THURSDAY, JULY 26, 1900.

TRADE IN ANCIENT ASSYRIA.

Babylonians and Assyrians: Life and Customs. By the Rev. A. H. Sayce. The Semitic Series. Vol. vi. Pp. x + 273. (London: John C. Nimmo, 1900.)

THIS little book belongs to a projected series of volumes which we gather are intended to deal with the Babylonians and Assyrians and other allied Semitic races, "the object of the series" being, according to the prospectus, "to state its results in popularly scientific form." The volume assigned to Prof. Sayce, which is the first of the series to make its appearance, describes the life and customs of the Babylonians and Assyrians, a subject which offers many points of interest to the general reader. Moreover, within recent years much new material has been published which has thrown considerable light on the social condition of the Babylonians and Assyrians during both the earlier and the later periods of their history. Thousands of clay tablets, which were unearthed at Telloh in Southern Babylonia and have found their way into the museums of Europe, contain temple-records, lists and inventories, receipts and tablets of accounts, and furnish a glimpse of the daily life of the early inhabitants of Babylonia at about 2500 B.C. The letters and commercial documents of the period of the First Dynasty of Babylon enable us to form a still more intimate acquaintance with the life of the Babylonians under some of the earliest of their Semitic kings; while the systematic publication of the legal and epistolary literature in the great collection of tablets from Kouyunjik has increased our knowledge of the social condition of Mesopotamia under the later Assyrian kings. Finally, the large collections of tablets of the Neo-Babylonian and Persian periods, which are now available for study, make it possible to trace the development of laws and customs down to the latest periods of Babylonian history. There is, therefore, no lack of material on which to base a sketch of the manners and customs of the Babylonians and Assyrians.

Prof. Sayce has written many popular books on this subject, and he is well qualified for the task he has undertaken; but we cannot help wishing that in one important point he had modified the plan on which he has compiled his volume. The book deals largely with small details, containing descriptions of sales of houses and lands and property, deeds of partnership, marriage contracts, receipts, records of loans, and numerous other commercial and legal transactions drawn from the thousands of "contract tablets" which have been published in various monographs and in the transactions and journals of different societies. Any book describing the life and customs of the Babylonians must necessarily draw upon this large and scattered literature in order to illustrate the general conclusions which the writer formulates. Prof. Sayce has made abundant use of this material, quoting and describing tablets freely; on p. 16, for instance, in one short paragraph, he refers to no less than nine separate documents of different dates. But from the first page to the last he has not given a single reference to the works in which the various tablets have been published, or any indication by which they might be identified; in fact, not including Biblical quotations, we have only found two references in the book (on pp. 1 and 66), and these are to the opinions of modern writers and not to original authorities. This is perhaps not Prof. Sayce's fault, but a defect in the general plan of the series, for it is possible that the editor has ruled that references to authorities are incompatible with "a popularly scientific" treatment. But, whoever may be responsible, this defect detracts largely from the value of the book. No doubt the expert knows already where to look for the original texts quoted, and can control the various statements for himself; but the series is not meant for the expert. In the editorial preface, we are expressly told that it is intended to "be serviceable to students in colleges, universities, and theological seminaries, to the clergy, and to intelligent lay readers." The object of the work is, therefore, essentially educational; but without references it can prove but a poor guide or introduction to the study of the subject of which it treats.

Although doubtless hampered by this deficiency in the general plan of the work, Prof. Sayce has produced a very readable, though perhaps a rather rambling, little book. He has written attractively on the general character of Babylonia and its inhabitants, the constitution of the family, the system of education, commercial and social life, laws and government, letter-writing and religion. To treat all these subjects fully in some two hundred and sixty octavo pages is, of course, impossible; but the author has touched his subjects lightly, and some of his chapters contain valuable summaries, as, for example, that in which he describes the legal condition of women in Babylonia. The plan of writing vaguely without reference to authorities, however, is not conducive to strict accuracy, and we occasionally meet with a rather misleading generalisation. The statement on p. 102, for instance, that

> "no deed was valid without the seal or mark of the contracting parties"

is not borne out by the facts, for many deeds of different periods are extant which bear neither seal-impression nor nail-mark. On p. 61 we are told that

> "the year was divided into twelve months of thirty days each, an intercalary month being inserted from time to time . . ."

Even for the Assyrian period this statement is probably not accurate, and it takes no account of the changes which the calendar underwent in the long course of Babylonian and Assyrian history. The arrangement of the calendar and the method of harmonising the lunar and solar years are not yet accurately known in many of their details and are still subjects of controversy, but the student would not gather this from Prof. Sayce's statement. The evidence for cremation (pp. 62 ff.) among the Babylonians and Assyrians is far from being conclusive, and many scholars hold that it was not practised in Mesopotamia before the Parthian period. The statement on p. 51 that the writing of the scribes was sometimes so minute that magnifying glasses were used for reading by the Assyrians, and that short sight "must have been common in the Babylonian schools," is, to say the least, rather fanciful, the only evidence for the statement being a circular crystal object found by Layard at Nineveh, and thought to be a lens, but the use of which is unknown. That there was ever "a monotheistic school" at Erech (p. 262) would, we think, be difficult to prove, and the evidence for "human sacrifice" referred to on p. 103 should surely have been given. It is, no doubt, a consequence of the omission of references that we sometimes come across repetitions in the book, as, for instance, the quotation referring to the Chaldeans and their ships in connection with Eridu on pp. 9 and 183; the suggested identification of Sar-ilu with Israel on pp. 17 and 191, the description of the letter referring to a ferry-boat on pp. 186 and 215, &c. Misprints, too, are not uncommon, as, for example, "the eighteen-hundredths part" (p. 114), "I will *lie* up five shekels of silver" (p. 225), "Emutalum" for "Emutbalum" (p. 211), "weight" for "night" (p. 266), "bears" apparently for "beasts" (p. 52), "cuneiplain" apparently for "plain" (p. 211), and on p. 157 we are told that "Aramaic became the *lingua panca* . . . in the commercial world." Prof. Sayce is probably not to blame for such misprints, for the American editor was doubtless responsible for the correction of the proof-sheets.

ELECTRICAL ORGANS. MUSCLE OR NERVE?

Beiträge zur Physiologie des elektrischen Organes der Zitterrochen (*Torpedo*). By Siegfried Garten. Pp. 116, 4 plates. (Leipzig: Teubner, 1899.)

ALTHOUGH electrical fishes have been the object of scientific curiosity and investigation for nearly 300 years, it is only in the last half of this century that physiologists have realised the great importance, for general physiological problems, of the phenomena presented by these remarkable animals. The discovery and investigation of the electrical phenomena accompanying excitation or activity of all the excitable tissues in the animal body have rendered it of supreme importance to attack the problem and the causation of these electrical changes in the organ, where the "electrical function," so to speak, attains its highest degree of development. It seems probable that electrical organs may be developed by the transformation of many different kinds of tissue. In the greater number of these fishes, however, including that which is the subject of the memoir under consideration (Torpedo), the organ is formed by a transformation of embryonic muscle-fibres, accompanied by a disappearance of the cross-striated contractile material, with a great hypertrophy of the nerve-endings. The electrical discharge of the organ, with an E.M.F. probably amounting to 100 to 200 volts (Gotch) and lasting about 6/1000 of a second, may be excited reflexly or by excitation of the nerve to the organ, or, using strong shocks, by stimulation of the organ itself. The direction of the current in the fish is from ventral to dorsal surface. The electrical organ in the torpedo consists of an array of columns, each column being composed of about 400 transverse discs representing the electromotive elements of the organ. On the ventral surface of each of these discs we find the complicated terminal arborisation or network of a nerve-fibre, embedded in granular protoplasm, and separated from the disc by the remains of the primitive muscle-fibre from which the organ was developed.

We must assume that it is in consequence of these structural arrangements that the excitatory electrical change in the whole organ, instead of passing from one end to the other as a wave, and so giving rise to a diphasic variation of small extent, causes merely a change in one direction, which is summated in proportion to the number of discs in the pile, so producing a monophasic variation of considerable E.M.F. It is evident that we could conceive of each disc as consisting of an inferior part, which is excitable and therefore capable of the chemical changes associated with excitation, and of a superior part, structurally and chemically continuous with the inferior, but incapable of excitation. The question at once arises whether these two parts are represented by nerve and muscle, or whether the chief excitatory change takes place in some of the structures derived from the embryonic muscle-fibre. Is the electrical change an action current of nerve-ending or of muscle?

Du Bois Reymond, for theoretical reasons, supported the latter view, and at the same time laid great stress on a remarkable property of the organ. He found that the electrical conductivity of the organ was greater for homodromous currents, *i.e.* those in the direction of the discharge of the organ, than for heterodromous. It was shown later by Gotch that this irreciprocal conductivity is only apparent, Du Bois Reymond's results being due to the fact that, in measuring the current passing through the organ, he was measuring the algebraic sum of the battery current and the current excited in the organ itself. Naturally, therefore, the homodromous current was greater than the heterodromous.

Gotch has also drawn attention to the fact that in the electrical organ we have an opportunity of deciding the nature of the demarcation-current consequent on injury. Since in this organ the demarcation-current is always in the same direction as the excitatory-current, whatever may be the position of the injury, he concludes that the demarcation-current or current of rest is really in all cases an action-current due to the continued stimulation at the seat of injury.

On these three questions, but especially with regard to the nervous or muscular nature of the excitable tissue, additional evidence is furnished by Garten, whose research is devoted chiefly to the elucidation of three points—the effect of nerve-section and subsequent degeneration on the direct excitability of the electrical organ; the effect of drugs, such as curare, which are direct poisons for nerve-endings; and the action of veratrin as a specific muscular poison.

The results of these experiments are a strong confirmation of the views put forward by Gotch. During the first eight days after section of the nerves, the organs can be excited either directly or indirectly; from the eighth to the eighteenth day after section, the organ can be excited to discharge, but the shocks are weaker than normal. After the nineteenth day, however, no response is obtained to stimulation either of the nerve or of the electrical organ itself. Thus the irritability of the organ disappears with that of the nerve, whereas a muscle is excitable long after the degeneration of its motor nerve with end-plates is complete. It may be mentioned that the organ-current, or current of rest, and the irreciprocal conductivity diminish during the period of lowered irritability of the organ, and are absolutely abolished after the nineteenth day, thus pointing to the excitatory nature of both these sets of phenomena.

The experiments on the action of curare are less satisfactory, owing to the enormous doses (1 grm. for a fish of 1200 grms.) which are necessary to paralyse the indirect excitability of the electrical organs. Since in these large doses the curare excites central discharges, it is necessary to cut all the electrical nerves to prevent paralysis by fatigue. In this case, however, with a sufficient dose of curare, direct and indirect excitability are abolished simultaneously. The same interdependence of direct and indirect excitability is observed in paralysis by fatigue, in marked contrast to the behaviour of voluntary muscle, where a muscle on direct stimulation gives a practically normal contraction after complete fatigue by stimulation of its nerve.

Veratrin, which causes a marked prolongation of the excitatory change in skeletal muscle, was found by Garten to produce a somewhat similar effect on the electrical discharge of the torpedo. This drug, however, diminishes and very rapidly abolishes the direct and indirect excitability of the electrical organ, and no proof is afforded that the prolonged response may not be due to the state of artificial "fatigue" produced by the drug, or that it is in any way specific. Waller's experiments have shown that veratrin has practically no action on the nerve, and although Garten quotes certain of his own experiments which appear to indicate an action of this drug on non-medullated nerve, the strength of the solution employed must be regarded as too great for the demonstration of the specific action of the drug.

We cannot, therefore, regard the experiments with veratrin as detracting in any way from the support afforded to the nerve-ending theory of excitation by the results of nerve-section. It is remarkable that a change which, as the current of action in nerve, needs all the appliances of a well-fitted laboratory for its demonstration, should, by a mere subdivision of the fibrils and their enclosure in compartments separated by non-excitable partitions, be able to produce the strong shocks of high intensity which characterise the discharge of the whole organ. No better demonstration could be afforded of the futility of those hypotheses which would explain the passage of the nerve-impulse as a mere propagated polarisation, and would deny any energy-producing changes in the axis-cylinder itself. The absence of fatigue in medullated nerve does not imply absence of chemical change, but merely equivalence of disintegration and reintegration, an equivalence probably connected, as Waller has suggested, with the presence of a medullary sheath.

E. H. S.

FLUORINE.

Le Fluor et ses Composés. Par M. Henri Moissan. Pp. xii + 396. (Paris: G. Steinheil, 1900).

THERE could scarcely be a greater contrast than that between the gaseous substances most recently added to our list of elements; fluorine on the one hand, argon and its companions on the other. The existence of the hypothetical element fluorine was postulated in many well-investigated compounds as early as the beginning of the present century; yet, on account of its intense chemical activity, fluorine was not prepared as a free element until 1886, despite the numberless attempts which had been made to isolate it in the intervening period. Argon, on the other hand, owing to its absolute inertness, and to the fact of its occurrence along with the very inert nitrogen, led an unsuspected existence until 1894, although it was contained in enormous quantities in the atmosphere—a constant subject of investigation. The compounds of fluorine, then, were known long before the element itself,—compounds of argon are still wanting. Indeed, as has been pointed out (Sedgwick, "Argon and Newton," p. 2), the name element in the ordinary sense cannot properly be applied to argon and its companions at all, since that term implies the existence, or at least the possibility of existence, of compounds concerning which we are still in total ignorance. As yet there is no chemistry of argon.

The time, however, has now arrived when fluorine and its compounds can be brought under review so as to give a picture of the element in itself and in its combinations, which in main outlines, at least, may be looked upon as final. Prof. Moissan was obviously the man to execute this task; he has fortunately undertaken it, and the book before us gives the result of his labours. As evidence of the extent of the author's research, we may adduce the bibliography given as appendix, which occupies eighty-five pages, and contains references to about six hundred books and papers. These references are arranged alphabetically according to authors, and also chronologically, beginning with Agricola, 1558, and ending with the year 1899.

In the book itself the author's investigations have naturally the first place, and one of the chief points of interest is that M. Moissan not only gives us an account of his apparatus, experiments and results, but also of the leading thoughts which guided him from one experiment to another, until the culmination was reached in the liberation of the gaseous element. The student beginning research could not find a more stimulating record of failure and eventual success than that afforded in Chapter i., on the isolation of fluorine. Chapter ii. deals with the most recent apparatus for the production of fluorine by electrolysis. At a temperature of about $-80°$, attained by the evaporation of a mixture of solid carbonic acid and acetone, it is possible to use an electrolytic vessel of copper instead of platinum, provided that the hydrofluoric acid employed is free from water. This substitution brings elementary fluorine within the scope of any well-equipped chemical laboratory. Chapter iii. deals with the physical properties of fluorine, its liquefaction, and the action of the liquid on various substances. In

Chapter iv. we have a systematic account of the action of fluorine on the non-metallic elements and on some of their compounds, together with a somewhat detailed study of the non-metallic fluorides. The action of fluorine on the metals and their compounds forms the subject-matter of Chapter v., the organic fluorine compounds receiving treatment in Chapter vi. The last chapter in the book deals with the atomic weight of fluorine, the volumetric composition of hydrofluoric acid, the action of fluorine and hydrofluoric acid on glass, and the position of fluorine in the system of the elements. The author definitely places fluorine at the head of the halogen family, sufficient stress, however, being laid on the points in which fluorine resembles the elements of the oxygen family; such as the ease with which it unites with carbon, and the analogies exhibited by hydrofluoric acid to some dibasic acids. A short summary of the properties of fluorine concludes the volume, and for frontispiece there is an excellent portrait of the author.

The book is as interesting as a monograph can well be, and M. Moissan has earned the gratitude of all chemists by thus placing before them a connected record of one branch of his splendid activity. J. W.

OUR BOOK SHELF.

A Text-Book of Physical Chemistry. By Dr. R. A. Lehfeldt. Pp. xii+308. (London: Edward Arnold, 1899.)

A FEW years ago the teacher of physical chemistry seeking a suitable elementary text-book, dealing with the more recent developments of the subject, which he could put into the hands of a class of students approaching the study of physical chemistry for the first time, was somewhat embarrassed to find one. This state of things is now changed for the better by the recent appearance of several very excellent works; among these Dr. Lehfeldt's book will take a high place. The author explains in his preface that the book "is intended to contain what a student—with limited time and many subjects to learn—may usefully read. It is by no means written to suit any examination, but still is written with the practical requirements of students in view."

Dr. Lehfeldt has succeeded in avoiding the unessential and in explaining the fundamental ideas of modern physical chemistry in a thoroughly lucid manner, so that a student who has grasped the contents of this book will experience little difficulty in appreciating the meaning of the larger handbooks or original memoirs.

