps more rarely, in popular language as the downward force of gravity on a body in certain specified circumstances. It seems impossible to discard the former use of the term even in scientific speech, and therefore we shall use the word generally in this sense and in the latter sense speak of the gravity of a body."

Again, in the next section we find the sentence, "We may take the inertia of a body as the measure of the quantity of matter in the body or, as it is called, the body's mass."

Thus weight and mass are to be used as synonymous, contrary to the practice of writers on dynamics during many years past. Such a change, unless the grounds for it be very strong, must lead only to confusion, and the fact that weight is used ambiguously in daily life is hardly a satisfactory reason for the innovation which has been adopted.

We have referred at length to these few pages of the work because of the importance of the fundamental ideas and conceptions with which they deal. It is impossible to deal with the rest in the same manner, nor, indeed, is it necessary. The reader will find the book a storehouse of valuable information, which is generally put clearly and well; experience alone will show whether or no it is useful for students "beginning at the elements of the subject." However this may be, the book should be found in every physical library, and is sure to be frequently consulted.

TROPICAL CRUSTACEANS.

The Stalk-eyed Crustacea of British Guiana, West Indies, and Bermuda. By Charles G. Young, M.A., M.D., Dublin, Member of the Royal Irish Academy, lately of the British Guiana Medical Service. 8vo. Pp. xix+514; 7 plates, coloured, and numerous outlines. (London: Watkins, 1900.) Price 12*s.* 6*d.* net.

FROM the equator to thirty-five degrees north the western Atlantic, with its neighbouring shores and rivers, can supply a group of stalk-eyed Crustacea not easily surpassed in interest by such a fauna from any other region in the world. The descriptions relating to this group lie scattered over numerous treatises. Dr. C. G. Young has conceived the meritorious idea of bringing them together under one cover. He modestly speaks of his performance as a hand-list for the use of collectors. Handiness and usefulness should therefore be among its characteristic features. As it lays no claim to originality, the virtues of accuracy, completeness and condensation might have been expected. In place of these there is offered to the student a volume expansively and expensively printed; serious omissions are balanced by a parade of unneeded trivialities; whilst from one end to the other slovenliness prevails in the use of older authorities and neglect or ignorance of those that are more recent. Like the curate with a questionable egg at an episcopal breakfast table, one might say of this book that "parts of it are good, my lord," but no one can tell which parts without consulting the very authorities which its publication presumes to be out of reach.

The first page includes an old definition of the class Crustacea, informing us that in these animals the body is "composed of segments, in general very distinct, motile," and this is followed by hundreds of pages dealing with crabs, in which, as Dr. Young well knows, for many or most of the component segments the distinctness is almost null and the "motility" absolutely *nil*. The end of the story is on a par with its beginning. It treats of the Squillidæ, and describes four species, adopting the synopsis of the genera from the work of Brooks on the *Challenger* Stomatopoda, but calmly assigning to the genus Squilla two species which, according to that very synopsis, belong

to Lysiosquilla. The discussion of a true Squilla from the coast of Yucatan by J. E. Ives in 1891, and the truly valuable report on the Stomatopoda of the *Albatross* by Dr. R. Payne Bigelow in 1894, were evidently unknown to Dr. Young. Naturally, therefore, he leaves unnoticed the species new or old in this or other orders recorded by those two writers. Perhaps his attention was too much concentrated on older essays, and, as these are often much less accessible than modern treatises, such a fault would deserve to be leniently regarded. It was, indeed, with some eagerness that the present reviewer, on first opening the book, turned to the excellent index for the name Glypturus. Of this genus Miss Mary J. Rathbun last year published a new species from Brazil. That is not in the region with which Dr. Young's work is concerned, but the genus was established long ago by Stimpson in the *Proceedings* of the Chicago Academy of Sciences, vol. i. p. 46, 1866, with repetition in the *Annals* of the Lyceum of Natural History of New York, vol. x. p. 120, 1874, for a species "not uncommon among the Florida Keys." Of this Dr. Young has nothing to tell us. He mentions, indeed, two species of the same family, *Callianassa occidentalis*, Bate, and *Callianassa major*, Say, but he was obviously not in a position to inform his readers that Stimpson instituted the genus Callichirus to receive Say's species, and he does not take the trouble to tell them that Bate's species was founded on a single leg, which left Bate himself doubtful as to its generic position.

On generic and specific names and lists of synonyms there are various opinions, but most naturalists agree that quoted names had better be quoted correctly, and that an author would do well not only to verify his references, but to give others a reasonable chance of verifying them after him. Dr. Young's adhesion to these views may be complete in principle, but is made very doubtful by his practice. The scope of his work scarcely required a "synonymy" for the term Brachyura, still he has been pleased to give one. It leads off with the information that the word was adopted by 'Leach, Latreille, Dana, Linné, Claus, Haswell, Miers,' Linné's name as a centrepiece reminding one of those Welsh genealogies which are reputed to have Adam halfway down the ancestral line. Where and when Linnæus changed his *Cancri Brachyuri* into Brachyura we are not told, and are never likely to be. The synonymy continues in separate lines with '*Brachyura*, H. Milne Edwards,' '*Cancri Brachyuri*, Lamarck,' '*Klistognatha*, Fabricius,' '*Tetrogonostoma*' bracketed with '*Trigonostoma*, Macleay.' Here again we are not told when it was that Fabricius changed the Kleistagnatha of his Supplementum into Klistognatha, and as for the implied but ungiven reference to Smith's "Illustrations of the Zoology of South Africa," there is confusion doubly confounded. In that work McLeay adopts and uses the term Brachyura in common, not only with half a dozen authors, but with half a hundred or an indefinite number. He divides the group into two tribes, and it is to these he assigns the names above quoted, with the difference that he spells the first of them correctly as Tetragonostoma. In dealing with genera and species Dr. Young shows no more ceremony than with the higher groups. He attributes *Podochela reisei* to Stimpson, A. Milne Edwards and Miers, though certainly the first and last write the specific name *riisei*, and Stimpson says that it 'was found at the Island of St. Thomas by Mr. A. H. Riise, after which indefatigable investigator of West Indian natural history we have named the species.' For the genus Ibacus, Leach, Spence Bate's spelling, Ibaccus, is adopted, and Leach is accused of having written Ibachus. *Cardiosoma carnifex* is attributed to Herbst, though he died long before the species intended was assigned by Latreille to Cardisoma. The young German naturalist, von Willemoes Suhm, who died on the *Challenger* expedition, is uniformly referred to as Suhn. The Pandalidæ are defined without any regard to the discovery published by Caullery and by Calman two years ago that the front feet in this family had been misdescribed. And, as if all this were not enough, the unhappy author re-introduces the name *Uca una*, Marcgrave de Liebstad, without mentioning the year 1648 as the date of it, and in defiance, or perhaps in ignorance, of all the trouble and accurate learning with which Miss M. J. Rathbun has shown that this typical West Indian species ought rightly to be called *Ucides cordatus* (Linn).

There are some interesting local names given. We are told, for example, that *Panulirus guttatus* is called in Barbados the "Guinea bird lobster." The pages have satisfactory margins. There is room, therefore, for a naturalist with leisure, by supplementary notes, corrections and verifications, to give the book a solid value.

T. R. R. S.

PRACTICAL INORGANIC CHEMISTRY.

Praktikum des anorganischen Chemikers. Von Dr. Emil Knoevenagel. Pp. viii + 332. (Leipzig: Veit and Co., 1901.) Mk. 7.80.

THE fact that this book emanates from the Heidelberg Laboratory and is dedicated to the memory of the great teacher who first gave that laboratory its fame is calculated to enlist the expectant attention of a critic. The book purports to be an introduction to inorganic chemistry on an experimental basis, and the object is to associate the directions for practical work with adequate theoretical explanations of the phenomena involved. It is, in fact, a blend of preparations, qualitative analyses, quantitative experiments and theoretical chemistry. The plan of the work as a whole is hardly describable, but some idea of its detail may be gathered from the beginning. The student is told to weigh out four grammes of caustic soda, dissolve it in water and make up to 50 c.c. Then, parenthetically, he is asked to calculate the content of caustic soda per litre, to express this in gramme molecules and to say what is the normality. The student is next told the solubility of caustic soda at 15° and 100°, and also informed that the density can be used to measure the concentration. The boiling points of solutions of various concentrations are given. The solution is now to be tested with litmus and turmeric and also to be tasted. Caustic soda is affirmed to be a strong base. A piece is to be left exposed to the air; it is said to deliquesce and also to absorb carbon dioxide, a property of all strong

bases. A piece is to be heated in an ignition tube, when it may be seen to melt. We now pass to the heading "Sodium Chloride, NaCl." Some of the caustic soda solution is to be neutralised with hydrochloric acid. Sodium chloride is said to be formed and the student is to write the equation and to make calculations as to the concentration and normality of the HCl solution. The solution of sodium chloride is evaporated until it crystallises, and the process is also observed under the microscope. The salt is tasted, some put into the flame and some treated with sulphuric acid. The next preparation is that of hydrochloric acid in quantity. The solution of the gas in water is to be examined on the same lines as the caustic soda solution. Some dilute acid and then some strong acid are to be heated in a test-tube, and the student is informed what variations of concentration have occurred. Then follows a disquisition on acids, bases and salts.

Space will not permit of further description of the course in detail. After the discussion of acids, bases and salts, we have the tests for hydrochloric acid; sulphuric acid follows, with remarks on its constitutional formula, its action on metals, &c. Nitric acid, hydrogen sulphide, carbonic acid, phosphoric acid and boric acid bring us, for the time being, to the end of the acids. Then come potassium, sodium and ammonium, followed by a discussion of their analytical separation. The rest of the book is much on the same plan. It ends with a chapter on the modern theory of solution (which is not employed in the body of the work) and details of the ordinary analytical separation. Tables of reagents, some density tables and a map of spectra are added.

The impression gained on reading through the book is that we have to do with a genuine attempt to combine accurate practical work with accurate theoretical knowledge. There is a great deal of admirable matter that is not usually to be found in books on practical chemistry. On the other hand, the style of the book is haphazard in the extreme and affords an example of logical detail without logical plan. There is also a constant variation of level in the instruction. A student who calculates the normality of a caustic soda solution and is soon after to have his attention briefly drawn to the possible constitutional formulæ of sulphuric acid is subjected to the indignity of trying the effect of his soda solution on litmus and turmeric paper. Then again, the student is told a great many things that he might easily and profitably establish by experiment, such as the fact that caustic soda exposed to air actually has absorbed carbon dioxide. It is desirable, no doubt, that the student of practical chemistry should understand the behaviour of concentrated and dilute acids on boiling, but the mere statistics of the subject are no explanation, and practical work on the subject should be linked to the simple generalisations that illuminate it.

It would not be right to dwell further on the weaker features of a book which, on the whole, is much more rational and luminous than the great majority of works on practical chemistry. It must be admitted that the task of writing a combined theoretical and practical work on chemistry is very difficult, and that Dr. Knoevenagel has given us a book that well deserves the attention of teachers. A. S.

OUR BOOK SHELF.

Central Electrical Stations: their Design, Organisation and Management. By C. H. Wordingham. Pp. xvi+496. (London: C. Griffin and Co., Ltd., 1901.) Price 24*s.* net.

WE venture to think that few, if any, persons could be found better qualified than Mr. Wordingham to write a treatise on central electrical stations, and there can be no question but that he has carried out his task in a very thorough and competent manner in the book before us. Whilst endeavouring to deal with practically every subject which enters into the organisation or management of a central station, the author has wisely given prominence to those matters which are not to be found already in other books. The central station engineer, especially if he have charge of a large generating station such as are now becoming more and more numerous, must be a man of wide experience and attainments, and it would be impossible to compress into one volume all the knowledge that he requires in his profession, quite apart from the consideration that such knowledge cannot be obtained from books alone. But whereas there is plenty of literature already dealing with the separate branches, such as steam engineering, dynamos, &c., there was none, until now, dealing thoroughly with the subject as a whole. Those who have charge of central stations, or those who are ambitious of attaining this distinction, will find Mr. Wordingham's book a very valuable guide.

Central station work has for long attracted a large number of young engineers, the rapid growth due to the spread of electric lighting offering great chances of advancement. It is true, perhaps, that now, as Mr. Wordingham says, the practice is becoming more settled and stereotyped and that entry into this branch of the profession will require a somewhat longer apprenticeship than has been usual hitherto; but this is not likely to discourage many, for the prospects for the future are even brighter than they were in the past. Large electric power schemes and the certain adoption of electric traction for tramways and urban railways point to an expansion which is sure to be both large and rapid for a long time to come. Those who are anxious to take part in this development cannot do better than study the book before us with care and attention. There is a fair amount in the book that is controversial, but this renders it none the less valuable; if the student is not always inclined to agree with the author, he will at least be benefited by the careful consideration of opinions derived from so wide an experience. Some may think, perhaps, that the clerical side of the organisation is given an undue amount of space; this is, however, only in accordance with the scheme of the work, seeing that this is one of those subjects not to be found in other books. Moreover, the student is too prone to think that scientific knowledge alone is sufficient to make a successful engineer and to underrate the importance of a sound and systematic organisation.

Hints to Travellers. Edited by John Coles. 2 vols. Pp. x+436 and viii+266. (London: The Royal Geographical Society, 1901.)

THIS useful work, of which the present issue is the eighth edition, has now been divided into two volumes. The first is devoted to the various problems of surveying and practical astronomy, and important additions have been made to the matter brought over from the last edition. The new chapters include a considerable expansion of the article on surveying, ordinary and photographic, a graphic method of predicting the occultation of stars by the moon, and an entire set of tables by the aid of which, and the *Nautical Almanac*, the traveller will have all the materials for computing the results of his observations.

Vol. ii. contains the articles on meteorology, photography, geology, natural history, anthropology, medical hints, &c. Of these, the sections on meteorology and medical items have been entirely re-written and considerably enlarged; the others all revised and brought up to date.

This work has already gained its reputation as a most serviceable and complete guide for almost all classes of travellers, and in its present elaborated form cannot fail to give additional satisfaction.

L'Optique des Rayons de Röntgen et des Rayons secondaires que en dérivent. Par G. Sagnac. Pp. 166. (Paris: Gauthier-Villars, 1900.)

THIS book gives a useful account of some of the properties of the Röntgen rays. The earlier chapters deal with the properties of the primary rays as they issue from the vacuum tube. A valuable feature is the explanation given of the cause of certain spurious effects which have been put forward as proving diffraction of the rays.

The second and larger part of the book deals with the secondary rays which issue from heavy metals when the primary rays from the tube falls on them. M. Sagnac makes it clear that this phenomenon is not properly to be described as a "surface effect." He shows that an element of volume of a heavy metal traversed by the rays gives out secondary radiation equally in all directions. The sudden change of conditions at the surface of the metal is not what is primarily concerned. The heavy metals absorb the primary rays so powerfully, however, that they can only penetrate to a small depth, consequently the secondary radiation does, in fact, come principally from near the neighbourhood of the surface. Many other original observations are described, but though of considerable interest they seem to leave the question of what causes the secondary radiation, and why only heavy metals emit it, almost as far from solution as ever. R. J. S.

Cerebral Science. Studies in Anatomical Psychology. By Wallace Wood, M.D., Professor of History of Art in the New York University. Pp. xii+128. (London: Baillière, Tindall and Cox, 1901.)

THE subordinate title of this book alone renders it impossible for us to take it seriously, despite the fact of its being dedicated to the memory of Taine and Broca. The book abounds in platitudes, ejaculations and short dictatorial declarations, with here and there an allusion to the historic, poetic and classic; but all without plan or logical sequence of ideas. The "creation of the human head—the study of the human brain," is defined as "the new science for the opening century," and "characterology" is regarded as the great field through which, by the study of man and the lower animals, there is to be reached the classification of souls. Of these our author would distinguish five classes, and when it is seen that he would locate the "strong" soul in the "parietal regions," the "good" in the "metopic chambers" and the "beautiful" in those of the "summit," we deem further comment needless, except to remark that the author is indeed amusing.

The Humane Review. Vol. i. April, 1900, to January 1901. Pp. 384. (London: Ernest Bell, 1901.)

WITH a few of the contributions to this volume, men of science and other observers of nature will find themselves in sympathy. Mr. W. H. Hudson pleads for the preservation of the furze wren or Dartford warbler, and other rare birds, and criticises the feather fashion; Prof. J. Howard Moore writes on the psychical kinship of man and the other animals; Mr. H. R. Fox Bourne states the claims of uncivilised races; M. Elisée Reclus champions vegetarianism; and Mr. Bernard Shaw makes amusing and characteristic remarks upon the alleged conflict between science and common sense.

LETTERS TO THE EDITOR.

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

The National Anti-Vivisection Society and Lord Lister.

I HAVE read your attack upon me in your issue of May 16.

In your comments on the anti-vivisection meeting at St. James's Hall you say that I "discoursed inaccurately on Lord Lister's scientific work." I did nothing of the kind, I never made any allusions whatever to his scientific work. You next say with respect to the fifty-eight vivisectors for whom Lord Lister signed certificates exempting them from the use of anæsthetics that "the probability is that personally he was not acquainted with half-a-dozen of the licensees." This is to bring a graver charge against Lord Lister than anybody has yet formulated, for the signature of Lord Lister is the evidence offered the public in the parliamentary report that the vivisectors in question are individually known to Lord Lister to be persons who will not inflict needless cruelties upon animals. I preferred to assume that they were all his intimate friends than to suppose that he had signed such certificates merely because he was asked to do so.

You are quite right in saying that I did not tell the audience that the vast majority of experiments under these certificates are mere "pin pricks." If I had done so I should have been misleading it. Inoculations may begin with a pin prick, but they commonly involve much subsequent suffering.

You next complain of my statement that "the more hospitals connected themselves with vivisection the larger was the grant per bed they might expect to receive from the Prince of Wales's Fund." It is simply waste of time to abuse me for making that statement till you can disprove it. I have given the figures and you will find them in the audited accounts of the hospitals.

Your account of what passed between my Society and the Poplar Hospital is inaccurate, and "the reply of this institution" cited by you is not to be found in the correspondence which has been published and which you should have read before affecting to quote from it.

Lastly, what we have suggested to the heads of the religious bodies in the matter of Hospital Sunday is, that if the offertories are to be handed into the general funds of hospitals from which same general funds schools licensed for vivisection are subsidised, the congregations should be informed from the pulpits that their money is not exclusively intended for the tending of the sick, but will in part be diverted to the education of medical students and to the support of vivisectional laboratories.

May I ask what is your objection to such a course being pursued?

I do not mind your attacking me in your paper personally by name—I have entered this controversy intending to give and expecting to receive good blows—but I have myself been scrupulous to make no statement that is not supported by unimpeachable authority, and I have a right to expect that a responsible paper such as yours should exercise a similar exactitude if it joins in the controversy and takes upon itself to allude to any statement of mine as "scurrilous."

STEPHEN COLERIDGE.

The National Anti-Vivisection Society, London, S.W., May 21.

[(1) Mr. Coleridge is reported to have stated that Lord Lister's experiment consisted in passing a needle and thread through the eyeball of a rabbit and leaving the thread there. The needle and thread were passed through a special part of the skin of the eye only (cornea). The object of the experiment would have been entirely frustrated if the needle and thread had been passed through the eye. The question to be answered was whether inflammation could be caused by irritation of non-vascular tissues. Speaking of Lord Lister's experiment as he did, showed that Mr. Coleridge not only did not take the trouble to get accurate fact with regard to the experiment, but also was totally ignorant of its object.

(2) The inference to be drawn from Mr. Coleridge's remark that Lord Lister was the "intimate friend" of fifty-eight vivisectors is that the signing of the respective licensees, exempting from the use of anæsthetics, was of the nature of a "job." This remark was obviously "scurrilous." Lord Lister signed

these certificates as President of the Royal Society; he knew the licensees to be fit persons to have the respective licenses, but there was no question of individual intimate friendship.

(3) The occurrence of pain after inoculation experiments is relatively very rare, and to refer to these experiments to a popular audience as vivisections is certainly misleading it, and Mr. Coleridge must have known this. The statement that the majority of these so-called vivisections were mere pin-pricks is true.

(4) We do not complain of Mr. Coleridge's statement of what he terms the "diversion" of hospital funds to the corresponding medical schools, but we simply say that the allotment of the Prince of Wales's Hospital Fund was not influenced in any way by whether a hospital had laboratories or so-called vivisectors attached to it or not. We regard the statement that Lord Lister wilfully diverted public funds to endow vivisection as scurrilous. We entirely deny that hospital funds are, by being used for the support of medical schools, "diverted," in Mr. Coleridge's sense, from the patients. Medical schools are essential to large hospitals, and any grant made to them out of hospital funds is only in return for services rendered, although it indirectly helps the progress of medical science.

(5) The statement that Mr. Coleridge tried to make a bargain with a London hospital concerning the appointment of its staff and that the hospital declined is true; the mere wording of the reply is a matter of no importance. If Mr. Coleridge will publish the correspondence to which he refers we shall be prepared to consider it exhaustively.

(6) We entirely object to the relation between hospitals and medical schools being put before the public subscribers to the Hospital Sunday Fund in the way Mr. Coleridge suggests. If Mr. Coleridge has any scheme by which the large hospitals can receive the services of the medical profession more cheaply than they do at present he is quite justified in putting this before the public. He is, however, not justified in stigmatising grants made to medical schools as being "diverted" from the use of the sick.—EDITOR.]

Vitrified Quartz.

A STUDY of the viscous properties of vitrified quartz in which I was engaged last year, and which I communicated to the Geological Congress of 1900, revealed a degree of plasticity and molecular instability which I think justify Mr. Shenstone's reserve in pronouncing on the applicability of this substance to thermometry at high temperatures (NATURE, May 16). A few of the measurements I obtained may be of interest. I may observe that the method of observation was to stretch a quartz fibre (as supplied by the Cambridge Instrument Co.) in a horizontal platinum tube, which is heated by a current and clamped in the meldometer, its temperature being determined in terms of its thermal expansion. The fibre, which passes axially through the tube, is fixed at one extremity, and at the other is attached to a light pendulum, the mass of which can be increased, and which it deflects from the vertical. It is observed by two micrometers placed at some few centimetres to either extremity of the tube, so that any slip in its fixed attachment will be detected. The tube is 10 cm. in length and ·2 cm. in diameter. Tensions are calculated in kilos. per square centimetre, and rate of elongation in centimetres per minute per unit of tension per centimetre of fibre. The different fibres used are designated *a*, *b*, *c*, &c.

Fibre	Temperature	Duration of observation in minutes	Tension	Rate of stretch per unit of tension
a	715°	270	638	$0{\cdot}23+10^{-8}$
b	735°	95	1350	0·16 ,,
b	785°	165	,,	0·66 ,,
c	870°	150	82·2	1·3 ,,
c	915°	60	27·4	5·3 ,,
c	,,	50	54·8	4·4 ,,
c	920°	60	82·2	6·2 ,,
d	915°	10	422	6·6 ,,
e	940°	10	320	8·5 ,,
f	1040°	10	,,	35·9 ,,

This table is abridged from one giving fuller details. The fibres varied greatly in diameter and possibly somewhat in their viscous properties, but the results are all one way—an increasing yield with increasing temperature and a rate of stretch approximately proportional to the applied force. But this last assertion cannot go without some reservation. At the higher temperatures, the rate of elongation was observed to diminish steadily when the observations were much prolonged. Ultimately the fibre generally breaks. When observed now between crossed nicols the fibre is found to be partially crystallised, the crystallisation extending inwards from the surface. This crystallised layer is sometimes cracked and peeled from the core beneath, the result, probably, of the very great volume-change attendant on crystallisation. The gradual diminution in rate of stretch, and a certain degree of irregularity in the results at higher temperatures, may well be due to this molecular alteration.

So far as can be inferred from the observations, the results are due to plasticity, complicated at higher temperatures by gradual crystallisation. Nor is there anything, so far as I can gather, in the least opposed to this view contained in Prof. Callendar's interesting experiments on the thermal expansion of vitreous quartz.

It will be seen from the experiments I have quoted that the viscous stretch at the lower temperatures is small in amount. With prolonged use, however, and if any considerable difference between internal and external pressure existed, thermometers would be affected by it sufficiently to necessitate frequent readjustment of fixed points. I find, for example, as the result of a rough estimation, that with an excess of pressure of one atmosphere within, a spherical bulb 1 cm. in diameter and ¼ mm. thick in the walls would, at 785° C., increase in volume by 0·1 per cent. in about 83 hours. At 870° C. this increase will occur in about 40 hours. At 920° C. the same increase in volume would occur in about 8 hours if the contraction due to crystallisation, which the experiments lead us to expect, did not act the other way. The final result, after 8 hours' heating at 920° C., would be impossible to predict.

I have more recently found that vitrified quartz, reduced to powder and exposed over a Bunsen for 35 days in a closed unglazed porcelain crucible at a temperature just under the melting-point of gold (1066°) loses its sharp edges, rounding every point and angle, and simultaneously develops incipient crystallisation, which appears in the form of radial spherulitic structures, often with anisotropic centres.

J. JOLY.
Geological laboratory, Trinity College, Dublin.

Statistical Investigations on Variability and Heredity.

EARLIER appeals in your columns have met with such friendly response from scattered workers that I venture again to trouble you with an appeal for aid. I have three investigations in progress wherein help would be very welcome:—

(1) The measurement of physical and intellectual characters in pairs of brothers or sisters. Upwards of 1400 have now been observed and measured, but I have still not sufficient data. Village schools usually present a great deal of measurable material, but it is difficult to reach their teachers except through individual approach. Any of your readers who can interest their local teachers in observing and measuring pairs of children will do me a great service, and I shall be glad to send papers of instruction and a head-spanner for their use.

In examining carefully the data from nearly thirty primary schools recently returned to me, I only found two cases in which the teacher had not been fully able to use the spanner to advantage. Of course I shall be equally pleased to send papers and head-spanners to masters or mistresses in secondary schools.

(2) I shall be glad of any number of orange-tip male butterflies. They must have been caught wild and not bred, and I should like contributions from as many districts as possible. The specimens need not be very carefully set, and if the upper wings are not badly damaged they will be sure to be of use.

(3) Clutches of blackbirds' or thrushes' eggs. Each clutch must be kept perfectly separate, and certainly be from one bird. They are better unblown. If blown the hole or holes must not be at the ends. As some of your readers may have clutches they wish to preserve, but would not mind the risk of lending, I will return those so desired.

Contributions desired under (2) and (3) are for determining the intensity of homotyposis, a factor, I believe, to be at the basis of all hereditary resemblance.

KARL PEARSON.
University College, London, W.C., May 25.

Prehistoric Implements in the Transvaal and Orange River Colony.

THE reason for writing these short notes is the desire to point out to those with the requisite knowledge the places where what are probably palæolithic remains can be found in South Africa. I am not able to dilate on the technical side of the question, having only a smattering of the subject.

Being a volunteer in the British Army, the immense distances covered by us gave one an opportunity of seeing a larger tract of country than would be possible as a civilian. Unfortunately, in South Africa the amount of systematic research into the subject of prehistoric weapons has been but small, and I think the Orange River Colony and the Transvaal would be found very rich in all such remains. The heavy rains and nature of the country allow many glimpses of the geological formations, and the dongas and dry river banks will nearly always reveal some old "drift." The nature of our marching did not allow us to go far from the beaten road, but a few worked stones could be picked up in every day's march.

Starting at Sterkstroom, with the 3rd Division, such specimens can be found all round the town of about 2 inches in length in a fair state of preservation, some few showing the effect of being water-worn. At a coal mine named Wallsend, the hill where we camped is simply covered with scrapers and chips; in fact I collected quite a dozen in the small circle covered by our bell tent. Further north, at Bethulie Bridge, they are lying in the subsoil of the river bank, as well as in the stony reaches of the river. Springfontein, Smithfield, Dewetsdorp, in fact right up to Bloemfontein, the country is covered with stones all about the same size, roughly chipped and, in all probability, of palæolithic origin. They are of the leaf form and vary from 1 to 2½ inches in length.

At the Vaal River they were more water-worn and larger, about 5 by 2 inches. Better specimens could probably be obtained by examining the drift, which I myself had no opportunity of doing. I found only two or three specimens round about Pretoria. Middleburg and Belfast were the last two places I was in, and in the former an immense quantity of implements can be picked up in the river bed and in the subsoil adjoining. They are of the large size, as those in the Vaal River, some which I found being about 5 by 5 inches and quite 1 inch thick.

Unfortunately, Army regulations as to the weight of kit had to be carried out, and I had three separate times to throw my collection away. I had kept the best specimens and ticketed them, but in the end I found myself discharged from the Army as a time-expired volunteer in Cape Town, with only three or four dilapidated specimens from Belfast.

If regulars and volunteers would write about their observations of other parts of the country covered by them it would indicate at a glance the richest places where a systematic research could be undertaken with the best possible results.

Sunderland. STANLEY B. HUTT.

The Age of the Woburn Abbey Musk-Ox.

IN the notice of the young musk-ox at Woburn Abbey which appeared in NATURE of May 16 it was stated that the animal was considerably more than two years of age when the photograph was taken. This age was assigned on account of a statement made by Dr. Allen in his recent memoir on the Greenland and American musk-oxen that the Woburn specimens must have been yearlings when they were first photographed in 1899. His reason for making that statement were that a young calf captured at Fort Conder in May, 1899, had a black face, instead of the white-spotted faces of the Woburn animals; and that the latter had consequently changed their coats. Now the Woburn specimens were captured on Clavering Island on August 16 of that year, and from information that has recently been supplied to me it seems almost certain that they were calves of that year, probably born the preceding April or May. If this be so, and if calves have black faces when first born, it would seem that the Woburn specimens had already changed their first coats when shipped for England during the late summer, a photograph of them having been taken on board ship showing the white faces. It thus appears that when the photograph reproduced in NATURE was taken, the animal was not more than two years old, and possibly rather less. R. LYDEKKER.

The Subjective Lowering of Pitch.

As a general rule, the pitch of a musical note does not in any way depend upon its intensity, but solely upon the wave-length. It appears probable, however, that any wave motion of very great intensity produces distorted effects. Thus we find that a very loud sound may so affect the ear of the observer as to appear flatter than it really is. This is a purely subjective effect.

Dr. Burton was, I believe, the first to investigate the phenomenon, and some of his results (together with his explanation of them) will be found in vol. xiii. of the *Proceedings* of the Physical Society. My own attention was first drawn to the matter by observing what appeared to be the false intonation of certain singers upon loud notes, either when I was conducting near those singers or when I was rehearsing in a small room. Reading then of Dr. Burton's researches, I was led to investigate them for myself.

The subjective lowering of pitch is an undoubted fact, *i.e.* a very loud note does appear flatter than it really is.

If a C tuning-fork (middle C, 256 vibrations per second) be *strongly* bowed, and then be quickly brought near the ear, before its loud note has had time to die away, the sound will appear flattened to about $B\flat_1$, or even A_1, the amount of the effect being different to different ears.

It is more difficult to obtain the effect with higher forks; indeed, a C^1 fork (512) must be bowed very strongly indeed to give the effect at all. An E fork (320) appears to give a flat $D\sharp$, and a G fork (384) gives $F\sharp$.

The effect is a subjective one, caused by great intensity, for it vanishes as the sound gets softer, and can then be restored by bringing the fork nearer the ear, thus again increasing the intensity. In this last case the restoration of effect is sudden, and is not due to any gradual movement of the fork (Doppler's principle).

If the position of the source of sound be fixed, the subjective note gets sharper as the intensity of the vibrations gets less; for instance, an E fork (320), when very strongly bowed, gave $C\sharp$ as its subjective note; but, as the vibrations died down, this $C\sharp$ varied to D, then became $E\flat$, and finally and suddenly stopped altogether.

The amount of the subjective effect differs with different individuals, both in pitch and in intensity. What to one person appears a flattening of a minor 3rd, to another auditor appears a flattening of only a major 2nd, but in every case it appears to be a flattening and not a sharpening. Also the loudness of the subjective note appears different, even to the different ears of the same person.

In the case of some organ-pipes tested, the following results were obtained:—

C pipe (open, 256) gave A_1 as subjective.
E pipe (open, 320) gave D as subjective.
G pipe (open, 384) gave $F\sharp$ as subjective.
C^1 pipe (open, 512) gave B as subjective.

If an ear-trumpet be used, a very loud source of sound is not necessary in order to obtain subjective effects. If the source of sound be placed at a distance just great enough to prevent subjective flattening, and then an ear-trumpet be used, the subjective note at once appears.

Much of my own musical work has been done amongst male voices, and I have frequently noticed that a singer of good concert-room power may, if practising in a small room, seemingly sing with flat intonation. I should be glad to have further experience concerning this from your contributors, who will also, I hope, have noticed the effect in the case of brass instruments.

E. HURREN HARDING.

Normal College, Bangor, May 15.

RECENT STUDIES OF OLD ITALIAN VOLCANOES.

THE abundant and well-preserved extinct volcanoes of Italy have long had a great fascination for students of geology. So many allusions to them are scattered through the literature of the science, and so many accounts of them, more or less brief, have been furnished by those who have visited them, that their general characters and the more important varieties of their rocks are now tolerably familiar. But until lately hardly

any of them have been subjected to that minute dissection which modern vulcanology and petrography now demand. The Italian geologists, however, have at last taken up the investigation in considerable detail, and are issuing excellent maps and monographs of different volcanic districts, which well deserve the careful attention of all who take an interest in the progress of volcanic geology. To some of the latest of these publications a brief reference may here be made.

The Italian Geological Survey has entered upon the study of the volcanoes of Central Italy and their products, and as a commencement has issued a detailed account of that remarkable volcanic centre which forms the group of the Alban Hills to the east of Rome. This work has been accomplished by one of the staff, Mr. V. Sabatini, who has long been known for his geological enthusiasm.[1] It forms a volume of nearly 400 pages, with an excellent map of the region, ten plates of views and petrographical sections and 79 figures inserted in the text. After a brief introduction devoted to a discussion of some of the theoretical principles involved in the interpretation of volcanic phenomena, the author proceeds to give a sketch of the topography of the region and of the position of its several eruptive vents. He recognises, as at Vesuvius, the records of two great periods in the volcanic history. The first, one of conspicuous vigour, which built up a large cone that was finally demolished by a stupendous explosion; the second, one of minor force, whereby a cone was formed within the original circuit. Each of these phases has been attended with the production of secondary or adventitious cones, and the author endeavours to trace a series of lines of fissure along which, in his opinion, these cones have been produced. It is to be noted that some of his lines appear to rest merely on the evidence of carbonated or sulphurous springs, and even where they run from cone to cone some effort of imagination is needed to picture the lines of fissure as he gives them. In Southern Italy the geologists are less fanciful in dealing with the unseen substructure of their volcanoes.

The second chapter treats of the various hypotheses which have been proposed in explanation of the origin of the Roman Campagna and the Alban Hills, and especially of the tuffs so widely developed in that region. A detailed description of these tuffs is given; they are classified as lithoid, homogeneous, granular, pumiceous and earthy, and reference is made to the terrestrial flora and fauna enclosed in them. Their plants include many familiar living species. On Monte Celio, land-shells were found; on Monte Verde, the molluscs were of fresh-water species; in the tuffs between Nettuno and Astura, Meli has collected a considerable number of marine and estuarine forms, while a large assemblage of bryozoans has been gathered from the volcanic tuffs of Anzio and Nettuno. The succession of the different varieties of tuff is next given as displayed in many sections in and around Rome, and an attempt is made to estimate the cubic contents of the vast sheet of tuff which has been discharged from the Vulcano Laziale.