An introductory chapter on physical units will be useful to chemical students, who are, perhaps, apt to be slipshod in such matters. This is followed by a chapter on molecular weights in gases and solutions, which includes electrolytes and the ionic theory, and by a very well-considered chapter on the connection between physical properties and chemical constitution. The principles of thermodynamics are then explained; and the two laws (*a*) of chemical equilibrium in a system of perfect gases at constant temperature, and (*b*) of the influence of temperature on chemical equilibrium are deduced from them. This chapter presupposes some knowledge of the elements of the calculus, but any student who wishes to understand physical chemistry must make up his mind to acquire the small amount of mathematical knowledge requisite.

The applications of the two thermodynamic theorems to chemical change and equilibrium in homogeneous and heterogeneous systems are then taken up. This treatment has the great advantage that the whole of the phenomena can be grouped in a very simple way, the close relationship of chemical and physical change is clearly brought out, and the student is not bewildered by the apparent multiplicity of the phenomena. The book concludes with a brief but most interesting chapter on the theory of the galvanic cell, and the connection between electromotive force and chemical affinity. The book may be unhesitatingly recommended as one of the best of its kind.

The only misprint we have noticed occurs on p. 141, line 18, where "increases" is written in place of "decreases." T. E.

An Introduction to Analytical Chemistry. By G. G. Henderson, D.Sc., M.A., and M. A. Parker, B.Sc. Pp. 228. (London: Blackie and Son, Ltd., 1899.)

THIS is a compact work covering the ground of ordinary qualitative analysis as well as the tests for a number of organic substances, and also containing an account of the most important processes of quantitative analysis.

Without being designed on any new plan or being explanatory to the fullest extent, the book is written in a scientific spirit. The authors state that they have made free use of the works of Dittmar and others, and it is perhaps not uncomplimentary to remark that the influence of that sterling chemist is apparent in the book.

The directions for work are clear and practical, and the analytical methods quite satisfactory. Perhaps the least useful part of the book is that dealing with organic substances and their separation from mixtures. This branch of analytical art is very difficult, and the particular form of it, which has been encouraged by certain examining bodies, has brought disaster to many a good student. It is difficult to understand what useful purpose is served by the efforts of second-year students to prepare for recognising the constituents of, say, a mixture of urea and an inorganic salt. It is of no importance to medical men, it does not help the teaching of organic chemistry, and it crowds out practical work which would be of real value. The examination of such mixtures is a matter for an analyst of mature knowledge and experience. A. S.

Maryland Weather Service. Vol. i. Pp. 566. (Baltimore: The Johns Hopkins Press, 1899.)

THE Maryland State Weather Service was established in 1892, and its reports and climatic charts are favourably known to meteorologists. In 1896 a plan of closer co-operation between the National and State Weather Bureaux was proposed by Prof. W. L. Moore and adopted. This marked the commencement of a new and very important period in the history of the Service, and the present volume is the first published since the two organisations have been in close connection. The energies of the Service are now to be devoted chiefly to the publication of special reports on the climatology of the State, and if the volume before us is to be taken as an earnest of future ones, we may be pardoned a feeling of envy at the sumptuous way in which scientific work of this kind is presented to the public in America. We notice that it is proposed to publish in the near future a full account of the climatic features of Maryland, in which the physiography, meteorology, hydrography, medical climatology, agricultural soils, forestry, crop conditions and the fauna and flora of the State will be considered.

The present volume is confined to the physiography and meteorology, and includes an introduction by Prof.

Bullock Clark, on the establishment and organisation of the Maryland Weather Service; a description of the physiography of Maryland, by Dr. Cleveland Abbe, jun.; a report on the meteorology of Maryland, by Dr. Abbe, Mr. F. J. Walz and Dr. O. L. Fassig; and a contribution on the aims and methods of meteorology, by Prof. Cleveland Abbe, already noticed in these columns (vol. lxi. p. 448). The illustrations are numerous, instructive, and of a very high class, most of them being full-page collotype plates or lithographs. No State or country has given to the scientific world a volume in which the operations of the "Weather Service" are interpreted more liberally, or the work presented in a more elaborate *format*.

Volta e la Pila. By Prof. Augusto Righi. Pp. 40. (Milan: Tip. Bernardoni di C. Rebeschini, 1900.)

THIS is an inaugural discourse delivered by Prof. Righi on September 18, 1899, at the National Electrical Congress at Como. It deals with (1) the science of electricity prior to Volta; (2) the scientific work of Volta considered apart from his discovery of the pile; (3) Galvani's discovery of electricity of contact; (4) the pile; (5) the theory of the pile; and (6) conclusions. In an appendix, Prof. Righi gives a note on the theories of the pile, in which he expresses favourable opinions on the "osmotic" theory.

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.*]

An Optical Phenomenon.

IN connection with Prof. Simon Newcomb's letter on "Terrestrial Gegenschein" (NATURE, October 5, 1899) and the subsequent letters of Mr. Mallock (NATURE, October 12 and November 9, 1899), I desire to call attention to an analogous and very beautiful phenomenon of perspective which I should have mentioned at the time but that the winter season of the year is not favourable to its observation in this country.

When the sun is high and shining brightly in a clear sky, let an observer stand so that the shadow of his head falls on the surface of water that is deep, clear, but not quite clear, and slightly agitated by the wind. He will observe that from the place where the shadow of his head falls shafts of light seem to radiate in all directions. When once well observed, the phenomenon is very striking, but it has surprised me to find how few persons have noticed it. I first observed it many years ago, when I used daily, about mid-day in summer, to cross the bridge over the channel leading to the boat store in the Portsmouth Dockyard, near the main entrance. But it was not till a year later, on Ulleswater, that I found the explanation. The lake was there turbid in parts from the washings of mines, but quite clear in others. Standing up in a boat, one could see the phenomenon very clearly where there was very slight turbidity, but not if the water was quite clear, nor if there was much turbidity, and never in a dead calm. This gave the explanation. The convexities of the surface, when there is a slight agitation, acting as lenses, split up the otherwise uniform illumination into separate, parallel shafts of light, each consisting of slightly convergent rays, which, traversing the liquid, are rendered visible by the suspended particles that they illuminate. These shafts seen in perspective have their point of apparent convergence exactly opposite to the sun, *i.e.* in the shadow of his head. If the water is smooth, there are no particles to illuminate and reveal the shafts; if too turbid (or too shallow), the light does not penetrate far enough. If the sun be too low in the sky, too little light enters the water; if it shines through clouds, so that the source is diffuse, a uniform illumination results. Hence the rays are not easily noticed in winter.

After the phenomenon has once been well seen under such circumstances as I have described, one can hardly enter a boat on a bright day without being haunted by it, and realising that, although the shadow of one's head may not actually fall on the water, yet every streak of light in the water radiates from it.

A. M. WORTHINGTON.

R.N Engineering College, Devonport, July 22.

Temperatures of Recently Killed Chamois.

MR. E. N. BUXTON, in his fascinating "Short Stalks" remarks (p. 38, footnote): "A friend of mine once took the temperature of a freshly killed chamois, and it stood at 130° F." There is no doubt that many professional chamois hunters believe that the temperature of the animal is considerably higher than that of domestic animals.

During the last three years I have determined the rectal temperature of twenty-nine recently killed chamois.

These may be divided into three classes.

A.—*Those successfully stalked and dropped dead by the first shot.* (12 observations.)

With two exceptions, the temperatures, taken in every case within five minutes of death, lie between 101°·1 and 101°·9, the average being about 101°·5 F., or 38° 6 C.

The two exceptions were (i.) a kid four or five months old, the temperature of which was 103°·2 F., or 39°·6 C., and (ii.) a doe which had received a severe flesh-wound in the back eight days previously, the temperature of which was 102°·4 F., or 39°·1 C.

B.—*Those shot au galop.* (7 observations.) These animals all dropped dead in their tracks, or died almost immediately.

The temperatures on the whole were found to be distinctly higher than in class A, being 101°·5, 102°·3, 102°·4, 102°·9, 102°·9, 103°·5 and 104°·5 respectively.

The first four of these had run from 40 to 50 yards, the fifth about 200 yards, and the last two about 100 yards. The last two were young bucks, which, to judge from the appearance of their incisor teeth, were four and three years old respectively.

C.—*Those wounded at the first shot, but only brought to bag after some interval.* (10 observations.)

Here the temperatures are, on the whole, still higher.

The lowest (101°·7) was that of an animal which ran 50 yards after the first shot, and was then dropped dead by a second.

The next (102°·4) ran about 300 yards. The third (102°·9) was wounded in the stomach, then walked about 250 yards towards me, and was dropped by a second shot at about 30 yards.

The fourth (103°·1) ran about 200 yards. The fifth and sixth (103°·3 and 103°·5) were shot through the kidneys, but were not killed outright by the shot.

The remaining four showed temperatures of 104°·9, 105°·6, 106°·2 and 106°·7.

Of these the first had its fore-leg broken, and was recovered twelve hours later.

The second and fourth were recovered about half an hour after being wounded.

The third was an animal whose hind-leg was broken. It then escaped into another valley, and hid itself in a cave on a rock-wall, where it was spied about four hours later. A second shot failed to hit it, but drove it out of the cave. It then tried to climb the steep rocks above it, and after twice failing to overcome a *mauvais pas*, slipped and fell about 100 feet, and was killed by the fall.

Results similar to these were obtained in 1898 by a Swiss friend of mine. Some of the animals were driven by dogs, and these always showed a higher temperature than those stalked and killed by the first shot, the temperatures of the driven animals varying from 103°·6 to 105°·8.

The highest temperature obtained by him was 107°·6 (42° C.). This was an animal which was severely wounded in the back, then lost till twenty-four hours later, when it was found and killed by a dog.

How far the average temperature given under A represents the normal temperature of the living chamois, I am unable to say, because I do not know to what extent sudden death by a bullet would be likely to affect the reading of the thermometer. Perhaps some physiologist would kindly throw some light upon this point.

To save the trouble of calculation to any foreign reader who may see this letter, I may add that 38° C. = 100°·4 F., 39° C. = 102°·2 F., 40° C. = 104° F., 41° C. = 105°·8 F., 42° C. = 107°·6 F.

G. STALLARD.

Rugby, July 12.

The London Mathematical Society.

A FEW months since it was announced in your columns that the Society had directed an index to the first thirty volumes of the *Proceedings*, and a complete list of members, to be drawn up by the secretaries. These have now been issued to members: the general public can have them from the publisher (F. Hodgson, 86 Farringdon Street) at the respective prices, 2*s*. 6*d*. and 6*d*. A free distribution of 1000 copies of the first part of the index, which comprises an arrangement of the papers in alphabetical order of authors' names, has been commenced, and upwards of 500 copies have been sent out. In the course of the existence of the Society some 440 persons have been recorded on the roll. This is not a great number, and some younger societies have shown greater vitality. Perhaps this issue may lead to the Society becoming more widely known. R. TUCKER.

London Mathematical Society, July 23.

The Consultative Committee and Technical Education.

THE Council of the Association of Technical Institutions has had under consideration the "Draft Order in Council" constituting the Consultative Committee of the Board of Education.

It welcomes the appointment of the Vice-President of the Association, Mr. Henry Hobhouse, M.P., as a member of the Consultative Committee, and as a representative of agricultural education and of technical education in rural districts. But it views with astonishment and regret the fact that technical education in the great towns of the United Kingdom is wholly unrepresented, although there are upon the Consultative Committee two representatives of elementary education in the persons of the Dean of Manchester and Mr. Ernest Gray, M.P., three heads of secondary schools, viz. Mrs. Bryant, Dr. Gow and the Hon. and Rev. Edward Lyttelton, as well as a large number of persons intimately acquainted with literary education.

It seems to the Council a matter of the greatest national importance that there should be upon the body which is to advise the Board of Education an adequate number of persons who are well acquainted with the applications of scientific knowledge to industries and commerce, and with the best methods of giving such technical training in this country as shall enable us to meet successfully foreign competition.

In view, therefore, of the very serious damage which may be done to technical education, and thereby to the trade and commerce of the country, if the Committee to which the Board of Education will look for advice is composed of persons without adequate knowledge of the matters to which I have referred, I venture to ask you to allow me, through your columns, to draw the attention of Members of Parliament, manufacturers, and merchants to this subject, in the hope that they may take steps to secure that the constitution of the Consultative Committee may be modified in such a way that due provision may be made for the presence of persons possessing special knowledge of trade, manufactures, and technical education.

Merchant Venturers' Technical College, Bristol, July 21. J. WERTHEIMER. (Hon. Sec.)

THE CENTENARY OF THE ROYAL COLLEGE OF SURGEONS OF ENGLAND.

THE Royal College of Surgeons of England celebrates its centenary on July 25–27. The actual month of course in which George III. founded the College by Royal Charter was March, 1800, but in the spring of 1900 it would have been impossible adequately to marshal the forces of English surgery. Sir William MacCormac and Mr. Frederick Treves, to name no others, were, if we remember rightly, still in South Africa. The belated birthday of the College is to be fitly commemorated by a grand degree-giving, at which a number of representative European and American surgeons will receive the newly-created distinction of Hon. F.R.C.S. H.R.H. the Prince of Wales has already been presented with the diploma of Honorary Fellowship, a deputation from the College having waited on him on July 24. The form of words used in the Royal diploma is the same as that employed in all cases. "Know all men by these presents, that we, the Royal College of Surgeons of England, do hereby admit his Royal Highness Albert Edward, Prince of Wales, an Honorary Fellow of the College."

Besides the degree-giving there will be a conversazione, a grand banquet, a Presidential address of welcome, which will deal at length with the history of the surgeon's art, and a reception at the Mansion House. But all such august ceremonial should be regarded neither as an end in itself, nor as specially typical of the progress of surgical education.

The centenary of the Royal College of Surgeons marks, in fact, not so much the hundred and first birthday of a noble institution as the audit-day of English surgery. It is as such that it should be regarded by all thoughtful men. How stands the surgical art of to-day in comparison to that of the opening years of the century? The question requires no long answer: it is not necessary to deal at length with the profound revolution, wrought since the days of Hunter, in surgery, whether intra-cranial, intra-thoracic, or abdominal. It suffices to mention only anæsthesia and antisepsis. In the year 1800 these two great agencies for good were unknown—the surgeon had to arm himself for his task after the manner of a skilled slaughterer, and Death, as often as not, stalked at his elbow through the hospital wards or to the rich man's bedside.

At the beginning of the century, too, science was everywhere in its infancy. The surgeons, though they had ceased to rank with manicurists and barbers, were often little better than bone-setters. They dreaded operations—considered them a confession of weakness, and this through a general ignorance of how safely to operate. Medical etiquette, in those old days, was an affair of various interpretation: quackery preyed unreproved on the general ignorance. To-day surgery has become, as far as may be, scientific. The modern medical man is trained as a man of science; he is in England also subject to perhaps the severest code of honour known to history. The scientific spirit has so far permeated the public mind that even modern quackery is compelled to pose in the garb of research based on the inductive method. Graham, Buzaglo, and the inventor of the "metallic tractors" appealed in the year 1800 to just such confused instincts as possess the affrighted victims of the savage medicine-men described by Messrs. Spencer and Gillen. To-day the clever impostor takes in vain the sacred name of science, or if he make his appeal to the religious instinct, he is careful to do so almost as philosophically as a Brahmin or a Buddhist.

The progress of social relations is spoken of by jurists as one from status to contract; the progress of the medical sciences might as fitly be described as from fetich to reason.

In this progress the Royal College of Surgeons has been no unimportant factor. The very conservatism of that great society has been a source of strength. In countries where leading institutions are less tenacious of privilege, less rigidly decorous, the interests they protect tend incessantly to degenerate for lack of ideals, of ethics, and of breeding. The names of countries, especially young ones, will occur to the philosophic, where the medical profession suffers continuously from the unacademic spirit of its academies. Yet there can be no doubt that the conservatism of the College was at one time excessive.