The third chapter deals with the nature and classification of the Latian lavas. These are grouped into normal leucitites and leucotephrites. The alterations which they have suffered are described, such as the transformation of leucite into felspar. Detailed descriptions are then given, in chapters iv. and v., of the rocks of each important part of the outer and inner cones of the volcano, and the author, following a practice for which he no doubt can cite high authority, adopts a somewhat complicated and cumbrous system of symbols to express the petrographical characters of each rock. Such a system may be convenient, especially where rapid comparisons of different species and varieties of rocks are desired by a student who has taken the time and labour necessary to understand it and commit it to memory. But life is too short and geological literature is too long for such a task on the part of ordinary readers. It would not have cost much more type to have accompanied the symbols with a brief statement of the composition of the rocks in plain language. The origin and constitution of the craters of Nemi, Castel Gandolfo and Ariccia take up the next three chapters. The author here, as in the rest of the volume, deals less fully with the tectonic than with the petrographical part of his subject. He would have added much to the geological interest of his memoir had he given more ample details of the structure of the great volcano and presented a clear and vivid outline of the whole succession of volcanic phenomena of which it preserves the record. Perhaps he may intend to deal with these parts of his subject in a subsequent treatise. A useful bibliography is appended to the volume. It is much to be desired, however, that precise references had always been given to the passages in the works of the authors whose names are cited in the text. The continuation of the important research of which Mr. Sabatini gives here the first instalment will be awaited with much interest.

In Southern Italy the investigation of volcanic phenomena is naturally incited by the irresistible attractions of the active volcanoes of that region. The study of the extinct cones and craters, however, has perhaps rather been retarded by the abundant opportunities offered there of witnessing the actual progress of eruptions. Within the last few years the subject of the older volcanoes has been taken up by several observers, who, without the resources of the National Survey to assist them, have nevertheless been successful in bringing much fresh information to light. Two of these geologists—Prof. G. de Lorenzo, of the University of Naples, and Prof. C. Riva, of the University of Pavia—deserve especial commendation for the enthusiasm of their researches. The volume just issued of the *Transactions* of the Royal Academy of Naples contains two detailed memoirs, one by Prof. G. de Lorenzo on the well-known Monte Vulture between Naples and the Adriatic, the other by the two authors conjointly on the seldom-visited crater-island of Vivàra between the islands of Ischia and Procida in the Bay of Naples.[1]

The memoir on Monte Vulture extends to 207 closely printed quarto pages, and is illustrated by numerous figures in the text as well as a map and a number of excellent plates in photogravure, of which one is here reproduced. In an introduction, the history of observation regarding this ancient volcano is briefly sketched. The author then proceeds to describe the various sedimentary series through which the volcanic explosions took place. These consist of Trias, Cretaceous, Eocene and Miocene formations, together with Pliocene and Pleistocene deposits both marine and terrestrial. The stratigraphical relations of these various groups of strata had already been discussed by M. de Lorenzo in a paper on the geology of the Southern Apennines, published in 1896, and they are well displayed in a plate of sections accompanying the present monograph. The incomplete series of Mesozoic formations is shown to have been considerably disturbed before Tertiary time, while the Eocene and Miocene deposits had likewise been plicated and denuded before the Pliocene strata were laid down upon them. In the southern outskirts of the mountain the volcanic pile rests on the younger Tertiary groups, while towards the north it spreads over the area of the Eocene and Miocene "Flysch." The faulted nature of the

[1] I vulcani dell' Italia Centrale e i loro Prodotti. Parte Prima—Vulcano Laziale, di V. Sabatini. Roma, 1900. (R. Ufficio Geologico. Memorie Descrittive della Carta Geologica d' Italia, vol. x.). This volume, the author informs us, is based on the work of 112 days in the field and the examination of 400 microscopic slides of rocks. The volcanic centre here referred to under the name of "Vulcano Laziale" comprises the Monti Laziali and the Monti Albani and their surroundings.

[1] "Atti della Reale Accademia delle Scienze Fisische e Matematiche di Napoli," second series, vol. x. 1901.

ground is well shown in some of the illustrations, but the author does not believe that Monte Vulture has had its site determined by the stupendous linear fracture which some theorists have imagined to extend eastwards from Vesuvius. He has satisfied himself, by a study of the geological structure of the surrounding country, that no trace of any such dominant dislocation exists.

The various rocks of the volcanic pile are then described in some detail. They are shown to form a numerous and continuous series of varieties between the two extreme limits of trachytoid phonolites, on the one hand, and basalts on the other. The principal types of lava are thus arranged: Hauyne-phonolite, anorthoclase-phonolite, hauyne-tephrite, leuco-hauyne-tephrite, leuco-hauyne-basanite, leucitic basalt, leucitite, nephelinite, hauynophyre. Each of these types is fully described and is illustrated by excellent plates of its microscopic structure. A section is devoted to the characters of the agglomerates by which the lavas are accompanied, and another to the inclusions contained both in the lavas and the fragmental materials, some of which were doubtless derived from the underlying sedimentary platform, others probably represent portions of the subterranean magma which have acquired a granitoid structure at a great depth, while in some cases their origin is doubtful.

FIG. 1.—View of the interior of Monte Vulture, showing the great exterior rampart and the crater lakes of Monticchio.

Having described the materials of the volcanic pile the author next furnishes an account of the way in which they have been built up into the huge mass of Monte Vulture. In a long and interesting section of the paper the structure and probable history of the mountain are discussed, and the position of its various rocks and some of the successive phases in the evolution of the topography are explained in diagrams inserted in the text. The next division treats of the lakes which, partly in consequence of the volcanic disturbances, were formed in some number and of considerable size during Pleistocene time. This subject had already been treated by M. de Lorenzo in a separate memoir (*Atti Accad. Scien. Napoli*, 1898) in which he had shown that Southern Italy in Quaternary time was dotted over with large and small basins of fresh water. Whether formed in consequence of changes in the topography produced by the volcanic eruptions or existing before these eruptions began, the lakes around Monte Vulture were more or less filled up with limno-volcanic tuffs containing fresh-water shells and likewise remains of *Elephas antiquus*, *Hippopotamus major*, *Ursus spelaeus*, *Felis spelaea*, *Hyena spelaea* and *Cervus elephas*.

In a final section the author states what he believes to be the bearing of the history of Monte Vulture on theoretical questions of volcanism. He insists on the total independence of the eruptions of this centre, which he thinks had no direct communication with those of any other. He can find no trace of the great connecting fissures which have been supposed to link together all the old and modern volcanoes of Southern Italy. He regards the eruptions of this centre as having begun long after the great orogenic movements that gave rise to the Apennine chain, and at a time when perennial snows and glaciers still lingered on the surrounding heights. Phonolitic lavas first made their appearance, followed by tephrites, basanites and basalts, which form the great mass of the mountain. Two peripheral vents can be distinguished, one anterior, the other posterior to the formation of the great central cone. The last stupendous manifestation of volcanic energy seems to have been the explosion which blew out the great crater in which the two crater-lakes of Monticchio now lie (Fig. 1).

M. de Lorenzo acknowledges the important services rendered to him by his friend Prof. Riva—the young and accomplished mineralogist of Pavia whose petrographical assistance and photographic skill were freely given in the preparation of this important monograph. The other memoir above cited is a joint production of the two observers. It is entitled "Il Cratere di Vivàra nelle Isole Flegree," and forms No. 8 in the same volume of the *Transactions* of the Naples Academy. It begins with an interesting historical introduction and then at once enters on a discussion of the rocks of which the remarkable island is composed. These consist entirely of fragmentary materials which have been heaped up around a crater, as in the other volcanic cones of the Campi Phlegræi. A careful account is first given of the coarse breccias or agglomerates, which include blocks of trachytic obsidian, sanidinites with quartz and catoforite, anorthoclase-trachytes with ægirine, augitic trachytes, mica-trachytes, andesitic trachytes, basalts, trachydolerites, rocks of dioritic type (monzonites) and other varieties. Full petrographical descriptions of these rocks, together with micro-photographs of their internal structure, are given. The varieties of pumice, lapilli and tuff are likewise detailed. It is shown that the eruptions of Vivàra, unlike those of the neighbouring region, did not consist solely of trachytic material, but discharged an admixture of a trachytic and a basaltic magma, so as to have heaped up a rich assortment of the most remarkable rocks, beginning with a quartziferous sanidinite and passing through various trachytic types to normal olivine-basalt. The relations of

these rocks to the other similar materials in the Phlegræan region are next discussed, and the authors then pass to the structure of the island, which they show to consist of successive sheets or banks of ejected fragmentary volcanic material without any accompanying lavas, and disposed in the usual divergent arrangement, the portions on the outer surface of the cone dipping steeply outwards into the sea, while those on the inside are inclined towards the centre of the crater. Vivàra rises out of the Mediterranean as a truncated cone which attains a height of 109 metres and a diameter across its upper rim of about 900 metres. The eastern half of the cone has been broken down and the sea now fills the circular crater. The waves and rains have cut many sections of the rocks, and thus the structure of the old volcano has been admirably dissected. All students of vulcanology will welcome these memoirs and hope that they may be regarded as the precursors of a long series in which the volcanic history of Southern Italy will be thoroughly elucidated. ARCH. GEIKIE.

AGRICULTURE IN NEW SOUTH WALES.

THE *Agricultural Gazette* of New South Wales has ushered in the century, and, at the same time, marked the consummation of an Australian Commonwealth, by issuing a special federal edition. The history of the agricultural development of the Colony is dealt within most interesting fashion by the chief inspector of agriculture, Mr. W. S. Campbell, who, in the hundred and thirteen pages that he appropriates, unfolds a fascinating tale of the early struggles and final success of this offspring of Great Britain, whose birth dates from the year 1788.

In the section devoted to chemistry in relation to agriculture a considerable feature is made of the value to the agriculturist of soil-analysis. Expert advice in the treatment of soils is said to be much sought after by the farmers of New South Wales, and a typical report on a poor soil is inserted with the view of showing the form that the information takes. The results of the physical and chemical tests are first tabulated, and from these the soil specialist formulates the following recommendations :— "This is a very sour soil, low in plant-food, and only moderately supplied with humus. Its retentive power for water is low, consequently its power of resisting drought. It will not give the best results till sweetened and brought into good condition. The treatment recommended is, first, liming at the rate of about one ton per acre. This will sweeten the soil, and supply lime in which the soil is deficient. Then a quick-growing crop, such as vetches, lupins, cow-pea, &c., should be grown and ploughed under when just maturing. This will supply vegetable matter, improve the texture, and supply nitrogen, in all of which essentials the soil is weak. After this treatment the soil should be able, with proper manuring, to grow any of the ordinary fruits suitable to the district, such as are mentioned in your letter. Peaches and stone fruit should do very well, as well as any vegetables. With regard to the most suitable manuring, this should be on the lines recommended in the attached departmental pamphlet, 'Formulæ for Fertilisers,' which gives the manuring required for the different crops in average soil. In your case the quantities recommended may be somewhat increased. I would particularly impress upon you, (1) That this report is intended to be merely suggestive, and must be followed up by careful experiments on your own part ; (2) . . . . (3) That you should impart to your neighbours any information you may gain from this report as freely as it is given to you ; (4) That you should communicate regularly with the Department as to the results of your experiments, for we have special facilities for advising you as to the best manures for your special needs, and the cheapest form in which you can get the same."

This typical report is reprinted almost in full in order to show what the Department of Agriculture of New South Wales professes to be able to do in one section of the farmer's business, namely, the management of his soil. Experience in other countries has shown that advice given in the light of laboratory tests on soil is apt to be rather uncertain in its results, but in Australia science has, in this respect, it is said, been very useful to farmers. The practice of liming in that country seems to vary considerably from what holds in England. Where sourness in soil is the trouble an English farmer would consider a dressing of five tons of lime per acre none too much, but in New South Wales one ton is recommended as the maximum dose, to be repeated, if need be, a few years later.

Not the least interesting section of this federal number is that which treats of agricultural education. Technical instruction in agriculture appears to be eminently practical, and it is noted with satisfaction "that among the large number of young people so trained there are to be found so great a proportion who have achieved signal success upon farms and orchards of their own." The curriculum at the Hawkesbury College is almost rigorous in its thoroughness. The students who are on dairy duty turn out at 4.15 a.m., and are probably ready for their breakfast, which is served at seven. The sixty-five horses and mules that cultivate the College farm of 1100 acres demand the attention of another "gang" of students, whose day's work does not close till 8 p.m. Hard manual work does not appear to discourage the young farmer of New South Wales in his pursuit of knowledge, the present accommodation of the College being inadequate to meet the demands for admission. Some illustrations of the practical character of the education are culled from the interesting volume before us, which reflects a colonial vitality most gratifying to the mother-country.

CLIMATE AND TIME AND MARS.

THE astronomical theory of an Ice Age, of which the foundation is attributed to Adhémar, has been the subject of much discussion. Its laborious exposition by Dr. Croll has been justly considered a work of great merit, but it may be said to have proved more interesting as a speculation than convincing as an argument. The adequacy of the theory to explain all that is required of it is a highly controversial matter, and was debated with no little heat in the columns of this journal in 1895-6. Consequently it is desirable to state that this note is written from the point of view of qualified belief in the argument as expounded by Sir R. Ball.

The contribution of astronomy to the data of the problem can be very easily stated. Let us consider the northern hemisphere of a planet, the eccentricity of whose orbit, e, is sensible, but so small that only its first power need be taken into account. In the first place the ratio of the total solar radiation received in summer and winter is $1+a : 1-a$, where $a = 2 \sin \omega/\pi$, ω being the obliquity of the equator to the orbit. This is the law discovered by Wiener, and in the case of the earth $a = .25$. The ratio of the duration of summer and winter, *i.e.* of the periods between the equinoxes, is $1+b : 1-b$, where $b = 4e \sin \lambda/\pi$, λ being the true anomaly of the spring equinox. Hence the ratio of the mean heat received in a given time in summer and winter is $(1+a)/(1+b) : (1-a)/(1-b)$. In the southern hemisphere the corresponding ratio is $(1+a)/(1-b) : (1-a)/(1+b)$. At the present time $b = .02$, but in circumstances which would cause the earth's eccentricity to reach its maximum value (about .0747), $b = .09$ when $\lambda = 90°$. Under such conditions, then, the southern winter would un-

doubtedly be more severe than at present, while the northern winter would be to some extent mitigated. Precession would have the effect of causing this state of things to alternate in the two hemispheres. The argument is perfectly simple and definite, and can only be questioned on the score of degree, not of fact. It thus passes from the domain of astronomy to that of meteorology. Here the ground is very debatable, and Mr. Culverwell's discussion of the solar radiation incident on individual zones of the earth may be regarded as a decided contribution to a study of this part of the question. But his researches do not seem to be necessarily so conclusive against the astronomical theory of an Ice Age as this author supposes. For the present purpose, however, enough has been said as to the application of the theory to our own planet.

The conditions which hold in the case of Mars resemble in a remarkable manner those which hold in the case of the earth, except in one particular. The eccentricity is ·0933, and hence $b = ·11$. The constant $a = ·27$. These values of a and b apparently afford an excellent example of the conditions required by the theory for a glacial epoch in the southern hemisphere of Mars. It would be illogical to compare the state of corresponding regions on the earth and on Mars, because the concomitant circumstances cannot be expected to be the same. But it is reasonable to suppose that in corresponding seasons the latter planet should show different phenomena in the two hemispheres. As an index of these variations we naturally look to the polar caps, the size of which is known to vary greatly with the seasons. The results to be expected are of this kind :

Hemisphere.	Season.	Duration.	Climate.	Size of Cap.
N	Summer	Long	Cool	Min.
N	Winter	Short	Mild	Lesser Max.
S	Summer	Short	Hot	Min.
S	Winter	Long	Cold	Greater Max.

The amount of heat during summer in either case being the same, there is room for question as to the relative size of the two minima. But it seems clear that the radiation incident on the southern hemisphere will be transformed into heat at a higher temperature than in the northern. According to the laws of thermodynamics it should, therefore, be more effective in the south. The total energy received is the same, but the available energy is greater. Or the matter may be considered differently. It is quite conceivable that during the long cool summer the temperature would not rise above the melting point of ice or whatever substance is in question, while it would be otherwise during the short hot summer. An approach to this condition would lead us to expect the more pronounced minimum in the southern hemisphere.

To compare the suggestions of theory with the facts of observation, we can turn to a recent paper on the subject by Mr. Lowell.[1] He concludes that the caps are composed of ice and not carbonic acid, on account of the difficulty of obtaining the latter substance in a liquid form, a state which he considers proved by observation to exist on Mars. He expresses a belief that the Martian sky is cloudless during the day and that the surface of the planet is protected by cloud at night. It must be confessed that the regularity of transition at sunrise and sunset from one condition to the other almost surpasses our belief and tends to discredit the deductions from the study of projections upon the terminator. Mr. Lowell then considers the evidence of the polar caps. The result is to confirm the expectations formed above, and the conclusion is perhaps the more convincing because the writer seems to find the phenomena surprising. And this point is rather important, for the evidence as to the maxima is not so complete as could be desired. It is to be hoped that Mr. Lowell's examination of this part of the question will lead to the acquisition of more complete and satisfactory evidence.

With regard to the minima, Mr. Lowell does not give the simple explanation suggested above, but attributes the phenomena observed to a deficiency of precipitation. In fact, he professes to prove that "as the precipitation increases a time must come when the southern minimum will actually exceed the northern one in size, *and do so more and more, indefinitely*." As no physical principle is invoked to account for this result, it would seem to be based on assumption. Examination shows that the assumptions tacitly involved are (1) that the maximum of each cap is increased in the *same* ratio, (2) that the amount melted at each cap remains exactly the same as before. It would then follow that in each hemisphere the rate of proportionate growth of the minimum would exceed that of the maximum. We now introduce the observed fact that the ratio of maximum to minimum is greater in the southern hemisphere. This, added to the foregoing, is necessary and sufficient to prove that the rate of proportionate growth of the minimum is greater in the southern than in the northern hemisphere. But the observed fact employed might equally well have been stated in this form : comparing the southern with the northern hemisphere, the ratio of the minima does not exceed the ratio of the maxima ; and by assumption (1) the latter is constant. Hence, even on the assumptions the words italicised in the above quotation do not appear justified. The southern minimum may tend towards a relative increase, but there is a limit to the increase. The general idea is perhaps suggestive, but the second assumption involved must be considered highly improbable, and without it the whole theory fails.

At the end of the paper Mr. Lowell turns his attention to the eccentric position of the southern cap. He declines to believe that this well-known peculiarity is due to local elevation, but, on the contrary, attributes it to a region of depression, where the cap has acquired an exceptional thickness. The phenomenon is a very curious one, but speculation as to its origin has probably not much value.

[1] "Mars on Glacial Epochs," by Percival Lowell : *Proceedings* of the American Philosophical Society, Nov. 16, 1900.

THE TELAUTOGRAPH.

IN an article on "Electric Signalling" which appeared recently in these columns (vol. lxiv, p. 6) we referred to the writing telegraph invented by Mr. Foster Ritchie. We have since had an opportunity of examining the instrument and seeing it at work, and are enabled to give a full description of it. The problem of devising an apparatus which should telegraphically transmit the actual handwriting or drawing of the person sending the message is one which has attracted a number of inventors. The difficulties to be overcome are, however, numerous, and in consequence up to the present no really satisfactory instrument has been invented. These difficulties seem to have been mastered in Mr. Ritchie's telautograph in a very ingenious manner, and the instrument is one which should prove thoroughly trustworthy and serviceable. Although it is not to be expected that the telautograph will replace ordinary telegraphic apparatus to any very marked extent, seeing that the speed of signalling is necessarily limited, yet there are numerous cases in which it should be of use. To give only one example, there are many persons possessing private telephone lines who would gladly supplement them with an instrument of this kind by which written instructions can be sent whether there is any one present to receive them or not. Other cases of like kind will doubtless occur to the reader.

One of the chief merits of the Ritchie telautograph lies in the fact that only two wires are needed to connect the

transmitting and receiving instruments; these are connected as a single loop earthed at each end, thus providing three distinct circuits since currents can be sent through either of the two wires to return by earth or can be sent through one wire to return by the other. The general principles of the apparatus will be understood from FIGS. 1 and 2. Fig. 1 is from a photograph of the instrument with the cover and paper removed in order to show the working parts. It will be seen from this photograph that the complete apparatus consists both of a transmitting instrument, fixed on the horizontal baseboard, and a receiving instrument, supported on the four upright pillars. Fig. 2 is a diagram of the connections, only the principal connections being shown in order to avoid a multiplicity of lines.

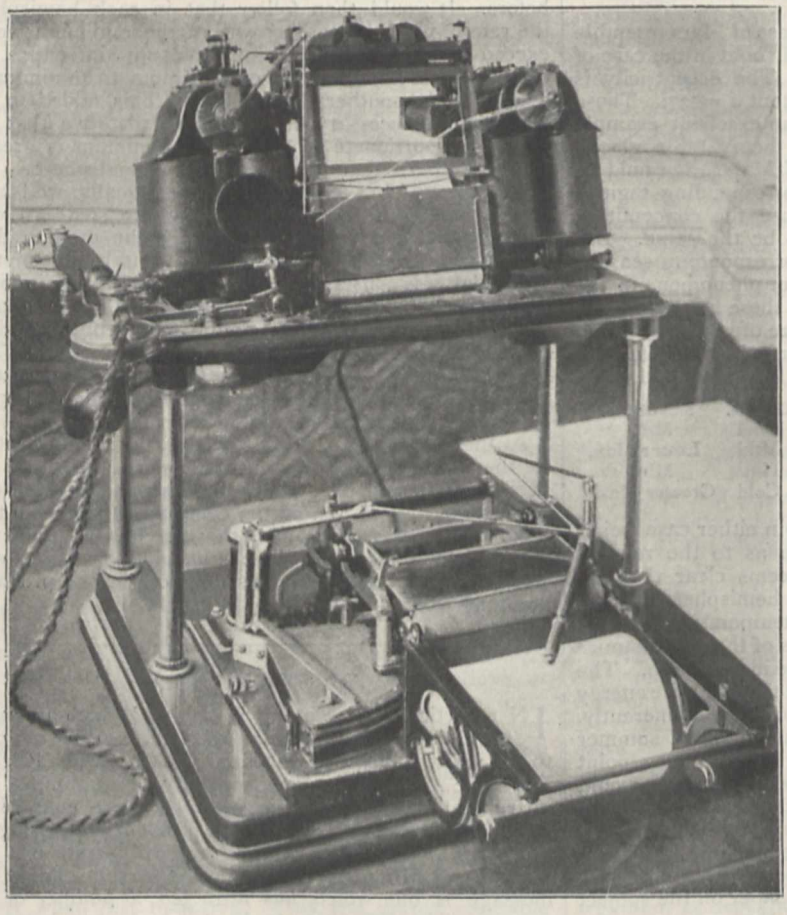

FIG. 1.—General view of the Telautograph.

When the operator wishes to send a message he takes up the transmitting pencil, A, and with the point shifts to the left the catch C. This operation actuates a grip which shifts the paper forward at both ends of the line, thus bringing up a clean piece to write upon, and also connects up the transmitting and disconnects the receiving apparatus at the home end. At the same time, it reverses the connections of one of the sets of batteries, two sets of which are used, one at each end of the line, which are normally connected in opposition so that when the connections of one set are reversed by shifting the catch C they are connected in series. The operator now proceeds to write on the transmitting paper: the pencil, A, is connected to two sets of levers, LL, which actuate the sliding contacts of two rheostats, RR′; these rheostats are connected one in series with each of the two lines, R in the line EWWE′, and R′ in the line EW′W′E′. As the resistances of the rheostats are varied by the motion of the sliding contacts corresponding to the motion of the pencil, A, the currents in the two lines will vary. These currents pass through and deflect the moving coils of two galvanometers of the d'Arsonval type, G, G′, in the receiving instrument; these coils are connected by two sets of levers, L′L′, to the receiving pen, B. It will thus be seen that the position of the pen B is controlled by the deflections of the two galvanometers, which are in their turn dependent on the position of the transmitting pencil A: the pen will therefore exactly follow in its motions the movements of the pencil and will consequently repeat on the paper at the receiving end the drawing made on that at the transmitting end. The currents, after traversing the coils of G and G′, pass through the relays D and D′ (the use of which will be explained presently) and then return by earth.

From what has been said so far it is obvious that the receiving pen will copy the movements of the pencil A, whether the pencil is being used to write on the paper or merely being moved about above it. It is necessary to prevent the pen B from making marks on the paper except when A is actually writing on the paper at the transmitting end. This is effected in the following ingenious manner. A small induction coil at the transmitting end has its primary circuit, P, completed through a contact, M, attached to the desk on which the writing paper rests: the terminals of the secondary coil, S, are connected to the line wires, W, W′, and the circuit is completed at the receiving end through the relay H and the condenser K′. Intermittent currents are thus sent round the circuit SWHW′S and, actuating the relay H, put in action a pen lifting magnet (not shown in the diagram) which raises the bar F and holds the pen B off the paper. When the operator starts writing the pressure on the paper breaks the contact at M and thus stops the vibratory currents; the relay H is released and the bar F falls back, thus allowing the pen to come into contact with the receiving paper. It will be noticed that the vibratory currents are superimposed on the ordinary line currents, but they are prevented from affecting the receiving pen by the self-induction of the galvanometer circuit, whilst at the same time the line currents are prevented from passing through the relay H by the condensers K and K′. A small amount of the intermittent current does pass through the galvanometer coils, but this is, as a matter of fact, advantageous, as it prevents, by the slight vibration it produces, any tendency to sticking.

When the writer has filled up the strip of paper he again shifts the clutch C and this moves forward the

paper at his end and also, through the operation of the relay D, shifts that at the receiving end. At the same time the pen B returns to the ink bath and takes a fresh supply of ink: the ink bath is not shown in Fig. 2, but can be seen, with the pen resting in it, in Fig. 1 in front of the

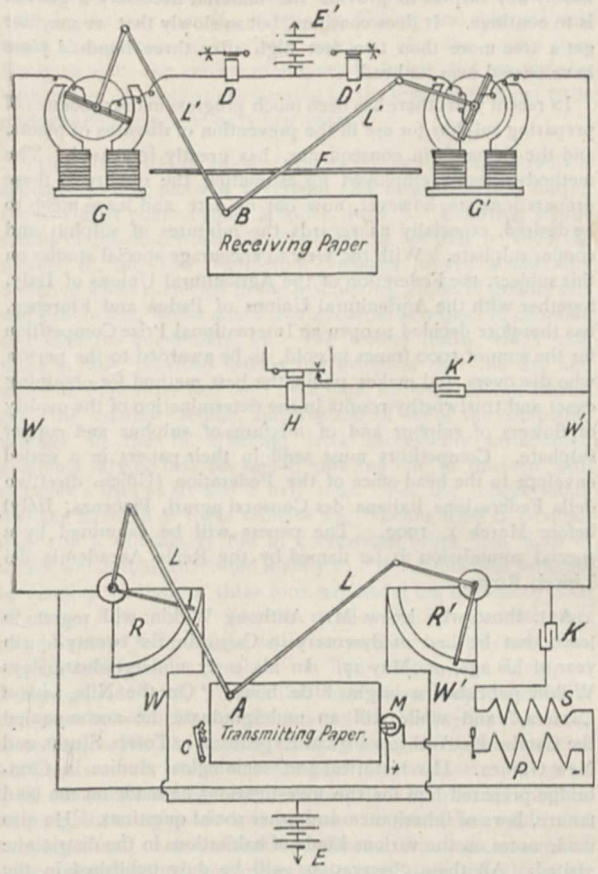

FIG. 2.—Diagram of telautograph connections.

galvanometer on the left. The pen, which is shaped like a small pipe, the bowl being a reservoir for the ink, holds sufficient ink to cover the amount of paper exposed at one time. The relay D' controls a local bell circuit and is used for ringing up. Neither the connections of this bell circuit nor of the paper shifting magnet are shown in Fig. 2, the relays only being shown in order to avoid unnecessary complication.

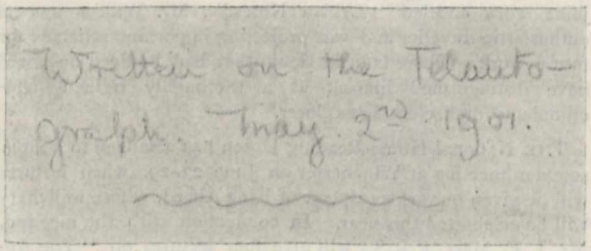

FIG. 3.—Transmitted message.

A specimen of the writing transmitted by the telautograph is shown in Figs. 3 and 4. Fig. 3 shows the words as written in pencil at the transmitting end, and Fig. 4 as received at the far end. These words were transmitted over an artificial line nearly 300 miles long; it will be seen that although the writing is somewhat distorted it does not lose its character and is indeed a very fair reproduction. The words were written on the first telautograph that Mr. Ritchie has constructed; in future instruments it is to be expected that the reproduction will be even more accurate, as several improvements in detail have been introduced, but it must be admitted that the performance of the present apparatus leaves little to be desired. There is no difficulty in writing, in spite of the pencil being attached to the rheostats and having to move

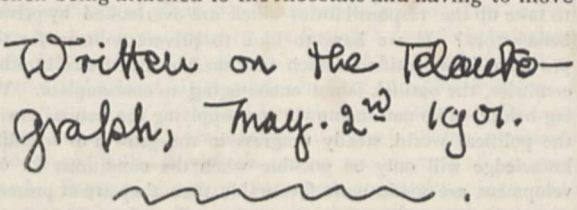

FIG. 4.—Received message.

them; everything seems to move very freely and it is almost as easy to write as with an ordinary pen. Moreover, as long as the paper is not shifted, the writer can go back and make alterations and additions with perfect accuracy.

We are much indebted to the Telautograph Co. for allowing us to examine the instrument, and to Mr. Foster Ritchie for very kindly explaining to us the details of its construction.

NOTES.

MR. BALFOUR has often pleaded for the increase of facilities for scientific research, and has pointed out how, in this respect, our country compares unfavourably with some others. The festival dinner of the Medical Graduates' College and Polyclinic, on May 22, gave him another opportunity to remind the public of existing deficiencies and the duties of wealthy citizens towards them. As purely scientific research can never be self-supporting, and as, moreover, every addition to knowledge is of value, it has peculiar claims upon the public and the nation. How small, comparatively, is the response to these claims is known to all of us. Here science is tolerated but it cannot be said to be encouraged; and this because the people who have the means to further scientific interests are not in sympathy with them. The State leaves the adequate provision for scientific research to private benevolence, but liberal benefactions are few and far between, so work which would be done here if means were available is left to other nations. Many men of science spend their private incomes to carry on investigations which elsewhere would be afforded generous support, and they often have to leave work unfinished because such assistance is not forthcoming. "I do not believe," said Mr. Balfour, "that any man who looks round the equipment of our universities or medical schools, or other places of education, can honestly say in his heart that we have done enough to equip research with all the costly armoury which research must have in these modern days. We, the richest country in the world, lag behind Germany, France, Switzerland, and Italy. Is it not disgraceful? Are we too poor or are we too stupid? Do we lack the imagination required to show what these apparently remote and abstract studies do for the happiness of mankind? We can appreciate that which obviously and directly ministers to human advancement and facility, but seem, somehow or another, to be deficient in that higher form of imagination, in that longer sight, which sees in studies which have no obvious, necessary or immediate result the foundation of the knowledge which shall give far greater happiness to mankind than any immediate, material, industrial advancement can possibly do; and I fear, and greatly fear, that, lacking that

imagination, we have allowed ourselves to lag in the glorious race run now by civilised countries in pursuit of knowledge, and we have permitted ourselves to far too large an extent to depend upon others for those additions to our knowledge which surely we might have made for ourselves." Unfortunately there seems little hope of improvement in this depressing condition of affairs. We would ask, however, how comes it that the members of the Government, knowing the position of things and expressing belief in the salvation of the nation through science, neglects to take up the responsibilities which are overlooked by private benefactors? If we have to look to private sources for the provision for scientific research furnished by the State in other countries, the outlook is not encouraging to contemplate. We lag behind other nations now; and, applying the natural law to the political world, steady progress in the growth of scientific knowledge will only be possible when the conditions for development are made more favourable than they are at present.

THE annual visitation of the Royal Observatory, Greenwich, will be held on Saturday, June 1.

AT the annual meeting of the Institution of Electrical Engineers to be held this evening, an illuminated address received from the American Institute of Electrical Engineers will be presented. The address has been sent as an expression of thanks for courtesies extended to members of the American Institute during their visit to London last year, and in connection with the joint meeting at Paris. It is a pleasant token of the cordial relationship existing between British and American electrical engineers, and the feeling which prompted the resolutions embodied in the address will doubtless be much appreciated.

THE success of the visit of members of the Institution of Electrical Engineers to Switzerland in 1899 has led to arrangements being made for a visit to Germany next month. There will be three parties, one visiting Berlin only, another visiting Berlin and Dresden, and a third visiting Berlin, Dresden, Nüremberg, Frankfurt-a-Main and other places. The whole party will leave London on Saturday, June 22, and upon their arrival at Hanover on Sunday evening will be entertained at dinner by the town authorities. At Berlin, in addition to visits to works, a visit will be paid to the Technical High School, where Prof. Slaby will show the college to the members. Several dinners and receptions will be given to the visitors in Berlin and elsewhere by electro-technical societies and other bodies. Ladies may accompany the members, and the visit promises to be pleasant and profitable to all who take part in it.

AS may well be imagined from the wealth of blossoms now to be seen in our gardens, the flowers exhibited at the Temple Show of the Royal Horticultural Society last week were very fine. Those, however, who looked for novelties met, for the most part, with disappointment. There was nothing of startling popular interest or of extraordinary scientific significance, while new garden plants were not very notable and seemed few and far between. Mr. H. J. Elwes, F.R.S., showed *Cypripedium guttata* in bloom, a plant which he obtained a year or two ago on the Altai Mountains. Its habitat was in a dense forest that was almost impenetrable. The markings on the perianth were of a very pleasing red, and the specimens did credit to their treatment, which included their being kept on ice during the winter. The series of insectivorous plants hard by, sent by Mr. A. J. Bruce, of Chorlton-cum-Hardy, was very fine, and the Sarracenias may be particularly mentioned. One flippant visitor likened the leaves of some to steamboat ventilators which had been twisted. A similar collection belonging to Mr. R. R. J. Measures was also worthy of careful examination. Very suggestive of the balance that must be maintained between roots and foliage were the trees artificially dwarfed by the Japanese. These were quite plentiful, being exhibited by professional and amateur horticulturists alike. Here the skilful grower has so limited the root system and so cunningly reduced the number of leaves that, practically speaking, only sufficient food is manufactured to maintain the plant in health, there being hardly any surplus to provide the material necessary if growth is to continue. It does continue, but so slowly that we may not get a tree more than two feet high after three hundred years have passed over its head.