This will be at once apparent to the readers of Sir William MacCormac's centennial address on the "History of Surgery and Surgeons." As a succedaneum to his text, sixty-one carefully prepared biographies of his predecessors in office have been published. Of these presidents certain of the earlier ones constitute an object-lesson in oligarchy and the art and craft of office-holding. Charles Hawkins, first Master of the College in 1800, had for years—since 1790—been Master of the old civic Corporation of Surgeons. Indeed, it died, through inadvertence, under his rule. He belonged to an office-holding race. His father, Sir Caesar Hawkins, the first baronet, and his uncle, Quennell Hawkins, both St. George's men, where office was bought for large sums of money paid to seniors, had been Serjeant Surgeons to George II., and as such were liable to accompany him on his campaigns. Whether they did so is doubtful; it was Ranby who attended the gallant little king at Dettingen. Charles Hawkins enjoyed the honours of the same office, which take us back in thought to Homer's Machaon and Podalirius, [and to the Sanskrit word "Shalya," "an arrow-head," or "surgery." But beyond this we know very little of Charles Hawkins. There are others like unto him whom we need not specify. The "Dictionary of National Biography" knows them not. Their peculiarity was silence, "the fool's best friend." Conjointly they published nothing; an aversion to intellectual exertion seems to have distinguished them. But we can imagine them at least as strict upholders of dignified routine, as courtiers, as men of the world. The delightful eighteenth century died very hard in England—in Latin countries it is not dead yet—and these old gentlemen, with their powdered hair and voluminous cambric cravats, seemed to carry on the tradition of an ample age, where a fine face, a white hand, and a capacity for classical quotation fitted an average great man for any sort of position from the Papal chair to the presidency of the English College of Surgeons. Others there were, however, even in the early days of the College history, who struck a different note. Such were the terrible Abernethy, a man driven into savagery of manner by his innate sense of justice, which abhorred the quacks of his day and generation and their self-indulgent victims, suffering from avoidable ills, chiefly due to the effects of over-feeding and the "*alcoolisme des gens de bon ton.*" Such also the variable Lawrence, an early Darwinian, a passionate reformer and reform journalist, in association with the famous Wakley, an eloquent orator, and, in the end, a conservative College Councillor of the strictest.

In the College Library and Council Room during the centenary celebrations, an exhibition is being held of portraits, busts, relics and manuscripts illustrative of the history of the College, and this in itself bears witness to the changes which a hundred years can bring forth. Among the exhibits never, we believe, shown before, but now sanctioned by the lapse of long years, are papers of importance from the Owen collection. Here, for instance, is the Curator Clift's determined evidence against Sir Everard Home, Bart., who plagiarised from Hunter's papers and then destroyed them. In one exhibited letter Clift quotes Sir Everard's words, "all gone, every Jack of them," in reference to Hunter's descriptions of cases and specimens. This is not the place to discuss the Home—Hunter controversy, which has long ago been given over by the experts, but we may be allowed a postscript. The question between Hunter and Home should be judged from the point of view of 1820. Home was an old-fashioned Scotsman of a proud and ancient stock. Hunter came of a race of "bonnet-lairds." Home looked indulgently down on his brother-in-law, Hunter. These family sentiments are almost incomprehensible to an Englishman, but they rage even in the Scotland of to-day. Home thought he might fairly make use of his humbler connection's notes. He was no academic—had no scholarly regard for literary *meum* and *tuum*. How few have even to-day? Hunter's notes, on the other hand, to judge by the remaining specimens of them, were extraordinarily rough and often illiterate, though at all times they betray the great and ardent mind fretting and hurrying under inadequate powers of expression. William Clift also, John Hunter's amanuensis and subsequent defender, has been described by one who knew him well as a typical Cornishman, extremely garrulous, prone to repeat himself. There is in the College Library a "solander," *alias* box, full to the brim almost of Clift's repeated indictments against Home. The thing suggests "*idée fixe*."

Still, though Home acted according to the lights of his day and his order, he committed a crime of magnitude, and owing thereto the history of the great Hunterian Museum since 1800 has been necessarily one of re-construction. Clift began re-writing the Catalogue as it were from memory. He had worked so long with the great John Hunter that he knew how the master would have again spoken of numbers of specimens of which Home had burnt the descriptions. Richard Owen, Clift's son-in-law, was to Clift very much what Clift had been to Hunter. The young man worked ardently under his directions, sometimes aided by Benjamin Brodie, in his youth a zealous comparative anatomist. In one of his Museum Reports Richard Owen yearns for the days when Clift, and he, and a very few others, including Everard Home, worked incessantly in the Museum-room, undisturbed by the visits of students and sight-seers.

The public were indeed discouraged from visiting Hunter's collections, not in any gross spirit of obscurantism, but half-unconsciously, half-hieratically, much as a modern undergraduate reading for a Pass degree is kept at arm's length by the learned Don who is the College librarian. In 1833 Earle, lecturing on the urinary apparatus, gave vent to one of those petulant outbursts which are more illuminating than pages of studied prose. The passage, now often quoted, appears in the *Lancet* of the period, and is a bitter satire on the uncatalogued and dusty condition of the then Museum. Earle, it seems, had searched in vain for hours for pathological specimens with which to illustrate his remarks. The whole amusing tirade, if we remember rightly, was discreetly suppressed by him in his republished lecture.

At the present moment the great Museum—and the Library, too, for that matter—can be read like a book. One of the most notable publications of the centenary is the first portion of the "Physiological Catalogue," which, with its finely executed plates, will remain an enduring monument to the graphic skill and scientific acquirements of the Conservator and his staff.

The Museum, the Library, and the College owe their being, as it were, to John Hunter; but their emergence from the coma of the first three decades of the century is in great measure due to Sir Richard Owen. It is notable that the moment he begins to lecture in 1835, Wardrop's grumbling commentary in the *Lancet* undergoes a change. It seems at first as though the serious young Conservator was not understood. What did he aim at? why should he do so well where others had wrought so indolently? Then gradually the *Lancet* critics change their tone, and bless where before they had cursed.

A lecture by Owen became in time one of the great social and intellectual functions of the London world. Science was not then so specialised as it is to-day, nor perhaps so divorced from the interests of the literary. Bishops presided over the British Association; hereditary peers over the Royal Society; the Prince Consort took an interest in microscopy; the poets had not yet become decadent or æsthetic; the Tractarian movement had not yet replunged the world of women in the ages of faith. The public mind, indeed, would seem to have been more liberal than now. To this mind—alert, interested, deeply curious—Owen addressed himself with zeal. It is singular to note, at this distance of time, that his lecture would end with a debate, in which the Dean of St. Paul's would heckle the professor.

The College Lectures became still more important when Huxley succeeded to the chair Owen had once occupied. Owen retired in 1855, after delivering a course on "The Structure and Habits of Extinct Vertebrate Animals." He had prepared a course for 1856, when, however, lectures were suspended. The Council, it seems, had carped at the long duration of Owen's catalogue-making, and Owen had addressed to them an eloquent *apologia* for his seeming delays. Hence, perhaps, Owen's retirement. In 1863 Thomas Henry Huxley began to lecture, his first course dealing with "The Structure and Development of the Vertebrate Skeleton." His first lecture was devoted to the glyptodon with much-broken carapace, now in the Museum. He continued to deliver a long annual course till succeeded by Flower in 1869. The late Sir William Flower's tenure of the chair, which he shared with the great but somewhat neglected William Kitchen Parker, brings us down to comparatively recent times.

It is as a lecturing body that the College should prove most interesting to the world of Science at large. The names of Owen and the greater Huxley link it with the grand world of Cuvier and Darwin. We might write at length of the beneficent work of the College in pathological anatomy, or serum-therapeutics, a work all the more praiseworthy because it has been sedulously and quietly carried on in despite of the clamours of a stupid section of the public. Of the College examinations it would also be possible to say much. As recently, it should be remembered, as 1860 a doctor could qualify without passing a written examination in medicine. Now, of course, it is scarcely possible, in view of the examinations of the Conjoint Board of the Colleges of Physicians and Surgeons, for any impudent dunderhead to launch himself in practice, and to pocket the fees of a public always a little in love with quackery and mystification. Of the College as a guardian of medical ethics and etiquette, a volume might be written. A hundred years ago the doctor was always satirised by all classes of writers as unscrupulous. Now that charge is only occasionally brought against him by the illiterate, who count for nothing in the long run. That this immense change has been effected is mainly due to the College. And here it is only fair, just reference having been made to the College Museum and Library, to mention the College Office. A long line of secretaries, from Okey Belfour to Mr. Trimmer and Mr. Cowell, have patiently and vigilantly guarded the surgical point of honour. If ever a black sheep has been driven out of the surgical flock it is the College Office that has weighed his demerits and impeached him in the first instance. And this not without deliberation, or, as it was once called, "prayer and fasting." On the other hand, if ever a practitioner has been wrongly accused of malpractice, or unprofessional conduct, it is the College Office that has been at the root of his rehabilitation.

To resume and to conclude—and with the thermometer at 87° it is as well to do so—the surgeon of 1900 is not as his far-off brother of 1800, and the College, in no small degree, has been responsible for the laudable and tremendous transformation. Mere literary men in England have no Academy at their head so drastic and salutary as the College to which surgeons can look up. The doctor in 1800 used occasionally to stipulate, when dealing with workhouse authorities, that he should not be required to treat fever cases. Fever, by the by, in the undrained London of the years prior to Sir John Simon's reforms, was a common cause of death among even the well-to-do. Now, to quote the sestet of an unpublished sonnet,

> "To-day skill'd Science runs where bullets hail,
> Or cholera's rife, for love of suffering man,—
> At the laboratory-table seeks
> Plague's grim bacillus, and, if need be, can
> Die as did Müller. Nor shall heroes fail:
> From Hunter on to Lister their fame speaks!"

VICTOR PLARR.

ELECTRICAL POWER DISTRIBUTION.

IN a lecture on "Electricity as a Motive Power," delivered to the working men of Sheffield, August 23, 1879, the following question was asked: "And why not now? Why should not the mountain air that has given you workmen of Hallamshire in past times your sinew, your independence of character, blow over your grindstone again? Why should not division of labour be carried to its end, and power be brought to you instead of you to the power? Let us hope then that in the next century electricity may undo whatever harm steam may have done during the present, and that the future workmen of Sheffield, instead of breathing the necessarily impure air of crowded factories, may find himself again on the hill-side, but with electric energy laid on at his command."

The present year sees the dawn of the realisation of this idea of twenty-one years ago. For soon it will no longer be: "If," as I said on that occasion, "a workman could have transmitted to him, just at the time he might require it, a small amount of energy at, say, one halfpenny per hour per horse-power—which would be three or four times the actual cost of production with a very large steam engine—and if he could turn off the power like gas when he did not want it, how many of the smaller workmen of Sheffield would be glad to avail themselves of such a facility?"

To enable such a scheme to be carried out in this country, four Electric Power Distribution Bills have this year been brought before Parliament—one for the county of Durham, one for Tyneside, one for Lancashire, and one for South Wales. And in advocating their second reading on March 1, the President of the Board of Trade expressed the opinion that "the question which the House has to decide is a very important one, perhaps one of the most important ones that have come before the House by means of a private Bill for many years." For he pointed out that "the electrical enterprise of this country is in an exceedingly backward condition," and that:—"It may almost be said that there are villages in North America which are in possession of advantages in connection with electricity which some of our largest towns do not possess."

This opinion was shared by Sir James Kitson and the Committee of the House over which he presided. For from May 3 to well into this month, July, they sat deliberating as to whether, and under what conditions, permission should be given for electric energy to be distributed over nearly 3000 square miles of Great Britain.

A vast amount of evidence was taken regarding the effect on British industry, on the cost of producing manufactured products, and as to the growing up of new factories, and even of new trades, that might come into existence through a general distribution of electric energy. Employer after employer came forward and spoke of his individual need for electrical energy to work scattered tools in his factory, to ventilate and pump his mines, as well as to cut and haul his coal.

"Cheap power is the panacea for the evil effects of foreign competition" was urged again and again by the long stream of manufacturers who occupied the witness box for weeks. The advocates of this cheap power were marshalled in groups like bands of warriors, and, from the various classes of witnesses champions were selected who bombarded the Committee with proofs of the paramount importance of their cause, and overwhelmed the members when they struggled to grasp the arithmetic of "load factors," and begged to know how many Board of Trade units there might be in a horse-power.

At first we recognised many provincial dialects among the crowd in the Committee Room, but when it began to be realised that the inquiry would occupy more weeks than it was at first thought it would need days, the

Northumberland burr was left dominant, and remained so during the whole of May. Then a Lancashire wave rolled in, and it was not until the beginning of the fourth week in June that the "ll" and the "y" formed part of so many of the words that even counsel who had come through the Severn Tunnel to Westminster to plead their cause found some difficulty in pronouncing the names of persons and places.

But the advocates of the universal supply of "electricity in bulk" had not it all their own way, since opposed to them was a band of skirmishers who delivered well-planted criticisms aimed at exposing the grasping character of some of the projects and the desire—not even thinly concealed—of some of the promoters to crush out all small existing systems of electric distribution and to establish huge monopolies for purveying electric energy.

So that one had to moderate the enthusiasm called forth by the near prospect of electric energy being regarded as a public necessity, and therefore being generally distributed like water or gas, with the exercise of a cautious regard for the interests of those undertakers—to use the legal term—who had already been entrusted with spending the money of the ratepayers or of shareholders in establishing electric distribution systems in their own areas. For they contended that this proposal to supply the small and scattered manufacturers with very cheap electric power, which it was alleged would enable them to compete successfully with their more powerful rivals, could not be commercially realised, and that these power distribution schemes had for their object the catching of the popular vote and the passing of Bills which would enable their promoters to pick out those of the customers who were the plums among the consumers already supplied by means of the existing electrical undertakings.

For nine weeks the Committee listened to the arguments *pro* and *con.*, and the tolerance which they showed in patiently hearing questions asked by counsel which had been already asked in their absence and replied to by witnesses who were unaware that the same questions had been answered at length days before, showed how willing the members were to devote their time to a full understanding of the points at issue in order that they might be able to ultimately deliver a sound decision.

The articles of commerce, which we are accustomed to purchase may be divided into those that have weight and volume and those that have not, and it is generally in connection with the former that our system of weights and measures is employed—a pound of mutton, a yard of cloth, four ounces of letter carrying, a thousand cubic feet of gas, a mile of railway journey. But the advance of civilisation has gradually led us to regard as equally suitable for buying and selling other conveniences which it would be far more difficult to meter for the purpose of ascertaining whether we had received our fair supply. A year of police supervision, a length of street improvement, a winter of snow removal, a season of South African campaigning are considered as being furnished at a fair price only when the grumbling in connection with the supply is not too great and the articles in the *Times* are not too severe.

But there remains one commodity which, although it has neither weight, volume, nor linear dimension, can be metered with extreme accuracy, and the public demand for which is daily becoming greater and greater, and that is—energy. Hitherto the working of factories has been associated with water and coal, and either the factories have been built near the stream or in a coal region. When, however, such a site could not be conveniently found, then it has been the custom to carry at a dear rate a black, bulky, dirty substance by rail or water for miles to the factory, and, after strewing a certain portion of its dirt over the neighbourhood in the form of a descending cloud, to cart the remainder away as dusty ashes.

So accustomed are we to all this—so little does it strike us as incongruous that scuttles full of black lumps should be regularly brought into a drawing-room, no matter how valuable the pictures or rich the curtains and carpets, that we forget that our successors will look with more scorn on our customs than we do on those of our ancestors, seeing that, at least, their floor-coverings of rushes, intermingled with old bones and other refuse, could not be much injured by smoke or by dust.

Electric-lighting, electric-heating, electrically-driven machinery are all undoubtedly clean, but will the two latter pay as well as the former? On this point the evidence before the Committee of the House was somewhat conflicting. What, in fact, is the cost of carrying coal compared with the cost of electrically conveying the energy, or the "essence of the coal" as one of the counsel poetically termed it? Further, what is the saving produced by combining steam-engines, and working one very large engine instead of many small ones at different places?

Briefly, then, apart from all question of dirt, is it cheaper to burn the coal at the pit's mouth, and to convey the energy electrically to each of many machines situated within a radius of, say, ten miles from the electric generating centre, or to load the coal on railway trucks, carry it in different directions to many factories, unload, stoke the furnaces at many places, and distribute the energy from the many steam-engines by shafting, belting, rope-gearing, compressed air, or an electric current generated at the individual factory?

At first sight one would be inclined to answer that without doubt the electric driving of individual machines over an area of, at any rate, fifty square miles from a single centre must be the cheaper. For can we not employ quite thin electric mains and still have only a small percentage loss of energy in transmission, by using a very high electric pressure and sending through the mains a comparatively small current, whereas we have no means of compressing coal, so that not merely its volume, but also its weight and its cost of transport, can be greatly diminished for a given amount of coal-energy conveyed? No doubt; but Great Britain has its Board of Trade, and that body not unnaturally looks with disfavour on the overhead wires in Western America, which are maintained at so high an electric pressure that it is only the spitting and brush-discharge that occurs which prevent a higher pressure being employed. For that is how the commercial limit of 40,000 volts has been arrived at in the United States for overhead electric transmission of energy.

Eleven thousand volts is the highest potential difference that has hitherto been allowed—even for buried conductors—by our Board of Trade, and even that pressure has been employed in connection with only two systems of transmission, viz. the one from the London Electric Supply Company's generating station at Deptford to their transforming stations at Trafalgar Square, Bond Street, &c., and the other from the Metropolitan Electric Supply Company's new generating station at Willesden to their transforming stations at Amberley Road, Manchester Square, &c.