IN recent years there has been much progress in the processes of preparing sulphur for use in the prevention of diseases of plants, and the demand, in consequence, has greatly increased. The methods actually employed for estimating the quality of these preparations are, however, now out of date and leave much to be desired, especially as regards the mixtures of sulphur and copper sulphate. With the view to encourage special studies on this subject, the Federation of the Agricultural Unions of Italy, together with the Agricultural Unions of Padua and Florence, has therefore decided to open an International Prize Competition for the sum of 1000 francs in gold, to be awarded to the person who discovers and makes public the best method for obtaining exact and trustworthy results in the determination of the quality of flowers of sulphur and of mixtures of sulphur and copper sulphate. Competitors must send in their papers in a sealed envelope to the head office of the Federation (Ufficio direttivo della Federazione italiana dei Consorzi agrari, Piacenza, Italy) before March 1, 1902. The papers will be examined by a special commission to be named by the Reale Accademia dei Lincei, Rome.

ALL those who knew Mr. Anthony Wilkin will regret to learn that he died of dysentery in Cairo, in the twenty-fourth year of his age, on May 17. In his early undergraduate days Wilkin published a bright little book, "On the Nile with a Camera," and while still an undergraduate he accompanied the Cambridge Anthropological Expedition to Torres Straits and New Guinea. His historical and sociological studies in Cambridge prepared him for the investigations he made on the land tenure, laws of inheritance and other social questions. He also made notes on the various kinds of habitations in the districts he visited. All these observations will be duly published in the Reports of the Expedition. Immediately after his first winter's digging in Egypt with Prof. Flinders Petrie, he went with Mr. D. Randall-Maciver to Algeria to study the problem of the supposed relationship, actual or cultural, of the Berbers with the ancient Egyptians. An interesting exhibition of the objects then collected was displayed at the Anthropological Institute in the summer, and later on in the year Wilkin published a well-written and richly illustrated popular account of their experiences entitled "Among the Berbers of Algeria." Quite recently the scientific results were published in a sumptuously illustrated joint work entitled "Lybian Notes." Mr. Wilkin was an enthusiastic traveller and was projecting important schemes for future work. There is little doubt that had he lived he would have distinguished himself as a thoroughly trained field-ethnologist and scientific explorer.

THE National Home-Reading Union has arranged to hold a summer meeting at Winchester on June 22–29, when lectures will be given on various aspects of King Alfred, whose millenary will be celebrated this year. In connection with the meeting, Mr. J. E. Marr, F.R.S., will give four lectures on "The Application of Geology to Scenery," a secondary purpose of the meeting being the study of the geology and botany of the district as well as its archæology.

THE Simla correspondent of the *Times* reports that the Secretary of State has sanctioned a scheme for an ethnographical survey of British India in accordance with the suggestions made

in 1900 by the British Association. The work will be done by civil officers in addition to their own duties, Mr. Risley being appointed director of ethnography. The annual expenditure will be 40,000 rupees, and the total cost is estimated at 1½ lakhs, excluding the cost of printing. The Government hope that ethnologists and scientific societies in Europe and America will assist the director with advice, refer to him the points they desire to make the subject of inquiry in India, and supply him with copies of publications bearing on the researches about to be undertaken during the next four years.

THE third series of trials of motor vehicles for heavy traffic is arranged to take place in Liverpool and neighbourhood during the five days commencing Monday, June 3. Referring to the results of previous trials, the *Times* points out that in 1898 the wheels of the four competing vehicles proved structurally defective when subjected to the hammering action of granite sets and cobble sets, whilst minor troubles arose in respect to adhesion and with the condensers, &c. The second trials, which took place in 1899, provided satisfactory evidence that the tire and adhesion difficulties had been overcome, for none of the wheels gave the smallest trouble, and five out of six of the competing vehicles in the hill-climbing tests successfully surmounted gradients varying between one in nine and one in thirteen with as heavy a load as six and a half tons. Yet the judges found that the strength of these vehicles was "below what is compatible with a satisfactory life in commercial work"—a state of things which they attributed mainly to "the difficulties imposed by meeting the limit of three tons tare under the Locomotives on Highways Act, 1896." In order to see whether manufacturers could improve their designs so as to produce an efficient commercial vehicle under the three-ton limit of tare, the Liverpool Self-propelled Traffic Association has allowed an interval of two years between the second trials and the third series now about to be held. For the coming trials an entry of thirteen vehicles has been secured, which will compete in four classes. Class A is for comparatively light vehicles propelled by internal combustion engines using deodorised naphtha or petroleum spirit, and carrying a load of only one and a half tons. The vehicles entered under the other three classes are all steam propelled, electricity being again unrepresented. The steam waggons, however, comprise a great variety of design, including several boilers of the flash, or instantaneous generation, type.

THE Report of the Council of the Royal Agricultural Society of England, read at the annual meeting on Wednesday of last week, was not an altogether satisfactory one. The total number of governors and members is more than ten thousand, but since last year there has been a nominal reduction of 633—which includes 314 voluntary resignations. A few of these have withdrawn from the Society on account of the decision of the Council to discontinue the annual migratory shows after 1902, because of the serious losses the last three have involved. The show this year will be held at Cardiff, from June 26 to July 1, and in 1902 the last of the series will be held at Carlisle. These migratory shows will be superseded by a permanent showyard at Twyford Abbey—a few miles out of London. For the prizes of 40*l.* and 20*l.*, offered by the Society for portable oil engines, eight entries have been received, the trials of which will take place in the Cardiff showyard in the week previous to the show. For the similar prizes offered for agricultural locomotive engines, no entry has been received; and for the prize of 15*l.* offered by the Society for the best small ice-making plant suitable for a dairy, only one entry has been made. The council report that at the Woburn Experimental Farm the feeding experiments have shown that sheep fatten perfectly well, and without any drawbacks, when fed on mangels instead of swedes. Gorse has been proved to be a useful food, but the results were slightly inferior to those obtained by the use of hay. Progress is being made with the usual field experiments and with the investigations of various agricultural problems, including the eradication of farm weeds. At the pot-culture station experiments are being continued in connection with Hills' bequest. Much attention has been given to the value of seeds, and reports have been supplied to members of the Society in regard to the purity and germination of 116 samples of different seeds. A disease in the cherry orchards of Kent, which has seriously affected the cherry crop, has been investigated by the Society's consulting botanist, and a description and figures of the disease have been printed as a leaflet and extensively circulated in Kent and other fruit-growing districts. The Zoological Department has been chiefly concerned during the past six months with pests injurious to stored produce and with such insects as are troublesome all the year round. Some of the more important applications have had reference to forestry, and advice has been given with regard to various insects attacking plantations of coniferous and other trees.

A DISASTROUS explosion occurred at the Universal Colliery, situated at the top of Aber Valley, a few miles from Caerphilly, on Friday last, no less than eighty-three men having perished through the accident. Mr. Dyer Lewis, assistant inspector of mines, is reported by the *Times* to have said that there was no longer any doubt that the explosion was caused by coal dust, adding that the long continuance of the north-east wind, which practically prevailed for three weeks, might probably have had the effect of drying up the air passing through the workings and thus have caused the coal dust to become drier.

WE understand that the Admiralty is proceeding energetically with the fitting of wireless telegraphy to the ships of the British Navy. The "Apps-Newton" coil has been adopted as the standard pattern, and a large number of coils and transmitters have been ordered.

A COMPLETE installation of Marconi's wireless telegraphy specially suitable for signalling purposes as used in the Navy has been fitted on board the Elder, Dempster Beaver liner *Lake Champlain*. This installation is the first which has been fitted on any of the Atlantic liners sailing from Liverpool. The *Lake Champlain* left the Mersey for Halifax last Tuesday with more than 1000 passengers, and arrangements were made to establish communication between the vessel and the Marconi wireless telegraph station at Holyhead. The *Times* states that at 9.37 p.m., when off the Skerries, communication was obtained with the Holyhead station, the vessel being then thirteen miles distant. Numerous telegrams were then forwarded from passengers to friends in all parts of the United Kingdom, each message being acknowledged by the receiving operator. Constant communication with the station was continued until 1 a.m., the vessel being then thirty-seven miles distant. Communication was established with the Marconi station at Rosslare, and at 4.30 a.m. a fresh batch of telegrams was forwarded, notifying the vessel's arrival off the Tuskar light to the owners, Messrs. Elder, Dempster and Co. The position of the ship was nineteen miles from Rosslare telegraph station. The last telegram was forwarded at 7.30 a.m., at a distance of nearly thirty miles from Rosslare.

OUR paragraph directing attention to the proposal to erect a memorial to the late Right Hon. Prof. Huxley in Ealing has elicited one noteworthy response. The contributor, who gives neither name nor address, begins his covering letter: "In the current issue of NATURE" (which presumably he had seen at a free library) "the reader is informed of a movement on foot in Ealing for a memorial to the memory of Huxley. With gladness I hasten to contribute my mite," and concludes an able, if lengthy, epistle as follows: "I enclose a postal order for 1*s.*

as some *little* help towards the memorial. Even now I am giving beyond my means, as I am merely a casual dock labourer, living from hand to mouth, and often hardly able to make both ends meet. But I never let my mind get rusty, and from my boyhood have had a keen partiality for 'Nature's leading lights' and their works. Among the brightest of these, and of whom any nation might be justly proud, flashes out Thomas Henry Huxley."

THE *Procès-verbaux* of the meeting of the International Committee of Weights and Measures at Paris in September last have been received. The Committee had under their consideration the reports of the director on the work of their bureau for 1899-1900, by which reports it would appear that besides the ordinary verification work of the bureau (standard metres, kilograms and thermometers for various Governments, Universities and scientific authorities) important researches have been carried out as to alloys of nickel and steel (Dr. Guillaume); as to comparisons of platinum and hydrogen thermometers (Dr. Chappuis and Dr. Harker), and the determination of the mass of a cubic-decimetre of distilled water. Dr. Benoit reports that the latter mass may be taken as equivalent to 999·936 grammes; but it does not appear that the true value of a cubic-inch of water is to be derived from the cubic-decimetre. The best ordinary alloy for measures of length (as bars, line-measures, survey ribands, &c.) appears from Dr. Benoit's report to be one of 64·3 per cent. of steel and 35·7 per cent. of nickel.

We note that the Committee referred to in the foregoing note propose to take up the vexed question of an international series of sizes of screw-threads, based on the millimetre. The annual expenditure of the Committee amounts at present to 75,000 francs, but it would appear that at the general conference to be held at Paris in October next, under the Metric Convention 1875, a proposal is to be made to raise the annual budget to 100,000 francs, at which sum it was formerly fixed, so as to meet necessary expenditure on the instrumental equipment and maintenance of the bureau. Towards this annual expenditure each High Contracting State contributes a sum based on its population, and on the extent to which the metric system may be in force within each country; Great Britain contributes about 5000 francs. Some effort appears to have been made in September last by the Decimal Association (London) to induce the Committee to lay before the French Government a proposition to invite the attention of the Governments of Great Britain, Russia and the United States to the desirability of making the metric system compulsory in these countries; but the Committee do not appear to have approached the French Government on this delicate proposition. From the communications addressed to the Committee by Prof. A. Michelson (Chicago), Mr. Chaney and Prof. Mendeléeff, it seems that the metric system is, however, making way in the three great countries above mentioned.

Die Umschau contains a short account of Hoffmann's model flying-machine. The peculiarity of this model (which weighs 3½ kilogrammes) is that it is supported on three long legs, by the aid of which it runs on wheels on a track or on the ground till it has gained sufficient velocity to rise in the air, when the legs fold up automatically and the model flies somewhat after the manner of a stork. It is claimed that such an arrangement applied to a man-lifting machine would obviate the difficulties connected with the starting and landing.

WE have received a copy of the magnetical, meteorological and seismological observations made at the Government Observatory, Bombay, for the years 1898 and 1899, under the direction of Mr. N. A. F. Moos, which extends the record of this important series to a period of fifty-four years. The observatory is very completely equipped both with ordinary and self-recording instruments, the standards being read five times daily, commencing with 6h. a.m. A Dines' pressure tube anemometer, probably the most satisfactory instrument for recording the varying strength of the gust of wind, was erected in February 1897, and a Milne's seismograph in September 1898. In addition to the tables of results obtained from the automatic instruments and from the direct eye observations, the volume contains the following valuable appendices:—(*a*) Hourly means of the magnetic elements, as determined from quiet days, for the years 1894-9; (*b*) Notes on the harmonic analysis of temperature and pressure for 1876-1895, with plates; (*c*) Hourly and daily normals of the several meteorological elements, and their variations expressed by Bessel's formula.

WE have received from Mr. J. Baxendell, meteorologist to the Southport Corporation, the report and results of observations at the Fernley Observatory and allied stations for the year 1900. With a small amount of means at their disposal, Mr. Baxendell and his staff perform a large amount of very useful work, much of it of an experimental kind, in addition to the routine work of a well-equipped observatory. Special attention is given to the results of various anemometers of the most modern construction, and it is stated that the highest pressure yet recorded by a pressure plate anemometer is 20·7 lbs. per square foot. Another useful investigation is the comparison between the amounts of bright sunshine recorded by the Campbell-Stokes and the Jordan sunshine recorders. The monthly percentages of three years show that the latter instrument records somewhat higher values, except in the winter months. The falling off at this period appears to be traceable to increased relative humidity and to greater prevalence of fog. The report contains useful tables of rainfall and sunshine values at a considerable number of stations—mostly sea-side resorts.

THE third sheet of the North Atlantic and Mediterranean Pilot Charts published by the Meteorological Council is devoted to the month of June. Being the midsummer month, the atmospheric conditions are usually of the quietest description, the region in which the gale frequency exceeds 10 per cent. being now limited to the far north, beyond the 55th parallel. Disturbances of a cyclonic character are, however, of frequent occurrence on the more frequented shipping routes, but as most of them are of slight intensity severe gales seldom result. At this season, the conditions begin to assume a less steady appearance in the doldrums off the African coast, developing later into conditions which give birth to hurricanes moving westward towards the West Indies. Similar local features of the winds on the American coasts and in the Mediterranean are dealt with. Fog is very frequent, above 50 per cent., from the coast of Maine eastward across the Newfoundland Banks, and even the 10 per cent. frequency extends, with only a narrow break in about 20° W., from Sandy Hook to the Severn and the Bay of Biscay. Fogs as dense and as wet as those of the Banks now visit the Straits of Gibraltar, but, fortunately, they last only a few hours. With the exception of a berg and some field ice sighted on March 16 last, there has been no report of ice at sea this year, though at various times the pack in some of the Newfoundland and Cape Breton bays has been driven out by high winds. The eastward drift of the Gulf Stream, which the May chart showed was interrupted in 47° N. 27° W., continues across the ocean to our south-western shores in June, there being a good deal of easterly and north-easterly current in the space between Ireland and the north-west of Spain. The equatorial counter-current of the doldrums is met with as a prevailing set as far west as the 42nd meridian; the equatorial west-going current attains a high velocity, 60 to 85 miles a day; and in Florida Strait the Gulf Stream may reach 100 miles in a day. In every way the June chart is as interesting and valuable as its predecessors.

WE have received from Messrs. Friedländer the second part of their valuable *International Zoologist's Directory*, containing the emendations and additions necessary to bring the issue of 1895 up to date. These emendations include a list of zoologists deceased since that date, as well as a record of all changes of address that could be ascertained. The lists of the staffs of all the more important zoological institutes and museums form a feature of this part; and, so far as we have been able to test it, the work is comprehensive and singularly free from errors.

THE only original article in the May issue of the *Zoologist* is a continuation of Mr. E. Selous' observations on the habits of the great crested grebe. The author expended a vast amount of time and trouble in watching a pair of these beautiful birds during the breeding season. Attention is drawn to the circumstance that the male bird takes a considerable share in the duties of incubation; and it is suggested that it likewise constructs a platform for its own use in the neighbourhood of the nest. This leads the author to formulate a theory as to the origin of the "runs" of the Australian bower-birds, which, in opposition to the views of other naturalists, he regards as specially modified nests.

DR. A. APPELLÖF sends us the first fasciculus of a new work under his editorship, entitled "Meeresfauna von Bergen," now in course of publication by the Bergen Museum. The systematic investigation of the marine fauna of Bergen was commenced many years ago, and since the establishment there of a marine biological station has advanced with great rapidity. Many interesting problems are connected with the fauna of the sea of this district, which is now to be described in considerable detail. The work will include a map showing the different faunal zones and dredging stations. In the present fasciculus Mr. K. Bonnevie, of Christiania, treats of the hydroid polyps, Dr. R. Hartmeyer of the holosomatous ascidians, and Mr. E. Arnesen of the calcareous sponges. The first two subjects are illustrated with plates or figures, and the names of the authors afford a sufficient guarantee of the manner in which each is treated.

WE have received numbers 6 and 7 of the Liverpool Marine Biological Committee's *Memoirs*, both of which maintain the high level of their predecessors. The first of these, by Mr. A. Scott, is devoted to the fish-parasites of the genera Lepeophtheirus and Lernæa. These crustacean (copepod) parasites are almost wholly restricted to portions of the fish they infest which are in direct communication with the exterior, such as the skin itself, the fins, mouth, gill-chamber and gills, nostrils, or even the eye. The full life-history of both the types mentioned is given in considerable detail; and it is shown that while in the former development takes the form of steady progression, in the latter it assumes an equally marked degradation. Indeed, so strange are the phases assumed by Lernæa (as is well shown in the plates with which the memoir is illustrated), that there is little wonder that the older naturalists, when its life-history was still unknown, were puzzled as to its serial position, and failed to recognise its near kinship to the other genus described in the present fasciculus. The second of the two *Memoirs*, by Mr. R. C. Punnett, deals with the genus Lineus, as exemplified by that common British nemertean worm, *L. gesserensis*, notable, if for no other reason, on account of having, in its different phases, received no less than ten generic and thirteen specific titles. Varying between 6 and 20 centimetres in length, and displaying two distinct colour phases, this worm occurs abundantly underneath stones between tide-marks and also in the laminarian zone, frequently occurring in tangled masses. Its distribution is also large, extending from Greenland to Madeira on one side of the Atlantic and to Florida on the other. In addition to a careful and well-illustrated description of its anatomy and life-history, Mr. Punnett furnishes his readers with an elaborate table, showing at a glance the exact systematic position of this curious worm.