The promoters of the four Power Bills, therefore, do not contemplate using at the outset a higher pressure than 10,000 volts, or sending more than 1000 kilowatts —that is, 1340 horse-power—through a single underground cable. The evidence as to the cost of such a cable showed that it could be made and laid for something like 1400*l.* a mile; some of the witnesses said 1000*l.*, while others thought that was a "promoter's figure," since they had not succeeded in getting similar cables constructed and laid in trenches in their own districts under 1800*l.* a mile.

It is well known that the relatively high price of electric-lighting arises from the small fraction of the twenty-four hours during which there is any great demand for electric energy, so that it is necessary to fit up in an electric-light central station engines and dynamos which can develop something like ten times as much horse-power as would be necessary to deliver the same total amount of electric energy in the twenty-four hours if the demand were a steady one. This is expressed by saying that the "load factor" is 10 per cent. In one or two English towns the load factor is actually as low as 6, and in very few cases is it higher than 12 per cent.

Now it was urged that if an electric generating station, instead of supplying current simply for electrically lighting a single town, were to supply electric energy for all sorts of purposes throughout a large district, the load factor would be very much higher, and the cost of production would be proportionately diminished. For example, with electric tramway work the load factor is about 40 per cent., that is to say, about 40 per cent. as much electric energy is used by the cars as could be produced by all the engines and dynamos in the tramway station if they were working at full load continuously day and night. With factories again, it was estimated that a load factor of some 30 per cent. might be obtained. Hence it was urged that one of these large electric power stations might rely on a load factor of about 25 per cent.

With this load factor of 25 per cent., it was estimated by Mr. Ferranti, for example, that if a generating station were erected in the coal-fields at a spot with a good supply of water for condensing the steam, and if the plant capacity were about 16,000 horse-power—of which 4000 would be kept as a reserve—the entire cost of generating a Board of Trade unit would be about 0·44*d.*, and the cost of transmitting it 0·2*d.* So that it could be sold to the consumer at 1¼*d.*, and a good business done, as contrasted with the 4*d.* or 6*d.* per unit now charged to private consumers in English towns.

As opposed to this, it was urged by central station engineers and others that this supposed great economy to be obtained by erecting electric generating stations at the pit's mouth and transmitting the energy electrically through considerable lengths of buried conductors was imaginary; that in towns like Manchester, Liverpool, Southport, Bolton, Cardiff, Newport, &c., electric energy for driving machinery was already offered to the public at as low a price as the promoters of these Bills proposed to offer it, that the fraction of the cost of delivering a Board of Trade unit which could be debited to the coal alone was small, and that the proportion arising from the mere cost of carrying the coal was still smaller.

As a matter of fact, although the average prices obtained for private electric lighting are 3·49*d.*, 4·04*d.*, 4·10*d.*, 4·68*d.*, 4·69*d.*, 5·29*d.* per Board of Trade unit by the Corporations of Manchester, Bolton, Southport, Cardiff, Liverpool and Newport respectively, any person in Manchester who desires to run an electromotor, no matter how small it may be, during the whole of the ordinary factory hours, only pays now 1¼*d.* a unit to the Corporation. In Bolton he is charged 1·35*d.* if he takes his full demand for 640 out of the possible 2184 hours in a quarter. Southport charges the Tramway Company 1¼d. per unit. Cardiff offers the unit at 2*d.* if 4000 units are taken per annum—which means a single motor of only 1 horse-power running for about eight hours a day for 300 days in the year. The Liverpool Tramway Company pays the Corporation only 0·9*d.* per unit; while in Newport, 1½*d.* is the price charged if more than 3000 units per quarter are taken.

The sweeping accusations, therefore, that some of the witnesses levelled against the local authorities of supineness, indifference to the public needs, &c., were hardly borne out; while such evidence as that of the electrical engineer of Southport, that the carriage of coal to that borough increased the cost of the unit by only one-twelfth of a penny, and of the electrical engineer of Manchester, that the charge for interest on the cost of *buried* cables added 0·49d. to the value of the Board of Trade unit if it were transmitted twenty-five miles, whereas the cost of conveying the equivalent amount of fuel by railway over the same distance only increased the value of a Board of Trade unit of energy by 0·059*d.*, that is by only about one-eighth of the former, combined with the evidence that on the Continent and in America cheap *overhead* wire transmission was allowed, and therefore was generally adopted, led the Committee to realise the following, viz.:—that while the assent to the new proposals might confer a great boon on collieries and manufactories in scattered districts, a great wrong might be inflicted if safeguards were not introduced to prevent the introduction of the new electric schemes crippling the natural development of those systems of electric distribution which at present existed in this country, and which had been brought to their present condition by the expenditure of about 40 millions sterling during the past ten years.

In addition to the opposition to all the four Bills, made by private companies who had already obtained provisional orders to supply electrical energy, and by local authorities, some of whom had, and some of whom had not, obtained statutory powers to act as electrical suppliers, two of the Bills, viz. the Durham and the Tyneside, opposed one another. For whereas in the Durham Bill the district up to and including the south side of the Tyne is scheduled, in the other Bill both sides of the Tyne, from the mouth to Ryton, are included.

The promoters of the Tyneside Bill maintained that the *two* sides of the Tyne together naturally formed a *single* supply district, and that a company which had powers to supply the manufacturers on *both* sides with electric energy could do so more economically than if it was confined to the land along the north shore only. But they added that they had no objection to competition on the part of the proposed Durham Company or of any one else.

The Durham promoters urged that they were including in their area a lean portion towards the south of the county of Durham, which they could only undertake to supply if they were given the possession of the south bank of the Tyne undisturbed by competition on the part of the proposed Tyneside Company. It was also alleged that, although these various Bills passed their second reading because the President of the Board of Trade had stated that he had "an assurance from the promoters to the effect that they will undertake to agree to an amendment in Committee which would make it perfectly clear that they do not ask for the power to distribute even in bulk without the consent of the local authority," the Tyneside scheme really aimed at obtaining *private* way-leaves, and by skipping about the district by means of *overhead* wires to supply even private customers in retail without asking for the consent of any local authority. And it was pointed out that the assent to such a proposal would be manifestly unjust in view of the fact that those who were already supplying under "provisional orders," or who might obtain such orders, were compelled under the terms of such an order to supply every one within a certain "compulsory area" within a limited time, as well as being subject to comply with other obligations.

Serious opposition to the Tyneside Bill was also raised by the Newcastle Electric Supply Company. This is the company which for some years has been supplying electric current to the east of the district of Newcastle-upon-Tyne, but which, by arrangement with various local authorities and with the Walker and Wallsend Union Gas Company—which obtained last year a Provisional Order for supplying electric energy to the districts of Wallsend and Willington Quay—has this session been promoting a Bill for distributing electric energy throughout a considerable area along the north of the Tyne to the east of Newcastle.

Between the proposed Tyneside Company and the existing Newcastle-on-Tyne Company a battle royal raged in the Committee Room, not merely because the area proposed by the one included that proposed by the other, but because a certain site on the Tyne bank was scheduled by both companies as the land on which they proposed to erect a generating station.

The advocates of the Tyneside Company, led by Lord Kelvin, asked, in fact, for authority to erect three generating stations—the one just referred to, one immediately opposite on the south bank of the Tyne, and one on the same bank, but much further west.

The advocates of the Newcastle-on-Tyne scheme, on the other hand, pleaded that the first site should be left to them, and urged, not unreasonably, that if the Tyneside Company confined its attention solely to that small bit which lay on the north bank of the Tyne to the west of Newcastle, of the whole of the area it contemplated, it would have ample scope for the spending of its entire capital, viz. a million sterling.

Indeed, one of the grounds of opposition to all the four large schemes before this Committee was that, while enormous areas were scheduled in the Bills, throughout which it was proposed to distribute electric energy, the capital asked for by any one of these companies was only a few hundred thousand pounds, or not more than a million, even when, as in the case of the Tyneside Bill, it was increased to that amount while the Bill was before the Committee. To this the advocates of these four Bills replied that the amounts put down for capital, even as increased during the progress of the Bills through Committee, were only intended to enable a start to be made, and that after a few years the companies would necessarily come to Parliament again for a large increase in capital. Further, that while it was proposed to start with erecting in each of the four districts a single 10,000 horse-power electric generating station, in a few years 50,000 or more horse-power would have to be electrically delivered in each of these districts if the Bills passed.

Excepting the Newcastle-on-Tyne Bill, which came before another Committee, the Lancashire Bill was the most moderate. On the other hand, the South Wales Bill was the most grasping, for it was the only one which professedly aimed at obtaining powers to invade a town and break up its streets without the consent and even against the wish of the local authority if the person whom the company aimed at supplying with electric energy was a "wholesale customer." And such a customer was defined in the Bill as one who was prepared to take 20,000 units a year.

Those who drafted this Bill no doubt were under the impression that there were very few people in the 1050 square miles of the counties of Glamorgan and Monmouth covered by this Bill who at present took more than 20,000 units a year. And no doubt that was the case, for only some six could be cited by those who represented the Corporations of Cardiff and Newport. But hitherto it has been almost exclusively for lighting that people in these boroughs have taken electric energy, and when from the electric supply systems of these Corporations, or from the mains of some outside company—should such a company gain access—manufacturers begin to receive current for working electro-motors, then a 20,000 unit customer would only pay 83*l*. 6*s*. 7*d*. a year for his energy, at 1*d*. a unit, and therefore in no sense could he come under the category of "wholesale."

In fact, when the promoters of the South Wales Bill realised that even a 3 horse-power motor running continuously day and night—in connection, for example, with a blast furnace—would consume 20,000 units a year, and that a 9 horse-power motor working ten hours a day for 300 days in the year would require the same amount of electric energy, they saw that their "wholesale customer" would have to be thrown overboard.

In despair, however, the promoters still clung to the reed that a local authority could not if it would, and should not if it could, erect plant for supplying factories with electric energy on the large scale contemplated by these Electric Power Distribution Companies, and they urged that the ratepayers' money ought not to be used for speculative purposes, forgetful apparently that, even when a local authority has bought up an electric supply undertaking at twice the sum that it cost the private company to erect it, the rates have been ultimately relieved in consequence of the purchase, and the ratepayers therefore benefited by the local authority becoming a purveyor of electric energy.

Ultimately, on Wednesday, June 27, the chairman, Sir James Kitson, who it is important to remember is not merely an M.P., but what is far more important the head of a great manufacturing firm, a director of a great railway, and the ex-Mayor of a great city, made the following most excellent declaration :—

"A local authority which undertakes and is prepared to give a full and ample supply of electrical energy for all purposes to consumers within its district ought not, without its consent, to be required to give facilities for the supply, within its district, of electrical energy by other undertakers. But if a local authority is unable or unwilling to provide on reasonable terms and within a reasonable time a full and adequate supply of electrical energy for any purpose to any company or person applying for the same within its district, such company or person should be at liberty, after notice to the local authority, to obtain their supply from other authorised undertakers, and the local authority should be required to give all necessary facilities for this purpose. Any difficulty arising out of the above questions should be subject to arbitration as provided by the general Acts."

Doubtless this decision did not please all; but how acceptable was it to those who, like myself, have been hungering for the realisation of our dream of twenty-one years ago—"power brought to the workman, not the workman to the power"—but who have seen with apprehension the growth of obstacles nourished by England's spirit of masterly inactivity and by its not unnatural, nor wholly unwise, veneration of vested interests.

For now local authorities are put on their metal. If you realise, says Sir James Kitson's Committee, what are your duties in providing all your people with "an ample supply of electrical energy for all purposes," we will be no parties to any hindrance through competition being put in your way. But if your district be one in which bumbledon reigns supreme, then our declaration is that no municipal barrier shall be left standing to oppose the free entrance of those who come with offers of cheap electric energy.

Next, on Thursday, June 28, the formal statement was made by the Chairman:—"that the preamble of the South Wales Electrical Supply Bill is proved, also that the preamble of the Durham (County of) Electric Power Supply Bill is proved; and the preamble of the Tyneside Electric Power Bill is not proved to the satisfaction of the Committee, and that the preamble of the Lancashire Electric Power Bill is proved to the satisfaction of the Committee." Then followed the lengthy process of drafting the clauses, and finally, on July 16, these three Bills, of which the preambles had been reported by the Committee as proved, were read a third time in the House.

On the following day, the North Metropolitan Electric

Power Supply Bill, which asks for authority to supply electric energy over a smaller region, consisting of the districts of Hornsey, Hendon, Barnet, St. Albans, Hatfield, Hertford, Ware, &c., was, after being considered by another Committee of the House of Commons, read for a third time, and finally, on Tuesday, July 24, the Newcastle-on-Tyne Electric Supply Companies scheme already referred to in this article received the sanction of a Committee of the House of Lords.

The era of Electrical Power Distribution on a vast scale in our country has, therefore, begun.

W. E. AYRTON.

THE DAILY WEATHER REPORT OF THE METEOROLOGICAL OFFICE.

THE Meteorological Council has made provisional arrangements for the sale of single copies of the Daily Weather Report at a penny each from the first of August next. The copies will be on sale from about 3 o'clock of the afternoon of the day of issue at the Meteorological Office and at the railway bookstalls of the following terminal railway stations in London: Victoria (S. E. & C. and L. B. & S. C.), Charing Cross, St. Pancras, King's Cross and Euston. Hitherto the issue of the reports has been confined to certain public offices and institutions, and to annual or quarterly subscribers. The distribution has been by hand or by book-post. The area within which delivery can be effected on the day of issue is necessarily very limited, and it is hoped that the facilities afforded by the new arrangement may bring the information which the reports contain within the reach of some of those interested in the subject who live outside the present limits of delivery on the day of issue. If the provisional arrangement should make it apparent that there is any public demand for the accommodation, efforts will be made to continue and extend it.

From the same date some modifications will be introduced into the form of the Report. The morning and evening observations of the telegraphic reporting stations will appear on the first page as usual, but the two charts on the second page, representing the morning distribution of pressure, wind and sea, and of temperature and weather respectively, will be supplemented by three smaller charts. One will represent the barometric distribution over the whole of Europe at 8 a.m. of the preceding day in order that the general atmospheric changes may be more readily traced. Another will represent mean monthly or bi-monthly morning isotherms for the British Isles, so that the distribution of temperature for the day may be easily compared with the normal distribution for the season as estimated for a period of twenty-five years. The third will represent the distribution of mean maximum temperature estimated in a similar manner.

There will also be several changes on the fourth page of the Report. Instead of "General Remarks on the Weather over Europe" there will be a table giving the latest information in the possession of the Office as to maximum and minimum temperature, rainfall, and weather at selected stations on the Continent and elsewhere which are beyond the area represented by the telegraphic reports The selection of the stations will be mainly determined by the current interests of travellers, and will be varied from time to time according to the information available.

The information as to the weather in the British Islands will also be supplemented by data as to sunshine for the preceding day from a number of stations which will report by post, and it is intended, in course of time, to replace "yesterday's 2 p.m. reports" by postal reports of maximum and minimum temperature and rainfall for a number of inland stations which are expected to prove a useful addition to the telegraphic reports of the first page.

For convenience of reference a small supplemental table will give the Greenwich time of sunrise, noon, and sunset for four selected stations in the British Isles, so that the variation in the duration of daylight and the standard times of local noon for any locality may be ascertained.

W. N. SHAW.

THE BRADFORD MEETING OF THE BRITISH ASSOCIATION.

THE local arrangements for the Bradford meeting of the British Association in September next are now rapidly approaching completion. The railway companies have agreed to give the usual special facilities, both to visitors who come to Bradford from long distances, and to members resident in Yorkshire who travel to and fro every day. Those persons who attend the meeting can obtain a return ticket from nearly all the railway companies at a fare and a quarter, provided they present to the booking-clerk a certificate, which can be obtained on application to the local office at 5, Forster Square. Any Members or Associates visiting Bradford day by day, and staying in places within fifty miles of the city, can obtain return tickets at the single fare on presenting their card of membership to the booking-clerk in Bradford. The following railway companies have entered into this arrangement:—the Caledonian, the Great Eastern, the Great Central, the Great Northern, the Great Western, Lancs. and Yorks, London, Brighton and South Coast, London and North Western, London and South Western, Midland, North British, North Eastern, South Eastern, Chatham and Dover, and the other companies belonging to the Associated Railways.

The local programme is now in the press, and will be issued within the next fortnight to the Members and Associates who have notified their intention of being present. The following items, however, will give a brief summary of the information contained in it:—

GENERAL PROGRAMME.

Wednesday, September 5.—4 p.m.: Meeting of General Committee at the Town Hall; 8.30 p.m.: the President's Address in St. George's Hall.

Thursday, September 6.—3.30 p.m.: Reception at the Technical College (Textile Exhibition); 8.30 p.m.: the Mayor's Conversazione in St. George's Hall.

Friday, September 7.—8.30 p.m.: Lecture in St. George's Hall by Prof. Gotch, F.R.S., on "Animal Electricity"; 9.30 p.m.: Smoking Concert in the Technical College in honour of the President.

Saturday, September 8.—Excursions (half-day); 8 p.m.: Artisans' Lecture in St. George's Hall, by Prof. Silvanus Thompson, F.R.S.

Sunday, September 9.—10.30 a.m.: Sermon by the Bishop of Ripon in the Parish Church.

Monday, September 10.—3.30 p.m.: Corporation Garden Party in Lister Park; 8.30 p.m.: Lecture in St. George's Hall by Prof. W. Stroud, D.Sc., on "Range Finders."

Tuesday, September 11.—8.30 p.m.: Corporation Soirée in St. George's Hall.

Wednesday, September 12.—3.30 p.m.: Private Garden Parties; 8 p.m.: Full-Dress Concert in St. George's Hall (Festival Choral Society; Permanent Orchestra; conductor, Mr. F. H. Cowen; Miss Ella Russell).

Thursday, September 13.—Excursions (whole day).

The conferences of delegates of corresponding societies will be held on Thursday, September 6, and Tuesday, September 11, at 3 p.m., at the Reception Rooms.

The Reception Room at the Grammar School will be opened on Monday, September 3, at 2 p.m. to 6 p.m., and on the following week-days at 8 a.m. to 6 p.m. On Sunday, September 9, the Reception Rooms will be open from 9 to 10.30 a.m., and from 3 to 5 p.m.

The temporary Museum in connection with the Sections is this year being made a special feature, more particularly in regard to Geology, Botany and Zoology. Joint meetings are being held, on certain days, of the Geological and Botanical Sections, to take up the subject of Carboniferous fossils, and it is proposed to form a collection of fossils found in the neighbourhood to illustrate the papers as much as possible; and also to display photographs bearing on the subject, taken from the Geological Society's collection in London. These exhibits will form the nucleus of the Museum, but there will also be other collections bearing on the main subjects dealt with by some of the other Sections. At the Municipal Technical College there will be an Exhibition during the week illustrative of the staple trades of the district; visitors will pass from room to room, and will see the gradual development, through innumerable processes, of the most elaborate fabrics from the unwashed fleeces. On Thursday afternoon, September 6, the Exhibition will be opened by Mr. W. E. B. Priestley, the chairman of the College, and a Reception held, to which all visitors to the meeting will be invited.

The preparations for the Excursions and Garden-parties are nearly complete, and full details will be given in the next article. RAMSDEN BACCHUS.

NOTES.

PROF. R. LIPSCHITZ, professor of mathematics in the University of Bonn, has been elected a correspondant in the section of geometry of the Paris Academy of Sciences.

LORD KELVIN has been elected Master of the Worshipful Company of Clothworkers for the year 1900–1901.

SIR JOHN EVANS, K.C.B., F.R.S., has been elected chairman of the Society of Arts for the ensuing year.

MR. GRANT-OGILVIE, principal of the Heriot-Watt College, has been appointed director of the Museum of Science and Art, Edinburgh.

THE sixty-eighth annual meeting of the British Medical Association will be held at Ipswich during next week, commencing on Tuesday.

DR. M. ARMAND RUFFER, president of the sanitary, maritime, and quarantine board of Egypt, has recieved from His Majesty the Sultan of Turkey the Order and Insignia of the Medjidjieh of the Second Class.

A CONFERENCE on the housing of the working classes, under the auspices of the Sanitary Institute, will be held on July 30 and 31, in the lecture-room of the Royal Medical and Chirurgical Society. In connection with the conference an exhibition of models and plans will be held in the Parkes Museum.

IT is stated in the *Engineer* that of the fifty-five ships taking part in the naval manœuvres this year, the *Adrienne*, *Camperdown*, *Jaseur*, besides some others, are specially fitted for wireless telegraphy. The *Majestic* and the *Diadem* have also been fitted. Torpedo officers have charge of the installation in each case.

THE thirty-seventh annual meeting of the British Pharmaceutical Conference was opened in London on Monday, under the presidency of Mr. E. M. Holmes. An attractive programme containing illustrations of the house of the Pharmaceutical Society where the meetings will be held, the president, and places to be visited, appears as a supplement to the current number of the *Pharmaceutical Journal*.

WE learn from the *British Medical Journal* that the Madras Government has passed an order sanctioning the excess expenditure over the original grant of 600 rupees incurred by Capt. R. H. Elliott in connection with the prosecution of his researches into the properties of snake venom, and has made him an additional grant of 200 rupees to cover the cost of further experiments. The Surgeon-General has been requested to report if Capt. Elliott's services will be available for special duty at the end of September when his tour of service terminates.

PROF. HENRY F. OSBORN has been appointed to succeed the late Prof. O. C. Marsh as palæontologist in the United States Geological Survey. Prof. Osborn's special field of work will be to take charge of the vertebrate palæontology of the survey, especially with reference to the completion of the monographs for which the illustrations were prepared under the direction of Prof. Marsh. Prof. Osborn graduated from Princeton in 1877, and was professor of comparative anatomy there until 1890. He was appointed Da Costa Professor of Zoology at Columbia University in 1891, and curator of vertebrate palæontology at the American Museum of Natural History, New York. He is a member of the National Academy of Sciences and other scientific bodies, and is the author of numerous papers and memoirs on fossil mammals and reptiles.

THE seventy-second annual meeting of the German Association of Naturalists and Physicians will be opened at Aachen on Monday, September 17. At the first general meeting, the advances of natural knowledge and medicine during the present century will be surveyed. Prof. van 't Hoff will review the progress of inorganic science; Prof. O. Hertwig will discourse on the development of biology; Prof. B. Naunyn will deal with internal medicine, including bacteriology of hygiene; and Prof. H. Chiari will speak on pathological anatomy in relation to external medicines. At the second general meeting, to be held on September 31, several scientific subjects of current interest will be dealt with. Prof. J. Wolff will speak on the correlation between form and function of individual structures of organisms; Prof. E. v. Drygalski will describe the plan and purpose of the German Antarctic expedition; Prof. D. Hansemann will discourse upon cell-problems and their significance in the scientific foundation of the treatment of disease; and Prof. Holzaphel will take as his subject the development of German coal-measures. On September 19, the naturalists and physicians will meet in separate groups. The questions to be brought before the former group include the circulation of nitrogen in the organic world, by Prof. M. W. Beyerink; the latest investigations upon steel, by Prof. E. F. Dürre; and language and technical teaching from a scientific standpoint, by Prof. Pietzker. The chief subject to be discussed in the medical section is the neuron theory in its anatomical, physiological and pathological aspects, by Profs. Verworn and Nissl. The remainder of the meetings will be held in the various sections of the Association, and as more than three hundred communications will be made, there will be no lack of subjects for discussion. In connection with the meeting, an exhibition of physical, chemical, and medical preparations and apparatus will be held.

IN the course of his presidential address, delivered to the Society of Chemical Industry on July 18, Prof. Chandler referred to some of the work of American chemists, and the development of chemical processes of manufacture. Many important investigations in agricultural chemistry have been conducted by the chemical division of the United States Department of Agriculture, among them being the practical determination of the number and activity of the nitrifying organisms in soil, the influence of a soil rich in nitrogen on the nitrogen content of a crop, the manufacture of sugar from the sorghum plant, and the comparative study of typical soils of the United

States. Of agricultural experiment stations there are now 59, and the 148 chemists connected with them have done a large amount of original investigation in subjects more or less closely allied to agricultural and physiological chemistry. Prof. Chandler gave a comprehensive account of the chemical industries. In particular he referred to the progress made in electro-chemistry, and described the methods now adopted for the reduction of aluminium at Niagara, and also for the manufacture of carborundum and artificial graphite. Speaking of water-gas, he described the opposition against its introduction for illuminating purposes. The question came before the Health Department of New York, and, after careful investigation, the department decided that the gas was such an improvement in quality and price, while the increased danger as compared with that from old-fashioned coal-gas was so slight, that it was not wise to interfere with it. The water-gas industry has now taken almost complete possession of the whole country. There are at least 500 gas companies using water-gas wholly or in part, and it is estimated that in 1899 three-quarters of the entire consumption, or 52,500 million cubic feet, consisted of carburetted water-gas. At the close of the address the Society's medal, which is awarded not oftener than every two years, was presented to Dr. Edward Schunck, F.R.S., in recognition of his classical investigations on natural colouring matters and other researches in connection with technical chemistry.

WE learn from the *Times* that the Select Committee to which the Sea Fisheries Bill was referred, presented a special report to the House of Commons on Thursday last expressing the view that it would not be expedient to pass the measure into law without further inquiry and investigation. The committee regards it as proved beyond the possibility of dispute that there is a very great and serious diminution of the fish supply, that the ancient fishing grounds are much depleted, and that in default of a remedy the consequences to the fishing industry and the fish supply will at no very distant future be disastrous. The prohibition of the taking and killing of such fish is described as practically impossible without prohibiting trawling altogether. As regards the prohibition of fishing within certain areas where small fish more particularly abound, the Committee thinks that it is established that there are certain well-known areas in the North Sea where undersized small and young fish congregate, and that to prevent fishing in such areas would be of great value. It is pointed out, however, that such a result could not be obtained without joint international action among the Powers bordering the North Sea, and that the difficulties of such international action and the policing necessarily ancillary thereto are obvious. In conclusion, the Committee considers that no effort ought to be spared—first, to arrange for international treatment of the subject generally, and especially for regulation of the North Sea area; and, secondly, to provide for the adequate equipment of the Government department in charge of the subject, so that it may effectively pursue scientific investigation, and ascertain with sufficiency and precision what has been done in the way of scientific research or in the matter of practical legislation by other inquirers and by other countries.

MR. E. H. L. SCHWARZ sends us from Cape Town some interesting remarks upon the snake-stone, *apropos* of the facts stated by Mr. Hervey in NATURE of May 24 (p. 79) as to the use of a stone by the Malays as a remedy for poisonous bites. Snake-stones are fairly common in South Africa, and are described as white, porous stones, which, when applied to the place where the snake has bitten a person, adhere till all the poison is drawn out into them, after which they are placed in milk, which in turn draws the poison from the stones, and renders them again fit for use. The farmers firmly believe they are taken from the head of a snake. It is suggested that snake-stones are made of pumice. To the uneducated, the structure of pumice has a close resemblance to that of bone, and this may possibly explain the popular delusion that snake-stones are made of bone. Mr. Schwarz thinks that the black colour of the stone, described by Mr. Hervey, may have been due to blood, or the stone may have been a black variety of pumice, for there is an instance of originally black pumice having been thrown up near the lighthouse on Cape Agulhas. The fact that the fable of the stone having been taken from the head of a snake is exactly the same in the Malay States as is prevalent in South Africa is interesting, though the Malay slaves which the early Dutch obtained from Batavia in exchange for quaggas, zebras, ivory, &c., may have carried the legend with them. It is not an uncommon custom in Germany for people to carry about with them nuggets of raw gold to draw out of their bodies all the more subtle evils, such as those produced by spirits and devils, while for the grosser evils they carry a potato. Is the snake-stone legend a derivative of these, or are they subsequent to the snake-stone?

MAGNETIC observations were made at several stations upon the day of the recent total solar eclipse (May 28), under the direction of Dr. L. A. Bauer. A brief statement of the results is given in *Terrestrial Magnetism*. Ten observers were engaged in the work, and eight complete series of observations were obtained—seven for declination and one for horizontal intensity. All the stations show a magnetic effect, which cannot be referred to any other cause than that of the eclipse, the principal effect occurring, like the fall in temperature, some minutes after time of totality. The effect is as though part of the night hours were interposed among the day hours, *e.g.* the declination at all of the stations having passed the morning elongation and approaching the mean value of day, is *increased* about 20″–40″ if the declination be east, and *decreased* if the declination be west; whereas, the horizontal intensity approaching at the time its minimum value for the day, is *increased* for a brief period after time of totality. The observations and results will be published in full in a *Bulletin* of the U.S. Coast and Geodetic Survey.

THE hot and dry spell which set in over a fortnight ago promises still to continue, and although the mid-day temperatures are not generally as high as they were on several days last week, they are far in excess of the average. There have been three days at Greenwich with the shade temperature above 90°, the highest reading as yet being 94° on July 16. The nights are also excessively warm, and on the night of July 22–23 the lowest reading at Greenwich was 67°·6, which is warmer than any night in July or August at Greenwich since August 8, 1846, when the thermometer did not fall below 68°. During the last week there have been five successive nights without the thermometer falling as low as 60°. There has been no rain in London for three weeks, and the same dry weather has been experienced generally in the south-east of England. The conditions have been less settled over the northern and western portions of our islands, where rain has fallen at frequent intervals and no very extreme temperatures have occurred.

FROM Dr. Oliver Lodge, F.R.S., we have received the reprint of a very suggestive lecture on "Modern Views of Matter," delivered before the Literary and Philosophical Society of Liverpool in March last. In it Dr. Lodge discusses the atomic theory, the ether, the conception of "electrons," and the still more recent hypothesis of the existence of "corpuscles."

ARRANGEMENTS have been made for six popular science lectures for young people, under the general title of "The World we Live On," to be delivered in Kensington Town

Hall during October and November next, and we have no doubt they will be as "instructive and entertaining" as the programme promises, for the lecturers are all experienced exponents of science. The quotation "Pupils trained on books, and books alone, are mere passive recipients of other people's ideas," which we notice on the programme, is not a very happy one; for popular audiences are, after all, only "passive recipients" of the ideas of the lecturer. Popular lectures upon scientific subjects direct attention to natural phenomena, and occasionally induce people to devote serious attention to some branch of science. On this account they are valuable, but there is of course a great difference between listening to an eloquent lecturer, or witnessing striking demonstrations, and actually carrying out the most elementary experiments.

WRITING to Sir Henry Burdett with reference to Mr. Craggs's endowment of a travelling scholarship in connection with the London School of Tropical Medicine, Mr. Chamberlain recently remarked:—"My experience at the Colonial Office daily impresses upon me the extreme importance of doing something to make life in our tropical colonies more healthy for those who are engaged there in the work of civilisation, whether as administrators, missionaries or traders. Science has already given us promise of good results in the near future, and nothing, I believe, can conduce more powerfully to a speedy and satisfactory result than such researches as those which Mr. Craggs has in contemplation. I hope that his munificent action may be followed by other benefactors, so that the work may be simultaneously pursued in different countries." The scholarship is one of 300*l.* per annum, tenable for three years, and is for research in tropical disease. The first scholar is now attached to an expedition which is engaged in attempting to give practical application to the theory of the inoculation of the human being with the malaria parasite through the medium of the mosquito. The expedition has been equipped by the Colonial Office and is now stationed in one of the most malarious districts of the Roman Campagna. When this experiment is completed, at the expiration of six months, the scholar will proceed to the West Indies, thence to the West Coast and probably to the interior of Africa.

THE fourteenth volume (for the year 1898) of the *Analele* of the Meteorological Institute of Roumania has just been published. Besides the usual tables, it contains several important memoirs. M. St. Murat compares the magnetic instruments of the Institute with those of the Observatory of Parc St. Maur, and describes the observations made during 1898. The director, Dr. Hepites, studies the climatology of Braila and of the Roumanian littoral of the Black Sea, the distribution of rainfall in Roumania during 1898 (this paper being illustrated by a series of monthly maps), and the earthquakes during the same year. Brief accounts are given of eleven shocks, all of them of very slight intensity.

IT appears from Part ii. of the Eighteenth Annual Report of the Fishery Board for Scotland that the salmon fishery for 1899 turned out considerably below the average of recent years. It is true that the weight of salmon forwarded by rail and steamship during the year was slightly in excess of that carried in 1898, but it was still 638 tons below the average; and such slight improvement as took place is attributed to the large run of grilse which occurred during the summer. Adult fish seem to have been comparatively scarce. As the inspector remarks, it is absolutely essential to the continuance of the Scottish salmon fisheries that a stock of breeding fish sufficient to counterbalance the loss caused by fishing, by the salmon's natural enemies and by disease, must be maintained by some means or other. It is satisfactory to learn that some proprietors have established hatching-stations in order to artificially increase this supply. The inspector is, however, of opinion "that if the present catching power continues to be developed, a very great increase in the number and in the capacity of hatcheries will be necessary to produce noticeable results." In artificially augmenting the stock of salmon we must necessarily be prepared to compete with a vast mortality.

AMONG several papers interesting to entomologists in the June number of the *Agricultural Gazette of New South Wales*, reference may be made to one by Mr. W. W. Froggatt, the Government entomologist, on insects living in figs. The interiors of young wild figs in all countries swarm with minute plant-feeding Hymenoptera of the family Chalcidæ. The males and females of these minute insects differ from one another in colour, size and shape; but the peculiar feature of the group is that, instead of the females being degraded into a wingless condition, it is the males that are devoid of wings, while they are also frequently blind, with abnormally short legs and aborted antennæ. A new Australian species is described and figured.