THE Summary Report of the Geological Survey of Canada for 1900 has a melancholy interest for geologists owing to the recent death of Dr. G. M. Dawson, the Director. It is a clearly printed work of 203 pages, with a colour-printed map of the Atlin gold-fields, and its price is ten cents. As usual, while due attention is given to the scientific work the practical subjects are treated as exhaustively as possible, and general observations on natural history are included. So many different topics are discussed that it is impossible to give any condensed account of them; suffice it to say that the Yukon district with its gold and coal workings, the coal of British Columbia and Nova Scotia, the lakes of Ontario and New Brunswick, the finding of natural gas in borings in the valley of the Nation river, the anorthosite of Quebec, and numerous other matters are dealt with.

WE have received from Messrs. Merck a pamphlet upon "Tannoform," an antiseptic which has lately been very much employed in veterinary practice. This substance was first prepared about six years ago, and is a condensation product of tannic acid and formaldehyde, its composition being represented by the formula $CH_2\begin{matrix}C_{14}H_9O_9\\C_{14}H_9O_9\end{matrix}$. Tannoform is a buff-coloured powder and is odourless and almost tasteless. It is insoluble in water, but fairly soluble in alcohol and ether, also in caustic alkalis and ammonia. Formaldehyde is one of the most powerful antiseptics and germicides which we have, but being at the same time a strong irritant it can only be used in very dilute solutions. Tannoform appears to possess all the antiseptic properties of formaldehyde, but is free from its unpleasant smell and irritating action, beside which the well-known astringent properties of tannic acid are also retained. Owing to its anhydrodic action, this substance was at first chiefly employed as a remedy for excessive perspiration of the feet and other parts of the body. Tannoform appears to have been first employed for veterinary purposes in the veterinary college of Berlin, when it was found that, not only could it be employed in place of the unpleasant smelling and expensive iodoform, but that wounds treated with it healed more rapidly than when iodoform was used. In cases of purulent and malodorous wounds, tannoform is said to be very beneficial, because of its antiseptic and deodorising properties. When taken internally, this substance appears to be quite harmless, even when large doses are administered. It has been found of special value in cases of diarrhœa and intestinal catarrh. Most antiseptics carry with them an odour—not usually pleasant—by means of which their presence can be detected. In tannoform we have an odourless and powerful antiseptic.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus* ♂) from India, presented by Mr. T. J. Erroll; a Guinea Baboon (*Cynocephalus sphinx* ♂) from Africa, presented by Mr. C. W. Fowke; a Grey Ichneumon (*Herpestes griseus*) from India, presented by Lord Hindlip; a Guilding's Amazon (*Chrysotis guildingi*) from St. Vincent, presented by the Earl of Crawford and Balcarres; a Woolly Opossum (*Didelphys lanigera*) from Colombia, a Violet-necked Lory (*Eos ricinata*) from Moluccas, a Razor-billed Curassow (*Mitua tuberosa*) from Guiana, deposited; a Demoiselle Crane (*Anthropoides virgo*) from North Africa, two Summer Ducks (*Æx sponsa* ♂ ♂) from North America, two Mandarin Ducks (*Æx galericulata* ♂ ♀) from China, an African Elephant (*Elephas africanus* ♂) from Abyssinia, purchased; a Duke of Bedford's Deer (*Cervus xanthopygius* ♀) a Japanese Deer (*Cervus sika* ♂) a Thar (*Hemitragus jemlaicus* ♂) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN JUNE.

June 3. 14h. 4m. to 15h. 13m. Moon occults μ Sagittarii (mag. 4·1).
3. 15h. 6m. to 16h. 12m. Moon occults 15 Sagittarii (mag. 5·6).
4. 9h. Jupiter in conjunction with moon, Jupiter 3° 53′ S.
4. 14h. 49m. to 15h. 59m. Moon occults B.A.C. 6536 (mag. 5·5).
4. 17h. Saturn in conjunction with moon. Saturn 3° 43′ S.
5. 20h. Uranus in opposition to the sun.
7. 0h. Mercury in conjunction with ϵ Geminorum, star 4′ N.
7. 14h. 59m. to 15h. 54m. Moon occults c^1 Capricorni (mag. 5·2).
14. Saturn. Outer minor axis of the outer ring = 17″·58.
15. Venus. Illuminated portion of disc = 0·977, Mars = 0·890
15. 17h. Mercury at greatest elongation, E. 24° 39′.
24. 12h. 2m. Minimum of Algol (β Persei).
25. 7h. 57m. to 9h. 18m. Moon occults B.A.C. 4531 (mag. 5·7).
27. 8h. 51m. Minimum of Algol (β Persei).
28. 9h. 47m. to 11h. 54m. Transit of Jupiter's Sat. IV.
28. 11h. 15m. to 12h. 15m. Moon occults ω^1 Scorpii (mag. 4·1).
28. 11h. 30m. to 12h. 48m. Moon occults ω^2 Scorpii (mag. 4·6).
30. 5h. Jupiter in opposition to the sun.
30. 10h. 4m. to 12h. 21m. Transit of Jupiter's Sat. I. The satellite will be almost centrally superposed on its own shadow.

THE RECENT TOTAL ECLIPSE OF THE SUN.—A further telegram from the *Times* correspondent at Sawahloento, dated May 23 gives a few more particulars respecting the results obtained by the various observers occupying the stations in or near Sumatra. The weather is described as having been moderately good at all these stations—best at Fort de Koch, worst at Solok—thin clouds were present at most of them.

In all eleven camps were formed, comprising one Dutch, two English, four American, one Russian, one French, one Jesuit and one Japanese. Generally partial success is reported from most of the camps, the unfortunate exception being that of Prof. Barnard, who had set up a most elaborate collection of instruments at Solok, the chief being a telescope of 61 feet focal length, with which he hoped to obtain photographs of the corona on plates 40 inches square. Three of the plates show only feeble fragments of the brighter portions of the coronal structure.

It is reported that good photographs of the *flash* spectrum were obtained here, and no names being mentioned we can only surmise that this refers to the spectroscopic party from the Yerkes and United States observatories, who were furnished with powerful spectrographs and established their camp at Fort de Koch, near by, so as to be approximately on the northern edge of the moon's shadow. Mr. Jewell had charge of a number of gratings of large size, both plane and concave, provided with films 36 inches long, intending to pay special attention to the ultra-violet regions of the chromospheric spectrum. Dr. Humphreys also took spectrographic apparatus. Prof. Skinner, in charge of the American party, had cameras to be used in searching for a possible intra-mercurial planet, but no mention is made of the fate of these observations.

The duration of totality at the American station was determined at 5m. 47s. instead of 5m. 42s. as predicted.

In consequence of the unfavourable meteorological conditions, the special investigations depending on the unusually long duration of totality were either unsuccessful or abandoned altogether.

Mr. Dyson, although he had to expose through thin clouds, obtained fairly good large-scale photographs of the corona; the small-scale plates show a considerable number of stars.

Mr. Newall is reported to have obtained good results with a grating spectrograph. Visual observation showed that the brightness of the green coronal ring was very uneven. A series of eight photographs with the polariscopic camera exhibit marked polarisation of the bright portions of the corona, especially in the case of the southern edge of the brightest streamer.

He was also successful in obtaining good photographs of the corona, which shows considerable similarity to that of last year.

The observations made to determine the *rotation* of the corona were unsuccessful.

M. de la Baume Pluvinel, who also observed among the mountains in Sumatra, announces partially successful results.

COMET *a* (1901).—A circular (No. 44) from the Centralstelle gives the following ephemeris for the new comet:—

Ephemeris for 12h. Berlin Mean Time.

1901.	R.A. h. m. s.	Decl. ° ′
May 24	6 19 16 ...	+6 22·9
26	26 16 ...	6 49·8
28	32 41 ...	7 14·4
30	38 37 ...	7 36·9
June 1	44 7 ...	7 57·5
3	49 15 ...	8 16·4
5	54 5 ...	8 33·7
7	6 58 38 ...	8 49·5
9	7 2 55 ...	9 4·0
11	7 7 1 ...	+9 17·3

HISGEN'S VARIABLE, 13 (1900) CYGNI.—At the request of Father Hisgen, Prof. E. C. Pickering has had an examination made of the Harvard plates showing the star, and gives the resulting measures in *Astronomische Nachrichten* (Bd. 155, No. 3712). 181 plates were found covering the region, extending over the period 1887 November 30—1900 September 26.

After plotting the measured magnitudes to a time scale it was found that the star varies with moderate regularity in a period of 218 days. It has a magnitude of about 10·2 at maximum, and 13 or fainter at minimum.

THE PLANET SATURN.

SATURN now passes the meridian in the morning twilight, and is situated about 4° east of the planet Jupiter. The two objects will form an exceedingly interesting couplet in the southern sky during ensuing months, their times of southing and apparent distances being as follows:—

	Jupiter south. h. m	Saturn south. h. m.	Distance. °
June 15 ...	13 9 ...	13 28 ...	5
July 15 ...	10 55 ...	11 21 ...	6
Aug. 15 ...	8 41 ...	9 11 ...	7
Sep. 15 ...	6 40 ...	7 6 ...	6
Oct. 15 ...	4 54 ...	5 12 ...	4
Nov. 15 ...	3 14 ...	3 19 ...	1
Dec. 15 ...	1 43 ...	1 34 ...	2

They will be evening stars during the late summer and in the autumn, but early in December will have approached too near to the sun for further observation. For telescopic scrutiny, the proximity of the two bodies will be found very convenient, but their low altitude of about 15° or 16° when due south will operate very unfavourably upon the character of the images.

It is a matter of common experience that Saturn will satisfactorily bear greater magnifying power than either Mars or Jupiter; but during the ensuing apparition moderate eyepieces will be best. Even with these, definition will be rarely good in latitudes so far north as Greenwich. The rings are now widely open, and their north side will continue to be presented to the earth until 1907. When Saturn is placed above the equator and traversing the zodiac from Pisces to Virgo, we see the southern surface of the rings, and the northern surface when he is below the equator and moving from Virgo to Pisces. The rings are turned edgeways towards us, and are practically invisible when the planet is in Virgo and Pisces.

Well-defined irregular markings are rare on Saturn. Dawes in January 1858 saw a bright spot and Asaph Hall followed a similar marking in December 1877, but it soon grew faint and disappeared. Several transits of the latter object were obtained, and a rotation period of 10h. 14m. 23·8s., agreeing nearly with Sir William Herschel's 10h. 16m. 0·4s. from a quintuple belt

seen in 1793, was derived which may be regarded as very near the truth. But apart from these and a few other observations it must be confessed that little is certainly known with reference to irregular markings on Saturn. Hall, with the 26-inch Washington refractor, Barnard, with the 36-inch Lick refractor and other telescopes, Young, with the 23-inch at Princeton, Hough, with the 18½-inch at Chicago, and others have all systematically endeavoured to distinguish spots on the planet's globe and all have failed, except in the particular case alluded to. The cream of observational talent, assisted by the finest and best telescopes ever constructed, has proved that irregular markings sufficiently well pronounced to be distinctly visible are somewhat of a rarity. Yet it should be stated that certain other observers discern alleged spots with ease and in prolific numbers as well as under many varieties of shape and tint. Indeed, the Saturnian spots would appear to be as frequent and to have as many vagaries as the markings on Jupiter if we may accept the testimony of a few observers. Whether these things are objective realities or the products of visionaries remains to be proved by the severe tests which future researches will apply.

Saturn comes to conjunction with Jupiter at intervals of about twenty years, previous conjunctions having occurred on April 22, 1881, October 25, 1861, January 26, 1842, June 19, 1821, July 16, 1802, &c. The ensuing conjunction takes place on the morning of November 28 next at 6 h., when Jupiter will be 0° 27′ south of Saturn. In 1881 the planets were 1° 18′ apart, in 1861 0° 52′. Mr. Crommelin gives the results of some computations in the *Monthly Notices*, lxi. p. 118, which show that the distance of the centres of the two planets will be less than 1° between November 21 and December 5. The near approach of these attractive objects will form an event of considerable interest to the general public as well as to the astronomical world.

W. F. DENNING.

MARINE BIOLOGY IN LIVERPOOL.

THE Editor of NATURE invites me to write a short account of the marine biological investigations and the scientific fisheries work carried on of late years in the Liverpool district, and I have pleasure in complying with this request since it will enable me both (1) to acknowledge the services of friends and fellow-workers, and (2) to distinguish between three very different local bodies whose work is frequently—and perhaps not unnaturally—confounded even by marine biologists and even in Liverpool. These three bodies are the Liverpool Biological Society, the Liverpool Marine Biology Committee, and the Lancashire Sea-Fisheries Committee. They are perfectly distinct in organisation, control and object, and although the work they do is to some extent similar, still, as a result of friendly arrangement and cooperation, there has been absolutely no rivalry and no overlap or duplication of work such as might under other circumstances cause waste of time, funds and opportunity. Let me state briefly the position and work of each of these three bodies, all of which are now contributing actively to the elucidation of the marine biology of the Irish Sea.

I. *Liverpool Biological Society.*—This is a public scientific society in the town, like its well-known sister society, the Liverpool Geological Society. It meets monthly in the zoological department of University College, and all local lovers of nature are eligible for membership. The president this session is Prof. A. M. Paterson, and the hon. secretary Mr. J. A. Clubb, of the Free Public Museum. The past presidents include the professors of all the biological departments in University College (anatomy, physiology, botany and zoology), the head officials of the Public Museum and such well-known local biologists as the late Dr. Drysdale, Dr. Wiglesworth and Mr. Isaac Thompson. The Society is now publishing its fifteenth annual volume of *Proceedings and Transactions*. The *Proceedings* at the beginning of the volume contain a brief record of the proceedings at the meetings, including exhibits; while the *Transactions* consist of those papers which the council decides to print in full. Although the greater number of the papers in the published volumes deal with the marine animals and plants of the district, still biology in the widest sense is represented at the meetings and in the publications, and communications will be found on ornithology, entomology, palæontology, embryology, botany, anatomy, physiology and even archæology. It has been customary for the president in each session to invite some outside original worker in his own department of biology to come and address the Society. In this way important lectures have been given by Drs. Gaskell, Sorby and D. H. Scott, and by Profs. Howes, Haddon, Miall and others. The address this year will be given by Prof. D. J. Cunningham, on the lessons to be drawn from the condition of the skull and the brain in the microcephalic idiot.

II. *Liverpool Marine Biology Committee.*—This, in contradistinction to the Biological Society, is a private body. It is not a Committee of the Society or of anything else, but is an independent organisation. It was constituted at a meeting of biologists held at University College in March, 1885, for the purpose of carrying out a scheme of investigation of the local marine fauna and flora with the intention of publishing reports thereon. The dredging, trawling and other collecting expeditions organised by the Committee have been carried on intermittently since that time, and a considerable amount of material, both published and unpublished, has been accumulated. Fourteen annual reports of the Committee and five volumes dealing with the fauna and flora have been issued since 1886.

At an early stage of these investigations it became evident that a biological station or laboratory on the sea-shore, somewhere nearer the usual collecting grounds than Liverpool, would be a material assistance in the work. Consequently, the Committee in 1887 acquired a lease of Puffin Island, on the north coast of Anglesey, and established there the L.M.B.C. Puffin Island Station,[1] which formed the centre of their work at sea for five years. Later on, in 1892, finding that their work was extending, and that the very limited accommodation at Puffin Island was insufficient, they moved to the more commodious and more convenient biological station at Port Erin,[2] in the centre of the rich collecting grounds of the south end of the Isle of Man. This locality has proved so interesting and so perfectly suitable in every way that it is likely to remain as the permanent marine laboratory of the Liverpool naturalists; while the office of the Committee, the place of meetings, the publishing centre and the museum, is the zoological department of University College, Liverpool.

The Committee consists of twelve members who were chosen originally as being representative naturalists of Liverpool, Manchester, Southport, Chester and the Isle of Man—and most of these members are still active workers. Amongst our losses, by death, are Prof. Milnes Marshall, the Rev. H. H. Higgins and Mr. Francis Archer. The Committee subscribe amongst themselves and ask for contributions from their friends in Liverpool. In this way, aided by occasional grants from the British Association and other bodies, they have paid the expenses of numerous dredging expeditions, have maintained their small biological station, with a resident curator (now Mr. Herbert C. Chadwick), for fifteen years and have issued a considerable number of publications. The regular income for the last few years has averaged about 200*l.* per annum, but in addition several friends in Liverpool, amongst whom may be mentioned Mrs. George Holt and Mr. F. H. Gossage, have kindly placed sums in the hands of the present writer to be expended either in special expeditions or in the publication of memoirs requiring plates. Thus it will be seen that the funds at the disposal of the Committee, although, thanks to the generosity of friends and the economical management of our hon. treasurer, Mr. Thompson, they have sufficed up to the present, are evidently too small and too precarious to admit of much advance; and consequently an appeal will sooner or later have to be made for a permanent endowment of the Port Erin Biological Station.

The publications of the L.M.B.C. consist of:—(1) the annual report, issued primarily to subscribers and other friends in Liverpool. Although this report gives a brief account of the investigations undertaken during the year, still it is to be regarded, not mainly as a scientific, but rather as a business publication for the purpose of keeping the organisation together and in touch with the people of Liverpool. (2) The volumes of the "Fauna of Liverpool Bay," containing reprints of those papers communicated by members of the Committee, and others working at the laboratory, to the Liverpool Biological Society, and which deal with the local fauna and flora. These volumes are bound and issued at irregular intervals when sufficient material has accumulated.

[1] See NATURE, vol. xxxvi. p. 275. [2] See NATURE, vol. xlvi. p. 155.