IN the *Victorian Naturalist* for June, Mr. Robert Hall gives an interesting account of the nesting habits of one of the Australian diamond-birds (*Pardalotus assimilis*). In common with some of their kindred, these birds make their nests at the end of a tunnel drilled by themselves in a bank. "The nest is made to fit in a cavity with a domed ceiling, excavated in the hard subsoil at the end of the tunnel. This tunnel is ten inches long, and is drilled with a slight upward tendency, as is usual in most ground-boring birds. The nest entrance is two feet below the surface of the ground, and in a creek-bank some nine feet above a stream." Both sexes take part in the drilling operations, one excavating while the other removes the rubbish, but it seems that the task of incubation falls to the share of the male.

IN the June issue of the *Johns Hopkins University Circulars* will be found an important communication by Mr. L. E. Griffin on the arterial circulation in the nautilus.

WE learn from the *Bulletin* of the New York Botanic Garden that the herbarium has acquired during the year specimens to the number of 70,000, and that over 4000 species and varieties of plants, belonging to 172 families and 1057 genera, are under cultivation in the Garden.

WE have received Supplement ix. to the *Journal of Reading College*, consisting of the sixth annual report on field experiments (for 1899), viz.:—field experiments in Dorset, Berkshire, Oxfordshire and Hampshire; spraying experiments on charlock; trials with sugar-beet; the manuring of crops; and notes on manures.

CONTRIBUTIONS from the Gray Herbarium of Harvard University, New Series No. 19, consists of a synopsis of the Mexican and Central American species of *Salvia*; a revision of the Mexican and Central American *Solanums* of the sub-section *Torvaria*; and some undescribed Mexican plants (chiefly Labiatæ and Solanaceæ), all by Mr. M. L. Fernald.

HERR PAUL SINTENIS announces that he is undertaking a botanical exploration of the mountain region on the confines of Turkestan and Persia, of the flora of which district very little is at present known. The expedition will probably extend through the present year. Application for sets of the plants collected should be made to Herr Baurath J. Freyn, Smichow-Prague.

THE Agricultural and Mechanical College of Texas, judging from the annual "Catalogue" for the session 1899–1900, is a well-appointed and flourishing institution. Full information as to the various departments of the college, courses of study, &c., is to be found in the "Catalogue," which also contains many full-page illustrations of the college buildings, interiors of the laboratories, &c.

THE *Journal* of the Straits branch of the Royal Asiatic Society for January, 1900, contains, *inter alia*, an important contribution by Mr. H. N. Ridley on the flora of Singapore. The district is a rich one, something like 1900 flowering plants, and 130 ferns being recorded. Mr. Ridley opens with an interesting introduction, in which he gives a sketch of the factors which determine or modify the vegetation. He also describes some interesting phenological facts, and finally gives a sketch of the history of the botanical work in the Island. The chief space is, of course, devoted to an enumeration of the plants, but it contains short notes respecting the more striking individual species.

THE revised edition of "First Records of British Flowering Plants," by Mr. W. A. Clarke, just published by Messrs. West, Newman and Co., is full of extracts of interest to every one who finds pleasure in the study of the British flora. To members of Field Clubs and Natural History Societies the book is particularly valuable. It gives, in the form of extracts from printed botanical works published in Great Britain, the earliest notice of each distinct species of our native and naturalised plants, the last edition of the "London Catalogue" being taken as a basis. The volume thus provides a concise answer to the question which a naturalist often asks, viz.: "How long has this plant been known as British?" An interesting analysis of the "first records" is given at the end of the book. William Turner was the first to record the majority of our native plants. His works, ranging from 1538 to 1568, contain notices of 238 flowering plants, and may be considered the foundation of our British flora. From Lobel (1570, &c.), Mr. Clarke obtains eighty first records and from Gerard's famous Herball (1597), 182 species, so that about 500 species of British plants were known and described three hundred years ago. The book in which these and many other particulars are given is one which every naturalist should keep handy for reference.

THE *Proceedings* of the London Mathematical Society (vol. xxxi.), containing papers read from April to December of last year, have just been published by Mr. Francis Hodgson. The titles and brief abstracts of the papers have already appeared among our reports of societies.

THE Great Eastern Railway Company's "Tourist Guide to the Continent," edited by Mr. Percy Lindley, contains concise notes and numerous illustrations of interesting and easily accessible places in Holland, Belgium, Germany, Switzerland, Norway, Denmark and Sweden. The book is a useful travelling companion for Continental tourists, and is as matter-of-fact as most guide-books.

THE volume of *Proceedings* of the forty-eighth meeting of the American Association for the Advancement of Science, held at Columbus a year ago, has just been received. The presidential addresses, papers and abstracts cover a wide field of scientific work. A noteworthy feature is the series of portraits of former presidents of the Association, accompanying an address by Dr. Marcus Benjamin.

THE value of a well chosen set of inorganic chemical preparations as a part of a course of general chemistry is now generally acknowledged, although the number of elementary text-books dealing with this branch of the subject is comparatively small. The works of Prof. Erdmann, of Halle, in this field are well known, and the English translation of his "Introduction to Chemical Preparations" (Chapman and Hall) by Dr. F. L. Dunlap, the German edition of which has already been noticed in these columns, will be of great service to students in England and America.

THE seventh part of vol. ii. of the seventh edition of Fresenius's "Quantitative Chemical Analysis," translated from the revised sixth edition by Mr. C. E. Groves, F.R.S., has just been published by Messrs. J. and A. Churchill. This completes the new edition of the work, which has been revised throughout. The special part, dealing largely with applications of chemical analysis to industrial products and other technical matters, has been considerably extended, and many new analytical processes have been introduced. The last section of the work includes sixty exercises especially designed for teaching the theory and practice of quantitative chemical analysis. In addition, there is an appendix containing analytical notes and tables for the calculation of analyses. Practical chemists and teachers are thus now provided with a complete new edition of a standard work on analysis.

THE reaction discovered by Lubawin of the formation of α-amino-acids by the interaction of ammonium cyanide and aldehydes, has been extended by Dr. W. Gulewitsch to ketones, and in the current number of the *Berichte* he describes the details of the preparation of α-amino-isobutyric acid from acetone, the yield under favourable conditions being as high as 74 per cent. of the theoretical. The same number of the *Berichte* also contains a masterly investigation of the action of soda solution upon nitrosobenzene by Prof. Bamberger. No less than twelve substances have been isolated from the products of this extremely complex reaction, including azoxybenzene, nitrobenzene, aniline, *p*-nitrosophenol, *o*-amidophenol, *p*-amidophenol, hydrocyanic acid, ammonia, and four new acids, and there are still further products awaiting investigation.

THE additions to the Zoological Society's Gardens during the past week include a Bonnet Monkey (*Macacus sinicus*) from India, presented by Mr. P. M. Thornton; a Rhesus Monkey (*Macacus rhesus*) from India, presented by Miss A. N. Ball; a Humboldt's Lagothrix (*Lagothrix humboldti*) from the Upper Amazons, presented by Mr. W. S. Churchill; two Masked Paradoxures (*Paradoxurus larvatus*) from China, presented by Mr. W. T. Lay; a Senegal Parrot (*Poeocephalus senegalus*) from West Africa, presented by Mr. S. Cordwell; two Chukar Partridges (*Caccabis chukar*) from North-west India, presented by Mr. Chas. E. Pitman; a Missel Thrush (*Turdus viscivorus*), European, presented by Mr. J. B. Williamson; a Common Cuckoo (*Cuculus canorus*), British, presented by Miss Lucy Holland; two Larger Hill Mynahs (*Gracula intermedia*) from Northern India, a Mauve-necked Cassowary (*Casuarius violicollis*) from the Aru Islands, a Clumsy Tortoise (*Testudo inepta*) from Mauritius, four Elephantine Tortoises (*Testudo elephantina*) from the Aldabra Islands, an Alligator Terrapin (*Chelydra serpentina*), six Blanding's Terrapins (*Emys blandingi*) from North America, deposited; a Guira Cuckoo (*Guira piririgua*) from Para, six Painted Frogs (*Discoglossus pictus*), South European, purchased.

OUR ASTRONOMICAL COLUMN

ASTRONOMICAL OCCURRENCES IN AUGUST.

August 4. 11h. 55m. Minimum of Algol (β Persei).
7. 8h. 43m. ,, ,, ,,
7. 5h. Conjunction of Mars and Neptune. (Mars 1° 27′ N.)
9. 11h. 34m. to 12h. 40m. Moon occults the star D.M. − 16°, 5609 (mag. 6).
11. Maximum of August meteoric shower. Perseids. (Radiant 45° + 57°).

Aug. 12. 16h. 10m. to 17h. 10m. Moon occults κ Piscium (mag. 5).
13. 20h. Venus at greatest brilliancy.
15. Venus. Illuminated portion of disc = 0·280.
15. Mars. „ „ „ = 0·932.
18. Saturn. Outer minor axis of outer ring = 18″·35.
18. 12h. 42m. to 13h. 24m. Moon occults ι Tauri (mag. 4·7).
18. 14h. 47m. to 15h. 39m. Moon occults 105 Tauri (mag. 5·8).
19. Mercury at greatest elongation (18° 32′ W.).
20. 22h. Venus in conjunction with moon. (Venus 1° 49′ S.).
22. Jupiter 26′ S. of β Scorpii.
23. Expected return to perihelion of De Vico-Swift's comet (1844–1894).
27. 10h. 26m. Minimum of Algol (β Persei).

NEW VARIABLE IN HERCULIS.—Prof. W. Ceraski, of the Moscow Observatory, communicates to the *Astronomische Nachrichten* (Bd. 153, No. 3650) the discovery of a new variable by Mdme. Ceraski on photographs taken by M. S. Blajko. The star's position is as follows:—

R.A. h. m. s.		Decl. ° ′ ″		Epoch.
18 30 54·8	...	+ 25 55 49	...	(1855·0)
18 32 44·1	...	+ 25 57 54	...	(1900·0)

The star is not found in the B.D. At maximum the star is slightly brighter than 9th magnitude, decreasing to a minimum of about 12th magnitude. At present its brightness is increasing.

NEW STAR IN AQUILA.—A telegram from Prof. Pickering, Cambridge, Mass., dated 1900 July 9, states that the *Nova* of the 8th magnitude found by Mrs. Fleming in April 1899 is now a nebula of 12 magnitude. Its position is

R.A. h. m. s.		Decl. ° ′
19 15 16	...	−0 19

A further statement is made in the *Astronomische Nachrichten* (Bd. 153, No. 3651) that the measures are from the photographs.

METEORITIC THEORY OF THE GEGENSCHEIN.—In the *Astronomical Journal*, No 483 (vol. xxi. pp. 17–21), Mr. F. R. Moulton puts forward a mathematical analysis of the conditions which would appertain if the *Gegenschein* were due to the presence of a more or less condensed region of meteorites. The idea of the problem appears to have been suggested by remarks of Prof. Barnard (who has made consistent observations of the phenomenon during the last sixteen years) to the author.

Discovered by Brorsen about the middle of this century, very few systematic observations are recorded until those of Barnard, who has made careful determinations both of its position and shape. He comes to the conclusion that it is always exactly opposite the sun, or as nearly so as can be determined. Other observers have stated varying positions, but in the case of so difficult an object it is advisable to consider the more systematic records as having greatest truth.

After citing the well-known reasons for considering that interplanetary space is densely occupied by meteoric particles, moving with widely varying velocities in all directions, he supposes that a great multitude will at any time be situated at the opposition point, and that a considerable proportion of these would be under such initial conditions as to remain there for some time. Then the meteors being very small compared with the earth, they are treated as infinitesimal bodies, disturbing neither the earth nor each other. He also neglects the eccentricity of the earth's orbit. Then referring the motion of one meteor to rectangular axes with the origin at the centre of gravity of the sun and the earth, he traces the conditions for stability for a certain time. Then by slightly varying the conditions, he finds the nature of the movement of the infinitesimal body with special reference to the circumstances under which it will make periodic oscillations around certain points. The result of successive integration suggests that meteors passing near one of these selected points with the assumed conditions of motion would be subject to forces directed nearly to this point, and would have a tendency to revolve round it. Although after a few revolutions they might escape, the average result would be a condensation with respect to space, if not with respect to time. The difficult point now to determine is whether a sufficient number would be captured to become visible. If the meteors are revolving round the sun at a distance of about 900,000 miles greater than the earth's mean distance, they will be moving slower than the earth, which will gradually overtake them in longitude. As they approach opposition they will be retarded and drawn in towards the sun, their motion being thereby accelerated. The net result of these actions will be to bring the meteors into the plane of the ecliptic, thus causing the condensation at opposition, and explaining the tendency to an oscillation in latitude which has been observed.

Instead of being exactly opposite the earth, the point of condensation will be nearly opposite the centre of gravity of the earth and moon, and consequently the *Gegenschein* should have a monthly oscillation in longitude of the nature indicated by the observations of Douglass, but much less in extent. The oscillation in latitude would, however, be monthly also, instead of yearly, as the observations tend to indicate.

A phenomenon, observed so far by Barnard alone, is the series of marked changes to which the *Gegenschein* is subjected in short periods of time, being large and round in September and the beginning of October, becoming slightly elongated by the 4th or 5th, very much elongated by the 10th or 11th, and showing merely as a swelling on the zodiacal band by the 18th. Although this is not directly explicable, the shape of the *Gegenschein* will depend on the thickness of the zodiacal disc of meteorites, and if the opposition point should pass through a dense portion of the swarm it is readily conceivable that a change of form would ensue. The distance of the opposition point works out at 930,240 miles from the earth. The period of oscillation would be 183·304 days. It is thus suggested as possible that meteors may move for long periods of time in the vicinity of the opposition point, in sufficient numbers to cause the faint glow of the *Gegenschein* by reflecting the light of the sun. Reference is finally made to a paper by M. Hugo Glydén in the *Bulletin Astronomique*, Tome 1, where similar views are enunciated.

METEOR OF JULY 17.—A bright meteor was seen in many parts of the north of England on the evening of Tuesday, July 17, shortly before nine o'clock. A few particulars concerning the phenomena are given by correspondents in the *Yorkshire Post*. An observer at Menston-in-Wharfedale saw the meteor at a point about N.N.W. from that place, and about forty degrees above the horizon. At Wiseton, Notts, it was seen at 8.47, and at Bramhope at 8.48. At Armley, a hissing noise was heard, and the meteor seen to disappear close by.

THE GREAT EARTHQUAKE OF JUNE 12, 1897.

THE investigation of the great earthquake of June 12, 1897, being the most extensive of which there is historic record, has naturally led to important additions to our knowledge. A detailed report of this earthquake, by Mr. R. D. Oldham, has been published by the Indian Government,[1] and its investigation suggested a line of further research, the results of which have been published in the *Philosophical Transactions* of the Royal Society.[2] The principal results described in these bulky publications are here given in the form of an abstract.

The known extent of the principal seismic area was about 1,200,000 square miles, a figure which will surprise many after the statement that this was the greatest earthquake of which there is historic record. One of the results of this earthquake was, however, a re-examination of the records of the great Lisbon earthquake of 1755, which has shown that the statements regarding it, copied from one text-book to another, are grossly exaggerated. The statement that it was felt in the lead mines of Derbyshire is shown, by reference to the original record, to be an error, the shock that was felt being clearly an independent, local, though possibly sympathetic, shock. Apart from this, there is but one doubtful record of its having been felt so far north as England, though its effects were visible, both in England and in Holland, in disturbances of the water in ponds. The accounts of its having been felt in Iceland and America refer to the sea-waves, which may travel to regions far beyond the utmost limit at which the shock could be felt. Omitting these records, taking only those which refer to the sensible shock, and rounding off the seismic area to an elliptical form, it

1 "Report on the great earthquake of June 12, 1897." By R. D. Oldham. *Memoirs* of the Geological Survey of India, vol. xxix. 1899, pp. xxx + 379 + xviii; 44 plates, 3 maps, 51 woodcuts in text.
2 "On the propagation of earthquake motion to great distances." By R. D. Oldham. *Phil. Trans.*, Series A, 1900, pp. 135–174.

is found to cover not more than 1,000,000 square miles; while if the shock of June 12, 1897, is treated in a similar manner, we obtain a total seismic area of over 1,750,000 square miles.

Owing to the paucity of good records, the course of the isoseists could not be traced in detail. The outermost isoseist was, however, determined with approximate accuracy for about half of its circumference. The seismic area presents a peculiarity in that there is a detached area in the alluvium about Ahmedabad over which the shock was felt, though it was unfelt over a tract of about one hundred miles separating this alluvial area from the furthest limit at which the shock was felt on rock. It is also reported to have been felt at Burhanpur, on the border of the Tapti valley alluvium, though it was felt nowhere else in the neighbourhood. Outside the area over which it was felt there are records, in India, of the passage of the earthquake wave as indicated by the swinging of lamps, &c.

Apart from the records in India, there is good evidence that it was felt in Italy; the observers at Catania, Leghorn and Spinea di Mestre all record having felt a slight shock at the exact time when the instruments throughout Italy recorded the advent of the first phase of the disturbance due to this earthquake. Had there been only a single record, it might have been attributed to a distinct local shock; but these three separate records, all agreeing with each other in time, and also with the advent of the first tremors, which, having a period of about ·5 second, might have been sensible, leaves little possibility of doubt that the Indian earthquake was actually felt. The observers are, however, to be complimented on their acuteness of observation.

The epifocal area is of a peculiar shape. Situated in Western Assam and North-eastern Bengal, it is bounded on the south by a straight line running about E.S.E. for some 200 miles; on the north it is bounded by a nearly symmetrical double sigmoid curve, the maximum breadth being not less than 50 miles, and possibly as much as twice this amount. Over the whole of this area of not less than 6000 square miles, the intensity of the shock was in excess of 10 degrees of the Rossi-Forel scale, and alterations of level have taken place; while for a year and more afterwards earthquake shocks—some severe, but most feeble and local—were very frequent. The changes of level were not only shown by faults, one of which was traced for a distance of over 12 miles, and had in places a measured throw of over 30 feet, and by differential changes of level, whereby streams were dammed up into lakelets, but also by a remeasurement of some of the triangles of the great Trigonometrical Survey. As the whole of the triangles reobserved lay within the epifocal area, it is not possible to say what amount of actual change has taken place; but changes of position of one hill relative to another were determined, which reach as much as 24 feet in a vertical, and 12 feet in a horizontal, direction.

The results of the triangulation, as published by the Trigonometrical Survey of India, indicate an increase in the horizontal distances between the stations; but in the geological report it is shown that this is probably due to a shortening, by compression, of that side which was assumed as an unaltered base-line. The true nature of the focus is regarded as a thrust plane, from which minor faults branched off, and in places appeared as such, while elsewhere they died out before reaching the surface and merely caused those changes of level which, where other circumstances were favourable, led to the formation of lakes. No less than thirty of these were observed, the largest having a length of $1\frac{1}{2}$ miles and a breadth of $\frac{3}{4}$ mile, and the smallest a few yards across; the depth varied from 1 to over 20 feet.

Within this epifocal area the violence was everywhere great, though subject to great local increase in the neighbourhood of the fault planes which extended upwards to the surface. Not only were upright stones broken, but sound hardwood trees of a diameter of 6 to 7 inches were snapped across by the violence of the motion they were subjected to; no masonry building was left standing, and the hill sides were scarred by landslips. In many places it was noticed that stones lying on the ground had been projected into and through the air.

The acceleration necessary to cause the fracture of standing monoliths, or sound hardwood trees, must have been great—much greater than the measured accelerations, as determined by West's formula from overturned tombstones, which range up to 32 feet per sec. per sec. It is doubtful, however, whether West's formula is applicable to cases where the height of the overturned column is less than three or four times its diameter; in the earthquake of 1897 all the high accelerations were obtained in places where there must have been a large vertical component in the wave motion, and the overthrow of squat pillars is regarded as a modified form of projection. It is improbable that accelerations of over 6 feet per sec. per sec. can occur, except in the vicinity of the epicentre, where there is a considerable vertical component in the wave motion, and the excessive accelerations which have been supposed to have been measured in the case of other earthquakes must be regarded with suspicion.

Opportunity was taken to review the various formula for deducting the accleration and velocity of movement of the wave-particle; these have been all collected in an appendix and discussed. One result of the discussion is in a manner reactionary, for the one quantity which it was believed could be determined with real accuracy, the velocity as deduced from projection, is shown not to be due to wave motion at all. The velocities deduced from observed projections are shown to lead to impossible results if combined either with the deduced acclerations or with any conceivable amplitude or period, and the conclusion is come to that the projection of solid objects was due, not to molecular wave motion, but to a molar displacement of the ground, resulting in permanent changes of level.

Instances of the rotation of objects, both within and without the epicentre, were numerous. As many as possible of these were carefully measured to determine, not only the angular rotation, but also the direction and amount of displacement of the centre of gravity. From a careful examination of the data, it is shown that none of the attempts to explain rotation by simple rectilinear motion are in accordance with the observed facts, and that it is necessary to accept the explanation of vorticose motion. This vorticose motion does not, however, take the form of angular rotation as has been assumed by some investigators, but the whole ground either moves in a more or less circular track, or is subject to a more or less rectilinear to-and-fro motion, whose direction changes continually in azimuth.

Over a large alluvial area the river channels were narrowed, railway lines bent into sharp curves, and bridges compressed and destroyed, much as in the Japanese earthquake of 1891. This compression is shown to have been due, in all cases, to displacement of the superficial alluvium, and not to any general compression. Over this same alluvial area fissures and sand vents were opened in myriads. With regard to the fissures, it is shown that Mallet's explanation of their formation by unsupported masses of clay being thrown off from free surfaces by their own inertia is incomplete, and that they were formed in places where no such action could have taken place. It is suggested that in such cases the fissures were due to the visible surface undulations which were noticed by many observers. The sand vents were formed in such numbers that large areas were temporarily flooded by the volumes of water which issued from them with such force that it rose in solid columns to a height of 3 feet and more from the ground, while splashes and spouts are said to have reached 18 or 20 feet in height. It is noteworthy that in several cases these sand vents are said to have been formed *after* the passage of the shock, and flowed for a period of half an hour or, according to some, several hours. This is attributed to the settling of clay beds on to underlying quicksands, which supported the overlying beds as long as these were continuous, but would not do so after they had been broken up by the earthquake.

Earthquake sounds were very loud and conspicuous, but the data available do not allow of much advance in this difficult branch of seismology. In some cases explosive sounds of short duration were heard after the earthquake had passed, and the connection of these with the "Barisal guns," "mistpœffers," "marina" and other similar phenomena is discussed, all being regarded as probably in the main seismic.

The most important results obtained are probably those connected with the rate of propagation. Numerous time observations in India yield a time curve with double curvature like that of Schmidt's "hodograph," but the curvature is too slight to accord with it, and the true time curve is shown to be most probably a straight line indicating a uniform rate of propagation of 3·0 km. per sec. Turning from the observed rate of propagation of the sensible shock to the distant records, it is shown that the records of the Italian seismographs exhibit three principal phases of motion, after each of which there is a marked diminution of movement. The first of these gives an average rate of propagation of 9 6 km. per sec., the second of 5·6 km. per sec., and the third, the phase of long period undulation, accompanied by marked tilting of the ground, a rate of transmission of 3·0 km. per sec. The agreement of this with the observed rate of transmission of the sensible shock is held to indicate that both are due to a form of wave motion which was propagated at a uniform rate along the surface of the earth. The first two phases, it is suggested, are due to wave motion transmitted through the interior of the earth, and as in the presumably isotropic, or nearly so, material of the interior of the earth a separation of condensational and distortional waves could take place, which Knott and Rudzki have shown to be impossible in the rocks of which the surface of the earth is composed, it is suggested that these two phases are due to the arrival of the condensational and distortional waves respectively, travelling by brachisto-chronic paths through the interior of the earth.

This suggestion is followed up in the second paper. The published records of distant earthquakes were looked up, and those selected of which the time and place of origin were known within a limit of error of 1 minute of time and 1 minute of arc respectively. Further, on account of the known impossibility of separation of the two simple forms of elastic wave motion in the surface crust of the earth, only those records were considered which came from a distance of not less than 20° of arc from the epicentre.

Seven distinct earthquakes were found of which the published records satisfied all these conditions, and as in some of them there was more than one shock, they constituted eleven distinct shocks. From the published records were extracted (1) the time of commencement of the record; (2) the time of any sudden increase of movement, when recorded; and (3) the time of maximum displacement. Tabulating these, it is found that each earthquake exhibits a three-phase character in the record; and, further, that if the times are plotted and a curve drawn through them, the time curves of the first two phases show precisely that curvature which Prof. Rudzki's investigations show to be characteristic of wave motion propagated along brachistochronic paths through the earth, where the rate of propagation increases with the depth. Continuing these curves by extrapolation to the origin, they give rates of propagation fairly concordant with the rates of propagation of condensational and distortional waves as experimentally determined for ordinary rock. As a subsidiary part of this investigation, it is shown that the "preliminary tremors" of earthquakes coming from Japan to Europe reach a depth of about ·45 of the radius from the surface, attain there a maximum velocity of 14·5 km. per sec. for the condensational, and 8·8 km. per sec. for the distortional wave, and traverse a medium which has, at that point, a bulk modulus of 17 times, and a rigidity of about 21·5 times that of granite.

The records of the third phase show some irregularity, but the time curve is a straight line, pointing to a uniform rate of transmission along the surface. There is, however, some indication that in the case of the greatest earthquakes it is higher than in the case of lesser ones; in other words, that the rate of transmission is in some way dependent on the magnitude of the earthquake, hence, probably, on the size of the wave. From this it is concluded that the propagation of these surface undulations is, in part at least, gravitational.

EXPLORATIONS OF THE "ALBATROSS" IN THE PACIFIC.[1]

WE left San Francisco in August of last year, and in latitude 31° 10′ N., and longitude 125° W., we made our first sounding in 1955 fathoms, about 320 miles from Point Conception, the nearest land. We occupied 26 stations until we reached the northern edge of the plateau from which rise the Marquesas Islands, having run from station No. 1, a distance of 3800 miles, in a straight line.

At station No. 2 the depth had increased to 2368 fathoms, the nearest land, Guadeloupe Island, being about 450 miles, and Point Conception nearly 500 miles, distant. The depth gradually increased to 2628, 2740, 2810, 2881, 3003 and 3088 fathoms, the last in lat. 16° 38′ N., long. 130° 14′ W., the deepest sounding we obtained thus far in the unexplored part of the Pacific through which we were passing. From that point the depths varied from 2883 to 2690 and 2776, diminishing to 2583, and gradually passing to 2440, 2463 and 2475 fathoms until off the Marquesas, in lat. 7° 58′ S., long. 139° 08′ W., the depth became 2287 fathoms. It then passed to 1929, 1802 and 1040 fathoms in lat. 8° 41′ S., long. 139° 46′ W., Nukuhiva Island being about 20 miles distant. Between Nukuhiva and Houa-Houna (Ua-Huka) Islands we obtained 830 fathoms, and 5 miles south of Nukuhiva 687 fathoms. When leaving Nukuhiva for the Paumotus we sounded in 1284 fathoms about 9 miles south of that island. These soundings seem to show that this part of the Marquesas rises from a plateau having a depth of 2000 fathoms and about 50 miles in width, as at station No. 29 we sounded in 1932 fathoms.

Between the Marquesas and the north-western extremity of the Paumotus we occupied nine stations, the greatest depth on that line being at station No. 31, in lat. 12° 20′ S., and long. 144° 15′ W. The depths varied between 2451 and 2527 fathoms, and diminished to 1208 fathoms off the west end of Ahii, and then to 706 fathoms when about 16 miles N.E. of Avatoru Pass in Rairoa Island.

Between Makatea and Tahiti we made eight soundings, beginning with 1363 fathoms, 2 miles off the southern end of Makatea, passing to 2238, 2363 (the greatest depth on that line), to 2224, 1930, 1585, 775, and finally 867 fathoms off Point Venus.

The deep basin developed by our soundings between lat. 24° 30′ N., and lat. 6° 25′ S., varying in depth from nearly 3100 fathoms to a little less than 2500 fathoms, is probably the western extension of a deep basin indicated by two soundings on the charts, to the eastward of our line, in longitudes 125° and 120° W., and latitudes 9° and 11° N., one of over 3100 fathoms, the other of more than 2550 fathoms, showing this part of the Pacific to be of considerable depth and to form a uniformly deep basin of great extent, continuing westward probably, judging from the soundings, for a long distance.

I would propose, in accordance with the practice adopted for naming such well-defined basins of the ocean, that this large depression of the Central Pacific, extending for nearly thirty degrees of latitude, be named Moser Basin.

The character of the bottom of this basin is most interesting. The haul of the trawl made at station No. 2, lat. 28° 23′ N., long. 126° 57′ W., brought up the bag full of red clay and manganese nodules with sharks' teeth and cetacean ear-bones; and at nearly all our stations we had indications of manganese nodules. At station No. 13, in 2690 fathoms, lat. 9° 57′ N., long. 137° 47′ W., we again obtained a fine trawl haul of manganese nodules and red clay; there must have been at least enough to fill a 40-gallon barrel.

The nodules of our first haul were either slabs from 6 to 18 inches in length and 4 to 6 inches in thickness, or small nodules ranging in size from that of a walnut to a lentil or less; while those brought up at station No. 13 consisted mainly of nodules looking like mammillated cannon-balls varying from 4½ to 6 inches in diameter, the largest being 6½ inches. We again brought up manganese nodules at the equator in about longitude 138° W., and subsequently—until within sight of Tahiti—we occasionally got manganese nodules.

As had been noticed by Sir John Murray in the *Challenger*, these manganese nodules occur in a part of the Pacific most distant from continental areas. Our experience has been similar to that of the *Challenger*, only I am inclined to think that these nodules range over a far greater area of the Central Pacific than had been supposed, and that this peculiar manganese-nodule bottom characterises a great portion of the deep parts of the Central Pacific where it cannot be affected by the deposits of globigerina, pteropods, or telluric ooze; in the region characterised also by red-clay deposits. For in the track of the great equatorial currents there occur deposits of globigerina ooze in over 2400 fathoms for a distance of over 300 miles in latitude.

We made a few hauls of the trawl on our way, but owing to the great distance we had to steam between San Francisco and the Marquesas (3800 miles) we could not, of course, spend much time either in trawling or in making tows at intermediate depths. Still the hauls we made with the trawl were most interesting, and confirmed what other deep-sea expeditions have realised: that at great depths, at considerable distances from land, and away from any great oceanic current, there is comparatively little animal life to be found.

The bottom temperatures of the deep (Moser) basin varied between 34·6° at 2628 and 2740 fathoms, to 35·2° at 2440

[1] Abridged from letters written to the Hon. George M. Bowers, U.S. Commissioner of Fish and Fisheries, Washington, D.C., by Mr. Alexander Agassiz, leader of the expedition of the U.S. Fish Commission Steamer *Albatross* to the Pacific.

fathoms, and 35° at 2475 fathoms; about 120 miles from the Marquesas.

Our deep-sea nets not having reached San Francisco at the time we sailed, we limited our pelagic work to surface hauls, of which we generally made one in the morning and one in the evening, and whenever practicable some hauls with the open tow nets at depths varying between 100 and 350 fathoms. The results of these hauls were very satisfactory. The collection of surface animals is quite extensive, and many interesting forms were obtained. As regards the deeper hauls with the Tanner net, they only confirm what has been my experience on former expeditions, that beyond 300 to 350 fathoms very little animal life is found, and in the belt above 300 fathoms a great number of many so-called deep-sea crustaceans and deep-sea fishes were obtained. I may mention that we obtained Pelagothuria at about 100 fathoms from the surface.

On our way to Tahiti from the Marquesas we stopped a few days to examine the westernmost atolls of the Paumotus. Striking Ahii we made for Rairoa, the largest atoll of the Paumotu group. Skirting the northern shore from a point a little west of Tiputa Pass, we entered the lagoon through Avatoru Pass, anchoring off the village.

We made an examination of the northern side of the lagoon between Avatoru and Tiputa Passes. The lagoon beach of the northern shore is quite steep, and is composed of moderately coarse broken coral sand at the base, and of larger fragments of corals along the upper face, which is about 5 to 6 feet above high-water mark. These coral fragments are derived in part from the corals living on the lagoon face of the northern shore, and in part of fragments broken by the waves from somewhat below the low-water mark. The ledge which underlies the beach crops out at many places on the lagoon side of the northern shore; we traced it also along the shores of Avatoru Pass, and about half-way across the narrow land running between Avatoru and Tiputa Passes. It crops out also at various points between them in the narrow cuts which divide this part of the northern land of the lagoon into a number of smaller islands. These secondary passes leave exposed the underlying ledge, full of fossil corals.

It became very evident, after we had examined the south shore of the lagoon, that the ledge underlying the north shore is the remnant of the bed, an old Tertiary coralliferous limestone which at one time covered the greater part of the area of the lagoon, portions of which may have been elevated to a considerable height. This limestone was gradually denuded and eroded to the level of the sea. Passages were formed on its outside edge, allowing the sea access to the inner parts of the lagoon. This began to cut away the inner portions of the elevated limestone, forming large sounds, as in the case of Fiji atolls, and leaving finally on the south side only a flat strip of perhaps 2500 to 3000 feet in width which has gradually been further eroded on the lagoon side, and also on the sea face to leave only a narrow strip of land about 1000 feet in width and perhaps 10 to 14 feet in height, the material for this land having come from the disintegration of the ledge of Tertiary limestone, both on the sea face and the lagoon side.