Five volumes have now appeared, bearing the dates 1886, 89, 92, 95 and 1901. (3) The "L.M.B.C. Memoirs," a series of detailed descriptions of the structure of certain common typical animals and plants, chosen as representatives of their groups and dealt with by specialists. Memoirs on the following types have already appeared or are in the press: I. *Ascidia*, II. *Cardium*, III. *Echinus*, IV. *Codium*, V. *Alcyonium*, VI. *Lepeophtheirus* and *Lernaea*, and VII. *Lineus*. Several others are nearly ready, and about thirty-five in all have been arranged for. Amongst other L.M.B.C workers whose names have not been mentioned are Mr. A. O. Walker, Mr. Arnold Watson, Mr. A. Leicester and Prof. Harvey Gibson.

III. *Lancashire Sea-Fisheries Committee.*—The district controlled by this Committee (recently amalgamated with the former Western Sea-Fisheries District to form what is now officially styled "The Lancashire and Western Sea-Fisheries District") is probably the largest, and in several respects the most important, of the sea-fisheries districts which have been established since 1890, in connection with the County Councils, round the coasts of England and Wales, under the Sea-Fisheries Regulation Act of 1888. The district extends from the Duddon, in Cumberland, to Cardigan, in South Wales, and thus runs for about 441 statute miles along the shores of the Irish Sea. It bounds in all nine counties and contains about 1500 square miles of sea. Nearly every kind of English sea-fishing is carried on within this district, including fish-trawling, line-fishing in all its branches, drift net, trammel net and draw net fishing; set nets and stake nets, weirs and hedge-baulks are also used. Besides these there is a very large shrimping industry which is carried on by the use of shrimp trawls, shank nets, hose nets and push nets. Lobsters, crabs and prawns are taken in many places, and there is a very large area of shell-fish beds—mussels, cockles and oysters.

The work of the Committee is mainly administrative, and is carried out by a superintendent, Mr. R. A. Dawson, who has at his command an efficient steamer and a staff of bailiffs. There is also a scientific department, of which the present writer is hon. director, and the work of which centres in Liverpool. In that department we have a central fisheries laboratory in University College, and a branch laboratory with sea-fish hatchery at Piel, near Barrow in the north of Lancashire. The fisheries assistant at Liverpool is Mr. James Johnstone, and the resident assistant in charge of the Piel Hatchery is Mr. Andrew Scott. Both these gentlemen are known to marine biologists by their investigations, those of Mr. Johnstone being on the mussel and the cockle, and those of Mr. Scott for the most part on Copepoda and fish-hatching.

The work of the scientific department of the Lancashire Sea-Fisheries is most varied throughout the year, and ranges from teaching fishermen and keeping up a fisheries museum to hatching fish, reporting on oysters, and carrying on research in regard to all kinds of fisheries problems. The following headings of sections in the last published annual report (the ninth) will give an idea of the scope of the work: required survey of fishing grounds, fish-hatching, spawning of mussel, statistics of shrimping grounds and fish, relation of deposits to shrimps, sporozoon parasite of the plaice, Copepod fish parasites, circulating fisheries exhibition, laboratory classes for fishermen, inspection of shell-fish beds, and the question of sewage contamination. In this report it is urged that "what we stand most in need of at present is full and accurate statistics in regard to our fisheries, and much more detailed information than we have as to the distribution round the coast both of fishes in all stages of growth and also of the lower animals with which they are associated and upon which they feed". . . "We must, in fact, get series of accurate observations which will give us fair samples of the more sedentary populations of our seas on the different grounds, such as trawling grounds, shrimping grounds, nurseries and spawning banks at the different seasons". . . "My contention, then, is that such an investigation of our seas must be made, that it is urgent and should be made now, and that the Irish Sea is favourably situated and circumstanced at present to be made a test-case before undertaking the much wider and still more difficult expanse of the North Sea, complicated by international questions. The Irish Sea is of moderate and manageable dimensions. It is all bounded by British territory and by sea-fisheries authorities which might agree as to their regulations. It is a 'self-contained' fish area, containing both shallow and deep water, spawning banks, feeding grounds and nurseries. It has several laboratories (Liverpool, Dublin, Port Erin and Piel) on its borders which would form centres for investigation, and it is controlled by powerful sea-fisheries authorities, two of which at least (Lancashire and Ireland) are provided with excellent steamers which might combine in the work. All that is required, beyond a carefully considered scheme, is authority from Government to the local committees to carry out such work, and a subsidy for, say, five years, to meet the increased expense." It is pointed out that there are two methods by which the required survey of our seas might be effected:—(1) By forming a properly equipped Government department (in some respects like the Geological Survey), with laboratories and steamers and a scientific staff competent to tackle the scientific problems involved; and (2) by making use of existing organisations, giving fuller powers to the local committees, and by encouraging and enabling them to spend money on the necessary investigations in their own districts.

It has been found in Liverpool that the only effective way of teaching fishermen is by means of practical classes. Lectures of all kinds, followed by discussions long and short, demonstrations microscopic and otherwise, have been tried in vain, or with only qualified success. Of course the brighter spirits amongst them, the picked men, can be instructed by any method, but for the average fisherman it takes the patient hammering of hour after hour and day after day in a laboratory class, where you appeal, not only to his ears, but also to his eyes and his fingers, and where he makes and remakes his own preparations, cleans his own cover-glasses and focusses the microscope for himself, before he can understand and will believe what he is told and sees, and finally becomes convinced, for example, that he is really looking at a young fish inside a minute transparent egg caught on the surface of the sea, or that what he and his fellows have always stoutly maintained to be the spawn of flat fishes is after all only the egg-capsule of an Annelid.

After deciding that this was the best plan to adopt in applying technical instruction to the fisheries, we started these laboratory courses in Liverpool last spring (February 1900). Two courses were held last year, two are being held this spring, and two others will follow later in the summer. The Technical Instruction Committee defrayed the expenses of the fishermen. That is, they gave 5*l.* to each man to meet his travelling expenses and his board and lodging in Liverpool during the fortnight he was under instruction. No charge was made for instruction or for the use of the microscopes, dissecting instruments, material and reagents—everything necessary was supplied by the laboratory. The teaching was carried on by Mr. Johnstone under my supervision, and the whole course was entirely practical in character, each man examining everything for himself and working every day, both forenoon and afternoon. For details as to the work of the course I must refer to our report, but I may say, in conclusion, that the results were most encouraging, and that from the reports of the superintendent of fisheries to his committee there can be no doubt as to the success of the method in the eyes of the fishermen and of the sea-fisheries officers.

I must now have nearly reached the limits which the Editor asked me not to exceed, and so I fear I must not enter upon further details, although I should have liked to have told how Mr. Thompson and Mr. Scott are working at the Copepoda, Mr. Chadwick and Mr. Ascroft at plankton, Mr. Johnstone and Dr. Jenkins at fishery statistics, Mr. Cole at the nerves of the flat fishes, and others of my excellent assistants and colleagues at various other special problems. But I must be content for the present with the above sketch of the local marine biological and fisheries work which centres in Liverpool, and with the following expression of my strong convictions on two points. I feel certain—

(1) That for such work the great thing is friendly co-operation. The field is so enormous and the work so varied in its nature that there is room and use for many individuals of very different capabilities. And if the work is to be carried on without Government subsidy or large endowments it is necessary to attract and combine various local organisations, such as University, County Council, local scientific societies, and that characteristically English product the serious amateur who does excellent original scientific work.

(2) That this work is only beginning, and that a great future lies before marine biology in all its branches, including the application of scientific methods to the investigation of fisheries problems.

W. A. HERDMAN.

PUBLIC HEALTH IN AMERICA.

THE thirty-first annual report of the State Board of Health of Massachusetts, dealing with the work of the various departments during the year 1899, has lately been issued. These reports are mainly known to this country in connection with the original investigations on the treatment of water and sewage which have for many years past formed an important feature of the work undertaken by this Board of Health.

The practical outcome of these researches is seen in the recommendations made by the Board to cities and towns, no less than 79 applications for advice regarding the establishment of systems of water supply, drainage and sewerage having been dealt with during the year, and the Board have the satisfaction of reporting that at the end of this period every city in the State and 132 out of a total of 321 towns were provided with public water supplies. If the death-rate from typhoid fever over a series of years be taken as an index of the sanitary condition of a community, then, indeed, the State of Massachusetts has just cause for congratulation on the results of the enlightened policy in regard to questions of hygiene which has been so persistently pursued by, and has so prominently distinguished, its officials.

In the years 1871–75 the death-rate from typhoid fever in the cities, as well as in the State at large, was as high as 8·2 per 10,000. This figure has gradually been reduced to 2·6, and in the four years from 1896 to 1899 the rate has been further brought down to 2·4 per 10,000. Again, while in the period 1871–75 there was not a single city amongst the 31 in the State having a lower death-rate from typhoid fever than 2·7 per 10,000, in 1899 there were 24 such cities. The most noteworthy improvement was that of Lawrence, where the typhoid death-rate fell from a mean of 11·2 per 10,000 in 1886–90, and 7·7 in 1891–95, to 2·5 in the four years 1896–99, following the introduction of sand filtration of the water from the Merrimack river supplied to this city.

In regard to consumption, the Board is able to make a no less satisfactory report, the decline in mortality from this disease having continued with a fairly steady and uniform rate throughout the past fifty years, reaching in 1899 18·7 per 10,000. In commenting upon this fact it is pointed out that it is between the ages of 15 and 60 that consumption is most fatal, and that in 1894 and 1895, out of 1000 deaths from all causes in Massachusetts between these ages 288 were due to tuberculosis, whilst in Paris the figures for the same period of life were 400 and in Vienna 459, or nearly one-half of all the deaths at that age. Emphasis is laid upon the necessity for taking further precautions for the control and prevention of this most destructive disease, a sentiment which will be given practical effect to this year in England at the British Congress for the Prevention of Consumption, presided over by the King, to be held in London in July.

Massachusetts is, however, not the only State in America which is alive to the urgency of dealing effectively with this disease. Michigan, which supports a State Agricultural College, has recently issued a valuable *Bulletin* in which practical methods are suggested for combating this scourge, based upon careful scientific experiments. The writer of the *Bulletin* states that tuberculosis causes more than twice as many deaths in Michigan as any other single contagious disease, and Dr. Keen, of Rhode Island, has calculated that more than 100,000 persons annually die of consumption in America, and that at this rate out of the 70,000,000 people in the United States 10,000,000 are practically condemned to death through tuberculosis.

In discussing the unusual prevalence of small pox which has characterised the period covered by the report, a special table has been appended showing the comparative fatality of the vaccinated and unvaccinated respectively. This table is based upon carefully compiled statistics kept between the years 1885 and 1899, and shows that the deaths from small pox among the vaccinated was 7·6 per cent. and among the unvaccinated 26·0 per cent., or more than three times as great in the latter case during these fourteen years.

In the pathological department of the Board much attention has been bestowed upon the preparation of diphtheria antitoxin, and a large number of examinations were made for the verification of diphtheria germs. The work of this department has largely increased during the year, for considerable quantities of the antitoxin have been used for the immunisation of healthy persons who have been exposed to the infection of diphtheria, whilst at the Children's Hospital, an institution at which several hundred patients are annually received for treatment, medical and surgical, but not for infectious diseases, it has been the custom to immunise each patient with diphtheria antitoxin soon after admittance.

No reference is made to the preparation of antityphoid serum, neither, apparently, have any investigations been carried out with regard to it. Likewise we note that tetanus antitoxin is no longer prepared, the reason given for its discontinuance being that the demand for the serum was small and irregular, and its application usually delayed until the patient was past recovery.

An interesting section of the report deals with the results of the food and drug inspections. Although the use of preservatives or any foreign substance in milk is illegal, 11·6 per cent. of the samples examined contained a preservative, in the largest number of cases formaldehyde being employed, which is widely used in the United States under the name of "Freezine." A pamphlet setting forth the special advantages of this preservative states that "it is not an adulterant, that it immediately evaporates, so that it defies detection as soon as it has rendered all the bacteria inert, it is beneficial to the health of infants, many of whom have been saved from sickness and even death by a liberal use of 'Freezine' in the milk!"

Butter, we are informed, was specially tested for the presence of boracic acid in consequence of the alleged extensive use of this ingredient in Great Britain. None was found, which may be attributed to the custom which prevails to a much larger extent in America than in England of eating salt butter, in which case the use of an additional preservative would be superfluous.

The above brief sketch may give some idea of the general scope of the work undertaken by public boards of health in America. It serves to emphasise, perhaps, that Great Britain is still waiting for an Imperial Board of Health, and that what individual States in America can accomplish we as an Empire are powerless to achieve. G. C. FRANKLAND.

THE EXTENSION OF KNOWLEDGE.

AN inspiring address, dealing with the influence of universities upon national life, delivered at the Johns Hopkins University at the last commemoration day by Dr. D. J. Hill, assistant secretary of State, is published in one of the University Circulars just received. Students of human history well know that the pursuit of knowledge has been the fundamental factor of progress through many centuries. The earliest universities in Europe were associations of teachers and students with this aim, and they exerted a powerful influence upon society long before their existence was recognised by Church or State. "It is not too much to say," remarks Dr. Hill, "that the transformation of Europe which marks the distinction between mediæval and modern times has been chiefly the work of the universities, for they have exercised the most potent influence upon social progress and popular liberty of any single class of human institutions." The spirit which has led to the establishment of so many institutions for higher education in the United States, by private munificence, seems to have been inherited from the Pilgrim Fathers. Even when the colony of Massachusetts numbered only four thousand, it was decided to found a college; but the resolution is less astonishing when it is remembered that among the first six hundred settlers one in every thirty was a graduate of Cambridge.

Dr. Hill concluded his address by referring to the changing conditions of life, and the need for all who are concerned with education to recognise their new obligations and make themselves equal to their modern mission. This part of the address is reprinted below.

"It is no longer a question of merely popular education, although that is always fundamental; it is a question of the higher and the highest education that confronts us now. We have passed the primary stage, the common schools are established, the colleges exist in sufficient numbers, and even universities do not need to be multiplied. We have sought the safeguard of liberty in the universal diffusion of knowledge, but it is not the mere rudiments that have saved us in any great emergency. In what crisis of diplomacy, in what complicated question of finance, in what quandary of economic policy, in what problem of constitutional interpretation have the elementary arts furnished saving knowledge to the nation? No, in

every grave complication, it is not these mere elements that are needed—though they indeed are always indispensable—but some broader and superior knowledge, some finer detail of information, some more acute discrimination, some keener analysis of evidence, some more penetrating intellectual vision or more ripened judgment—the fruits of long and serious study, which a whole nation of half-trained persons could not supply; and in the moment of perplexity it is to some quiet scholar or studious thinker that the nation makes appeal; and when he speaks light dawns, the clouds are swept away, and the path of action is made plain. . . .

"The time has gone by when merely individual and local efforts can secure to our country its place among the nations; for we have entered upon a period of world-relations—of world competition, of world-policies and of world beneficence—from which it is impossible to recede. Our only hope of great national prosperity lies in the possession of a world-culture that will place us on a level with the best thought and highest knowledge attainable by man. Every humblest toiler on the farm and in the factory will henceforth be affected by the discoveries of science, the movements of foreign commerce and the resources of national industry. We have won our present industrial pre-eminence, without the advantages of technical education, through the fertility of our soil and a native genius for construction and organisation; but the time must come, and it may not be far distant, when the highest technical education will be necessary to the success of the simplest American industry. The competition of the hand is rapidly resolving itself into the competition of the brain, and the comprehension, guidance and application of natural forces in accordance with natural laws become questions of national consequence.

"Give us, then, O learned doctors, more discoveries of science, for we know not what new revelations may yet burst forth from your laboratories; give us more of art, for it is only through the channels of expression by word and sign and symbol that new truth can be lodged in the minds of the people; give us more of history, for it is only by conning the lessons of experience that the children of men grow wiser; give us more of literature, for it is only through the life of letters that man rises to the full comprehension of himself; give us more of ethics and philosophy, for it is only in the light of great principles that character becomes firm and conduct noble; let earth, and sea, and sky, and the stars in their courses, the long struggle of man and the story of his aspirations, the tongues of the busy day and the silence of the voiceless night, the instincts that stir us to passion and the still small voice that drops its calm out of eternity, all teach us the ways of creation and the mystery of our divine descent; for it is through the totality of their culture that nations rise, and through ignorance or defiance of unbending laws that nations fall."

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—Dr. G. C. Bourne has been appointed to represent the University on the Board of Governors of Coopers Hill College.

The seventh Robert Boyle lecture will be delivered by Prof. Sylvanus Thompson on June 6; the subject will be "Magnetism in Growth."

Mr. H. B. Hartley, scholar of Balliol College, has been elected to a fellowship at that college as science tutor in succession to the late Sir John Conroy. Mr. Hartley obtained a first class in chemistry and mineralogy in 1900.

CAMBRIDGE.—Sir W. Martin Conway has been elected Slade professor of fine art in succession to Dr. Waldstein.

Seventy-three men and twenty-six women have acquitted themselves so as to deserve mathematical honours in the first part of the tripos.

It is proposed to appropriate from the Benefaction Fund a sum of 21,000*l.* to the new botany school building, and 16,000*l.*, together with some 5500*l.* specially contributed, to the new medical school building.

Prof. Macalister is appointed an examiner in anatomy for medical degrees in the place of Dr. Barclay-Smith.

THE field studies in natural history arranged by Mr. David Houston for the Essex Technical Instruction Committee provide an excellent means of becoming familiar with nature, and should be of special assistance to teachers who desire to adopt the scheme of nature study recently issued for rural schools by the Board of Education. Rambles are arranged for Saturday afternoons, and demonstrations in general natural history are given by the director, so that an introductory knowledge of the natural vegetation of the county can be obtained in a pleasant way. A ten days' vacation course has been arranged to be held in the New Forest, from August 12 to 22. The programme of the course, and the field notes appended to it, show that the members of the party will have the opportunity of spending a profitable short holiday in the New Forest and neighbourhood.

APPROVAL of the Government Education Bill has been expressed by several educational bodies concerned with technical and secondary education. The chief difficulties raised by the Bill relate to the constitution of the local authorities to be responsible for the educational work of their respective districts, and the funds which are to be available for technical and secondary education. At present technical instruction committees administer the "whisky money," and in a few places an additional penny rate is also levied. The new Bill proposes to let the local authority administer these funds, and to give it the power to levy another penny rate; but as the funds are to be used for both secondary and technical education, the extension of rating power is wholly inadequate to the requirements. This view is held by the council of the Association of Technical Institutions, and in order to give expression to it a special meeting of the Association will shortly be held. Resolutions will be brought forward to the effect that, while the general principles of the Bill are approved, adequate provision must be made to defray the necessary additional charges in respect of secondary education which will fall upon the local authorities, and technical instruction must be provided for before the residue available under the Local Taxation (Customs and Excise) Act is used for purposes of secondary education in general.

SCIENTIFIC SERIALS.

Annalen der Physik, May.—Researches on the normal cell, especially the Weston element, by W. Jaeger and St. Lindeck. This paper contains the results of an exhaustive experimental study of the Clark and Weston cells. The researches of E. Cohen had thrown some doubts upon the suitability of the Weston cell as a standard, especially in the neighbourhood of 0° C. In the present paper it is shown that these irregularities only occur about 0° C. and with the cell containing 14·3 per cent. amalgam, no trace of any irregular deviations appearing when the cell is used at 10° C. or higher temperatures. Further, if the amalgam is made slightly weaker in cadmium, 12 per cent. or 13 per cent., these irregularities near 0° disappear, and the measurements are trustworthy at all temperatures. It is concluded that the strictures of Cohen with regard to this cell are not justified, and that the Weston element is eminently suitable as a standard of electromotive force.—The calculation of isotherms, by C. Dieterici. The fundamental equation of condition of van der Waals is modified, in part empirically, without assuming that the cohesion pressure and the volume correction are determined, and the results applied to the measurements of Young on isopentane and benzene, of Ramsay and Young on ether and water, and of Cailletet and Matthias on sulphur dioxide and carbonic acid.—Contribution to the theory of electric discharges in gases, by J. Stark.—On the variation of the dielectric constant with pressure and temperature, by J. Koenigsberger.—The constancy of the sparking potential, by K. R. Johnson.—On Jaumann's clear J-surface, by A. Korn. A discussion of a phenomenon first observed by Jaumann in a vacuum tube.—The internal friction of argon and its variation with temperature, by H. Schultze. The absolute value found for the viscosity coefficient of argon is practically identical with that previously determined by Lord Rayleigh, but the alteration of viscosity with temperature is found to be somewhat greater according to the author's experiments. The formula suggested by Sutherland gives a good approximation to the results of the experiments.—On the internal friction of gases and its change with the temperature, by P. Breitenbach. An application of Sutherland's formula to the experiments previously published by the author on the temperature coefficient of the viscosity of air, ethylene, carbonic acid, hydrogen and methyl chloride. The agreement between the calculated and experimental results is so good as to amount to a proof of Sutherland's theory.—The equilibrium

figures of powders, by F. Auerbach.—On the influence of temperature on the elasticity of metals, by C. Schaefer. Experiments were carried out on nine metals, and the value of the torsion modulus measured at −186° C., −70° C. and about 20° C. If the temperature coefficients of the different metals are plotted as ordinates, and the melting points as abscissæ, a smooth curve passes through the whole of the results.—Remarks on a paper of T. Middel on the cause of the thermal change of delicacy in balances, by W. Felgentraeger.—Liquid crystals, by O. Lehmann. A reply to some remarks of G. Tammann.—On the distribution of electricity on an ellipsoid, by G. Jaeger.

Symons's Meteorological Magazine for May contains a useful reference table of the annual means and extremes of the meteorological observations taken at Camden Square for each of the forty years 1858-97. During the years 1898 and 1899 Mr. Symons gave for each month the means and extremes for the various elements, and the present third set of tables completes this unique and valuable record of the climate of London. It may not be out of place to quote a few of the extreme values of the period in question, which are shown by a glance at the table, although we have referred to most of them on former occasions. The highest solar radiation temperature (since 1870) was 137°·7 in 1881, and the lowest terrestrial radiation temperatures (since 1860) were 0°·6 in the same year and 0°·5 in 1867. The extremes in the screen were 94°·6 in 1881 and 6°·7 in 1867. The same low reading occurred in 1860, and 7°·3 in the severe frost of 1895. The greatest rainfall (34·08 inches) occurred in 1878, and the least (16·93 inches) in 1864.

SOCIETIES AND ACADEMIES.

LONDON

Anthropological Institute, May 14.—Mr. R. Shelford, of Sarawak, exhibited a number of carved bamboos and commented on the elements of Dyak decorative art.—Mr. W. MacDougall read a paper by Dr. Hose and himself on the animal cults of Sarawak. He showed that though many of them exhibit elements frequently associated with totemism, such as the respect paid to an animal believed to be the resting-place of the soul of a deceased ancestor, totemism itself could not be regarded as the starting-point of any of the cults, and was at most only present in a rudimentary stage. He also gave details as to the beliefs of the Sea Dyaks about the Nyarong or spirit-helper believed to be acquired by some men in dreams.

EDINBURGH.

Royal Society, May 8.—Dr. Burgess in the chair.—Prof. Copeland and Dr. J. Halm, in further notes on the new star in Perseus, gave a description of the changes which had accompanied the star's decrease in brightness. One of the most interesting features was the periodicity which had recently established itself, indicating a period of three to five days with a possible longer period of several weeks. The corresponding changes in the spectrum were also discussed, the apparent shifting of certain bands being explained as due to the fading of the one and the relative brightening of the other of two overlapping bands. Broadly speaking, the change in the spectrum had been towards the nebular type. It was suggested that the absorption bands flanking the bright bands were an effect of high internal pressure.—Prof. John Gibson read a paper on certain relations between the electrical conductivity and the chemical character of solutions, following up a previous communication published three years ago. The paper was based upon a large number of experiments, some of which had been going on for years and were not yet completed. The broad principle underlying the results he had obtained was that in solutions inter-molecular reactions tend towards maximum specific electrical conductivity. In one series of experiments solutions of hydrochloric acid of varying concentration were formed and a small proportionate quantity of chromic anhydride added to each. In strong solutions above the concentration which gives the maximum specific conductivity, the reaction, represented by the equation $12HCl + 2CrO_3 = 2CrCl_3 + 6H_2O + 3Cl_2$ and indicated to the eye by the change in colour, went on more rapidly the further removed the concentration was from that which corresponds to the maximum specific conductivity. In one experiment the critical concentration of 18·2 per cent. was used and the mixture kept in the dark. The reaction is not yet complete, although three years have elapsed. With a 20 per cent. solution the reaction was completed in about six months, and with a 24 per cent. solution in less than one month. Similar results were obtained with other solutions involving more rapid reactions, requiring for their completion times comprised within a small number of weeks or even minutes. In the case of sugar solutions another determining factor came in, namely, the viscosity, a diminution in which by the destruction of the sugar by sulphuric acid increases the conductivity independently of change in concentration. An interesting illustration of the same principle was afforded by the fact that in vinous fermentation a greater concentration than about 14 per cent. cannot be obtained. By making a series of artificial musts with proper proportions of salts, sugar and alcohol so as to represent approximately successive stages of the fermentation, Dr. Gibson found that the conductivity approached a maximum as the concentration of alcohol approached 14 per cent. The paper ended with a novel and interesting discussion of the phenomena of plant life along the same broad physico-chemical lines. The *rôle* of the inorganic salts necessarily present in the sap, the special usefulness of certain salts and the influence of varying concentration were discussed and connected with principles in regard to photochemical action and chemical action generally embodied in two short papers read in 1897 and published in the Society's *Proceedings*.—Prof. George Forbes, F.R.S, read an additional note on the Ultra-Neptunian planet the existence of which is indicated by its action on comets, supplementing papers on the same subject published twenty years ago. The general idea was that comets were attracted into the solar system by the action of outlying planets; and there were seven comets having aphelion positions corresponding with positions of a planet revolving round the sun at a distance 100 times that of the earth, with a period of about 1000 years. It was suggested that this planet, by its disturbing action on the comet of 1264 and 1556, which had not reappeared as expected in 1848, had so altered the elements of the orbit as to make it no longer recognisable; and reasons were given in favour of the identification of the lost comet with either the comet 1844 (3) or the comet 1843 (2), both of which had parabolic orbits assigned. If these were assumed to be ellipses of the proper size the aphelion positions would not be far removed from the positions occupied by the supposed planet. To produce the changes demanded in the orbit the mass of the supposed planet would, however, require to be greater than that of Jupiter.

PARIS.

Academy of Sciences, May 20.—M. Fouqué in the chair.—On the total eclipse of May 18, by M. J. Janssen. A short report on observations of the recent eclipse by M. de la Baume, at Sumatra. The rotation of the sun's corona, and the presence of Fraunhofer's lines in the light thereof, have not been confirmed.—Researches on the condition of alumina in soils, by M. T. Schlœsing. A number of specimens of earth from Madagascar were found to contain considerable quantities of alumina, either in the free state or in the form of a silicate readily attacked by dilute caustic soda solution. The greater part of the alumina or the silicate exists in a pulverulent, sandy state, and is not the cause of the tenacity of the soil; it has no adverse influence on vegetation.—M. Laveran was elected to fill the vacancy in the Section of Medicine and Surgery caused by the decease of M. Potain.—On the eclipse of Jupiter's fourth satellite, observed at Paris, May 17, 1901, by M. G. Bigourdan.—Observations of the brightness of Nova Persei, by M. Luizet. The variations in the brightness of this star are said to show no regular periodicity.—On regular groups of a finite order, by M. Léon Autonne.—On the molecular depressions of the temperature of maximum density of water produced by the dissolution of the chlorides, bromides and iodides of potassium, sodium, rubidium, lithium and ammonium; the relations between these depressions, by M. L. C. de Coppet. The experimental results are given in tabular form. The lowering of the temperature of maximum density is proportional to the quantity of salt dissolved, whilst the *molecular* lowering is almost constant. Lithium salts, however, are an exception to the latter rule, their molecular lowering increasing with the concentration. The salts of sodium are the most, and those of lithium the least, active. Iodides produce a greater depression than bromides, and bromides than chlorides, the relations between the observed values being the same for all the metals of the group.—Alcohols and calcium carbide, by M. Pierre Lefebvre. A continuation of previous work on the

subject. In the present paper are given the results of the analysis of the gases produced by the action of the vapours of amyl, isobutyl, ethyl or methyl alcohols on heated calcium carbide.—On the condensation of acetylenic hydrocarbons with formaldehyde; synthesis of primary acetylenic alcohols, by MM. C. Moureu and H. Desmots. The action of the sodium derivatives of œnanthylidene or phenylacetylene on the solid polymeride of formaldehyde results in the formation of two new alcohols. Amylpropiolic alcohol boils at 98° under 13 mm. pressure, and has a specific gravity 0·8983 at 0°, whilst phenylpropiolic alcohol boils at 139° under 16 mm. pressure, and has a specific gravity 1·0811 at 0°; both are colourless, oily liquids.—Action of acid chlorides on ethers in presence of zinc, by M. P. Freundler. Remarks on a recent paper by M. Descudé.—Oxidation of primary alcohols by contact action, by M. J. A. Trillat. All primary aliphatic alcohols are oxidised when a mixture of air with the vapour of the alcohol is passed over a heated platinum spiral, and it is possible to limit the reaction to the formation of the corresponding aldehydes; the presence of water vapour appears to favour the oxidation. The use of porous substances, such as platinum black, tends to the production of acids rather than aldehydes. Acetals are also produced, at any rate from the lower alcohols; their formation is a reversible reaction.—On the substitution of zinc-white for white-lead in oil painting, by M. A. Livache. According to the author's experiments, the injurious white-lead in oil paints may be successfully replaced by zinc-white, provided certain conditions are observed.—The evolutionary cycle of *Orthonectides*, by MM. Maurice Caullery and Félix Mesnil.—On a glucoside characteristic of the germinating period of the beech, by M. P. Tailleur. The beech, in its germinating stage, contains a glucoside and a corresponding ferment which, in the presence of water, give rise to methyl salicylate and glucose, the latter being assimilated by the plant. The reaction is localised in the hypocotyledonous axis, and does not occur in the seed or in the old plant.—On the petrographic classification of the schists of Casanna and the Alps of Valais, by M. L. Duparc. A description of seven types of schist.—On the electrolysis of animal tissues, by MM. Bordier and Gilet. The fall in strength observed on the reversal of a current passed through animal tissues, is not observed to any appreciable extent if the tissues at the level of the electrodes are impregnated with an electrolyte.—On the formation of urea by the oxidation of albumin by means of ammonium persulphate, by M. L. Hugounenq. Under favourable conditions, about 5 per cent. of urea may be obtained by the oxidation of egg albumen by ammonium persulphate in alkaline solution.—New seismological observations at Grenoble, by M. W. Kilian.

DIARY OF SOCIETIES.

THURSDAY, MAY 30.

ROYAL INSTITUTION, at 3.—The Chemistry of Carbon: Prof. J. Dewar, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS (Society of Arts), at 8.—Annual General Meeting.

FRIDAY, MAY 31.

ROYAL INSTITUTION, at 9.—With the Allies in China: A. H. Savage Landor.

PHYSICAL SOCIETY, at 5.—On a Model which imitates the Behaviour of Dielectrics: Prof. Fleming, F.R.S., and A. W. Ashton.—(1) On the Resistance of Dielectrics and the Effect of an Alternating Electromotive Force on the Insulating Properties of India-rubber; (2) Note on the Electrification of Dielectrics by Mechanical Means: A. W. Ashton.

SATURDAY, JUNE 1.

ROYAL INSTITUTION, at 3.—The Biological Characters of Epiphytic Plants: Prof. J. B. Farmer, F.R.S.

MONDAY, JUNE 3.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—The Need of Greater Care in Introducing Gas-Firing into Small Gasworks: G. Cecil Jones.—The Chemical Aspects of Bacteriology: Dr. Walter C. C. Pakes.

INSTITUTE OF ACTUARIES, at 5.—Annual Meeting.

TUESDAY, JUNE 4.

ZOOLOGICAL SOCIETY, at 8.30.—On the Structure and Affinities of the Anomodont Genus Udenodon: Dr. R. Broom.—Notes on the Type Specimen of *Rhinoceros lasiotis*, Sclater; with Remarks on the Generic Position of the Living Species of Rhinoceros: Oldfield Thomas, F.R.S.—On a Small Collection of Fishes from the Victoria Nyanza, made by order of Sir H. H. Johnston, K.C.B.: G. A. Boulenger, F.R.S.

WEDNESDAY, JUNE 5.

GEOLOGICAL SOCIETY, at 8.—On the Passage of a Seam of Coal into a Seam of Dolomite: A. Strahan.

ENTOMOLOGICAL SOCIETY, at 8.—Cases of Protective Resemblance, Mimicry, &c., in British Coleoptera: Horace St. J. Donisthorpe.—A Revision of the American Notodontidæ: W. Schaus.

THURSDAY, JUNE 6.

ROYAL SOCIETY, at 4.—Election of Fellows.——At 4.30.—*Probable papers*: On the Electric Response of Inorganic Substances, Preliminary Notice: Prof. J. C. Bose.—On Skin-Currents: Dr. A. D. Waller, F.R.S.—Vibrations of Rifle Barrels: A. Mallock.—The Measurement of Magnetic Hysteresis: G. F. C. Searle and T. G. Bedford.—A Conjugating Yeast: B. T. P. Barker.——Papers to be read *in title only*: Thermal Adjustment and Respiratory Exchange in Monotremes and Marsupials: a Study in the Development of Homo-thermism: Dr. C. J. Martin.—On the Elastic Equilibrium of Circular Cylinders under Certain Practical Systems of Load: L. N. G. Filon.—The Measurement of Ionic Velocities in Aqueous Solution, and the Existence of Complex Ions: B. D. Steele.

ROYAL INSTITUTION, at 3.—The Chemistry of Carbon: Prof. J. Dewar, F.R.S.

LINNEAN SOCIETY, at 8.—On the Necessity for a Provisional Nomenclature for those Forms of Life which cannot be at once arranged in a Natural System (Adjourned Discussion): H. M. Bernard.

CHEMICAL SOCIETY, at 8.—A Laboratory Method for the Preparation of Ethylene: G. S. Newth.—Oroxylin: W. A. H. Naylor and C. S. Dyer.—Some Relations between Physical Constants and Constitution in Benzenoid Amines, II.: P. Gordon and L. Limpach.—The Constitution of the Acids obtained from α-Dibromocamphor: A. Lapworth and W. H. Lenton.—The Decomposition of Chlorates. IV. The Supposed Mechanical Facilitation of the Decomposition of Potassium Chlorate: W. H. Sodeau.—Condensation of Phenols with Esters of the Acetylene Series. V. Homologues of Benzo-γ-Pyrone: S. Ruhemann.—On the Action of Sodium Methoxide and its Homologues on Benzophenone Chloride and Benzal Chloride: J. E. Mackenzie.—Preliminary Note on Hydrides of Boron: W. Ramsay and H. S. Hatfield.—Gum Tragacanth: C. O'Sullivan.

RÖNTGEN SOCIETY, at 8.30.—X-Ray Diagnosis of Aneurism: Dr. Hugh Walsham.

FRIDAY, JUNE 7.

ROYAL INSTITUTION, at 9.—Mimetic Insects: Prof. Raphael Meldola, F.R.S.

GEOLOGISTS' ASSOCIATION, at 8.—The Geysers of the Yellowstone: John Parkinson.

SATURDAY, JUNE 8.

ROYAL INSTITUTION, at 3.—The Biological Characters of Epiphytic Plants: Prof. J. B. Farmer, F.R.S.

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