The underlying ledge is not the remnant of a modern reef; its character is identical with that of the elevated limestones of Fiji, which are of Tertiary age, and the rock is in every respect the same as that I observed on many of the elevated islands of Fiji. The atoll of Rairoa is in a stage of denudation and erosion very similar to that of Ngele Levu, in Fiji, only in Ngele Levu the elevated limestone attains a height of about 60 feet. Our visit to the south shore of the lagoon, both on the lagoon side and on the sea face, left us no doubt regarding the character of the underlying ledge of the north shore. As soon as the south shore was sufficiently near, as seen from the lagoon side, for us to distinguish its character, we could see that the entire shore line was formed of a high ledge of limestone, honeycombed, pitted and eroded, both by atmospheric agencies and the action of the waves, in its lower parts both on the lagoon side and on the sea face. The great rollers of the weather side broke through between the columnar masses of the ledge into the lagoon, and as far as the eye could reach there extended a more or less continuous wall.

Crossing over to the weather side of the southern land of Rairoa in one of the passages between two of the islands, we came upon the limestone ledge, from 12 to 14 feet high and about 40 to 50 feet wide, which formed the sea face of the islands and islets, and extended far to the westward as a great stone wall more or less broken into distinct parts. We found this ledge to consist of elevated limestone as hard as calcite, full of corals, honeycombed and pitted, and worn into countless spires and spurs, and needles and blocks of all sizes and shapes, separated by deep crevasses or potholes, recalling a similar scene in Ngele Levu on the windward end of the lagoon. In the passages the parts of the ledge which had not been eroded extended as wide buttresses, gradually diminishing in height till they formed a part of the lagoon flat and extended out below the recent beach rock which covered it in short stretches.

The amount of water which is forced into such a lagoon as Rairoa is something colossal, and when we observe that there are but a small number of passages through which it can find its way out again on the leeward side, it is not surprising that we should meet with such powerful currents (7 to 8 knots in several cases) sweeping out of the passages on the lee sides.

The islands and islets of Rairoa are fairly well covered with low trees and shrubs and large groves of palm trees.

It was with great interest that we approached Makatea, as it is the only high elevated island of which Dana speaks as occurring in the western Paumotus. For though he mentions some others as possibly having been elevated 5 to 6 feet, yet he considered them all, as well as Makatea (Metia or Aurora, of Dana) as modern elevated reefs. Yet, from the very description given by him of the character of the cliffs and of the surface of Makatea, I felt satisfied that it was composed of the same elevated coralliferous limestone so characteristic of the elevated reefs of Fiji, and which, from the evidence of the fossils and the character of the rock, both Mr. Dall and myself have been led to regard as of Tertiary age.

The cliffs had the same appearance as those of Vatu Leile, Ongea, Mango, Kambara, and many other elevated islands of Fiji. There were fewer fossils, perhaps, but otherwise the petrographic character of the rock was identical with that of Fiji.

The south-western extremity of the island sloped gradually to the sea, and showed two well-defined terraces. The lines of these two terraces could, as a rule, be traced along the faces of the vertical cliffs by the presence of caverns along the lines of those levels, similar to the lines of caverns indicating the line of present action of the sea at the base of the cliffs.

During our stay in Papeete some time was spent in examining that part of the barrier reef of Tahiti which had been surveyed by the *Challenger*. We found the condition of the outer slope of the reef quite different from its description as given in the *Challenger* narrative. The growing corals were comparatively few in number, and the outer slope showed nothing but a mass of dead corals and dead coral boulders beyond 16 or 17 fathoms, few living corals being observed beyond 10 to 12 fathoms.

We also made an expedition to Point Venus, to determine, if possible, the rate of growth of the corals on Dolphin Bank from the marks which had been placed on Point Venus by Wilkes, in 1839, and by MM. Le Clerk and de Bénazé, of the French navy, in 1869. We found the stones and marks as described, but on examining Dolphin Bank in the steam launch I was greatly surprised to find that there were but few corals growing on it. I could see nothing but sparsely scattered heads, none larger than my fist! the top of the bank being entirely covered by Nullipores, although we sounded across the bank in all possible directions and examined it thoroughly. It is greatly to be regretted that Dolphin Bank was not examined, neither in 1839 nor in 1869, and notes made of what species of corals, if any, were growing on its surface; for an excellent opportunity has been lost to determine the growth of corals during a period of 60 years. The choice of this bank as a standard to determine the growth of corals was unfortunate, as it is in the midst of an area comparatively free from corals.

From Papeete we steamed back to Makatea, and examined the island more in detail. We crossed the island from west to east, the path leading down from the summit of the cliffs bordering the island into a sink at least 40 to 50 feet lower than the rim of either face of the island. The sink occupies a little more than one-third the length of the island. It is deeper at its southern extremity, where it is said to be 75 to 100 feet below the rim of the adjoining cliffs.

It is difficult to determine if this sink is the remnant of the former lagoon of the island, or of a sound formed during its elevation, or if it has been formed by the action of rain and atmospheric agencies. The amount of denudation and erosion to which this island has been subjected is very great, as is clearly indicated by the small cañons, pinnacles, and walls of limestone, as well as by the crevasses which occur in the surface of the basin in all directions. The extent to which this action has penetrated into the mass of the island is also plainly shown by the great number of caverns which crop out at all levels along the sea face of the cliffs, some of which are of great height, and extend as long galleries into the interior of the island.

From Makatea, we visited Niau, Apataki, Tikei, Fakarava, Anaa, Tahanea, Raroia, Takume, Makemo, Tekokota, Hikuero, Marokau, Hao, Aki-Aki, Nukutavake, going as far east as Pinaki, when we turned westward again and made for the Gloucester Islands. These, as well as Hereheretue, proved most interesting; they formed, as it were, an epitome of what we had seen on a gigantic scale in the larger atolls of the western and central Paumotus. We could see at a glance in such small atolls as Nukutipipi and Anu-Anurunga the connection between structural features which, in an atoll of 40 miles in length and from 10 to 15 miles in width, it was often difficult to determine.

The deepest sounding among the Paumotus was on the line to the northward of Hereheretue in the direction of Mehetia, where we found a depth of 2524 fathoms, and a continuation of the red clay characterising the soundings since we left Pinaki.

We have seen nothing in this more extended examination of the group tending to show that there has anywhere been subsidence. On the contrary, the condition of the islands of the Paumotus cannot, it seems to me, be explained on any other theory except that in their present condition they have been formed in an area of elevation—an area of elevation extending from Matahiva on the west to Pinaki in the east, and from the Gloucester Islands on the south to Tikei on the north.

All the Paumotu Islands we have examined are, without exception, formed of Tertiary coralliferous limestone which has been elevated to a greater or less extent above the level of the sea, and then planed down by atmospheric agencies and submarine erosion, the greatest elevation being at Makatea (about 230 feet), and at Niau, where the Tertiary coralliferous limestone does not rise to a greater height than 20 feet. At Rairoa it was 15 to 16 feet high. At other islands it could be traced only as forming the shore platform.

The appearance of the old ledge and of the modern reef rock is so strikingly different that it is very simple to distinguish the two, even where only comparatively small fragments are found.

In the Paumotus, the islands have been elevated to a very moderate height, and probably to nearly the same height, for the old ledge forming the base of the modern structure is found exposed nearly everywhere at about low-water, when it cannot be traced at a slightly greater elevation. This would readily account for the nearly uniform height of the islands throughout the group.

But there is another element which comes into play in this group, and has an important part in shaping the ultimate condition of these atolls. At the Fijis we have seen the submarine erosion continue until there is little left of many of the atolls beyond the merest small islet or rock to indicate its structure. In the Paumotus, in the great atolls which are evidently only the exposed summits of parts of ridges or spurs of an extensive Tertiary coralliferous limestone bed, the rim of the atoll is, after having been denuded to the level of the sea, again built up from the material of its two faces, which is thrown up on the wide reef flats both from the sea face and from the lagoon side.

Many of the lagoons are filled with shoals or ledges awash or a few feet above the sea-level. These shoals are parts of the old ledge which have not as yet been eroded, and the disintegration of which has gone far to supply the material for the land of the outer rims of the atolls.

The lagoons of these atolls have a general depth of 13 to 20 fathoms. In some cases they are somewhat deeper, as is stated, but there are no measurements, the greater depths, 30 fathoms or more, being due to orogenic conditions. Some of the atolls are quite shallow, as at Matahiva, as well as Pinaki, where the lagoon is not more than 2 to 3 fathoms, and Takume, where it is from 5 to 6 fathoms deep. Some of the smaller islets we visited, among which are Tikei, Aki-Aki, and Nukutavake, have no lagoons.

The only atoll we have seen the lagoon of which is entirely shut off from the sea is Niau In this case the old ledge forming the rim of the land, which surrounds the nearly circular lagoon, is about a third of a mile in width and sufficiently high, 15 to 20 feet, to prevent any sea from having access to it except in case of a cyclone. It is very difficult in this case to decide whether this lagoon has been gradually filled up after elevation, or whether it is merely a sink on a more or less uneven limestone surface.

Dana and other writers on coral reefs mention a great number of lagoons as being absolutely shut off from the sea. I take it these statements are due to their descriptions being taken from charts, many of which, as in the cause of the Paumotus, are very defective. For nothing is easier than to pass at a short distance by the wide or narrow cuts which give in so many cases the freest access to the sea to the interior of the lagoons, and described as closed because they have no boat passages. I could mention, as instances of such lagoons, those of the atolls of Takume, Hikuero, Anaa, &c., which may be said to be closed, yet into which a huge volume of water is poured at every tide over low parts of the encircling reef flats.

The character of the coral reefs of the Paumotus is very different from that of other coral reef regions I have seen. Nowhere have I seen such a small number of genera, so many small species, and such stunted development of the corals. None of the great heads of the genera so characteristic of the West Indian regions, or of the Great Barrier Reef of Australia, are to be seen, with the exception of a couple of species of alcyonaria they are absent, so far as our experience shows, and there are but few sponges and gorgonians to be found among the corals.

The same paucity of animal life seemed to extend to the deep-water fauna. All the hauls we made off the islands, in from 600 to 1000 fathoms, usually the most productive area of a sea slope, brought nothing, or so little that we came to grudge the time spent in trawling on the bottom, as well as towing on the surface or near it, a great contrast to the conditions in the Atlantic in similar latitudes, and very different from our anticipations.

From Papeete we steamed to Aitutaki, Niue, and for the deep hole of the Tonga-Kermadec Deep, about 75 miles to the eastward of Tonga-Tabu, and in 4173 fathoms made a haul with the Blake beam-trawl, by far the deepest trawl haul yet made. We found in the bag a number of large fragments of a silicious sponge belonging probably to the genus Crateromorpha, which had been obtained by the *Challenger* in the Western Pacific, but in depths less than 500 fathoms. We also brought up quite a large sample of the bottom; it consisted of light brown volcanic mud mixed with radiolarians.

On our way back to Papeete from the Paumotus we examined the eastern coast of Tahiti, and from Papeete studied the western coast as far as Port Phaeton, at Tararoa Isthmus. We also examined, in a general way, the Leeward Society Islands; Murea, Huaheine, Raiatea, Tahaa, Bora-Bora, Motu Iti and Maupiti. There are excellent charts of the Society Islands, so that it was comparatively simple to examine the typical points of the group and to gain an idea of their structure so far as it relates to coral reefs. The Society Islands are all volcanic islands edged with shore platforms, some of great width, upon which the barrier or the fringing reefs of the islands have grown. The structure of the reefs of the Society Islands is very similar to that of the Fiji reefs round volcanic islands. A comparison, for instance, of the charts of Kandavu, Viti Levu, Mbengha, Nairai, and of other volcanic islands in the Fijis, with those of the Society Group, will at once show their identity. Huge platforms of submarine denudation and erosion characterise both, with fringing and barrier reefs determined by local conditions. Perhaps it is easier to follow the changes which have taken place in the Society Islands; and such islands as Tahaa and Bora-Bora, where we anchored, as well as Maupiti, are admirable examples and epitomes of the structure and mode of formation of the coral reefs of that group.

The only island of the Cook Group which we examined was Aitutaki, as Atiu is composed of elevated limestone, and Rarotonga is volcanic; I hoped we might find that atoll to be in part volcanic and in part composed of elevated coralliferous limestone; we found it to be volcanic, an island with the structure of Bora-Bora on a smaller scale.

We anchored at Niue, an island composed of elevated coralliferous limestone showing three well-marked terraces, the lowest of not more than 5 to 10 feet and in many places disappearing completely, the limestone cliffs rising vertically from the sea well into the second or even the third terraces.

The second terrace varies in height from 50 to 60 feet, the third from 90 to 100 feet. The second terrace is deeply undercut; and in the higher vertical cliffs extending into the third terrace from the sea, the former positions of the terraces are usually indicated by lines of caverns.

From Niue we went to the Tongas, which we found a most interesting group. The elevated Tertiary coralliferous limestones take here their greatest development, and are on a scale far beyond that of their development in the Lau Group of the Fijis, or the Paumotus. The first island of the Tongas we visited, Eua, is perhaps the most interesting of the islands composed of Tertiary elevated coralliferous limestone I have visited. From Dana's account of it, evidently given at second hand, I expected to find an island somewhat like Viti Levu on a very much smaller scale. But as we steamed up to it from the east there could be no mistaking the magnificent face of nearly vertical limestone cliffs forming the whole eastern face of the island, and at points rising to over a thousand feet in height. At all projecting points lines of terraces were plainly marked: at the northern point three could be followed, and at the southern extremity five, with traces of a sixth perhaps.

Upon rounding the southern extremity of the island we could see that the island was composed of two ridges, running north, separated by a deep valley, the western ridge being much lower than the eastern, not rising to a greater height than a little over 500 feet. The western ridge is also composed of limestone, and at the headlands we could trace three terraces.

We anchored at English Roads, opposite the outlet of the drainage of the interior basin, where a small river has cut its way through a depression in the shore terrace. On landing we followed the crest of the western ridge for a few miles and could see the whole valley forming the basin of the island lying between the two ridges, at our feet. Nothing could show more clearly that such an island was not an elevated atoll, but a plateau which had been eroded and denuded for a long period of time by atmospheric and other agencies.

To the westward of the Tonga Islands is a line of volcanic islands extending nearly 200 miles, at a distance of from 15 to 20 miles parallel with the trend of the four irregularly-shaped plateaux upon which rise the Tonga Islands.

The Tonga-Tabu plateau is separated from the Namuka Group plateau by a funnel-shaped channel with a depth passing rapidly into 300 fathoms from the 100-fathom line. The Namuka plateau is rectangular; its principal island is Namuka, where we anchored.

This part of the Tongas is, like the Lau Group in Fiji, made up of islands in part volcanic and in part composed of elevated coralliferous limestone.

The Haapai plateau is triangular, with isolated islands rising on the north-western side from the deep water separating it from the Vavau plateau. On the northernmost plateau of the broad ridge of the Tonga Islands is the Vavau Group, by far the most picturesque of the Tonga Islands. Several parts of the island of Vavau, as at the entrance to the harbour of Neiafu, and at Neiafu, are finely terraced; four terraces are indicated there, and other flat-topped smaller islands show traces of two or three terraces. The northern edge of Vavau Island rises to a height of more than 500 feet, and slopes in a general way southward and inland. The southern shore is deeply indented by bays and sounds, and flanked by innumerable islands and islets, some of considerable height (150 to 250 feet) which gradually become smaller and smaller as they rise towards the southward and eastward, these islands having been formed from the denudation and erosion of the greater Vavau. They form tongues of land and sea and sounds of all shapes and sizes, showing the traces of the former land-connections of the islands and islets, and their disintegration on the eastward and southward by the action of the sea.

It is evident that in the Tonga Group, which is a very extensive area of elevation, the recent corals have played no part in the formation of the masses of land and of the plateau of the Tonga Ridge, and that here again, as in the Society Islands and the Cook Islands, both also in areas of elevation, they are a mere thin living shell or crust growing at their characteristic depths upon platforms which in the one case are volcanic, in the other calcareous, the formation of which has been independent of their growth.

After leaving Suva we steamed to Funafuti, stopping on the way at Nurakita, the southernmost of the Ellice Islands. I was, of course, greatly interested in my visit of Funafuti, where a boring had been made under the direction of a committee of the Royal Society, in charge of Prof. David, of Sydney, after the first attempt under Prof. Sollas had failed. The second boring reached a depth of more than 1100 feet. This is not the place to discuss the bearing of the work done at Funafati, as beyond the fact of the depth reached we have as yet no final statement by the committee of the interpretation put upon the detailed examination of the core obtained, and now in the hands of Prof. Judd and his assistants. In addition to the abovenamed islands, we also examined Nukufetau, another of the Ellice Group.

After leaving Nukufetau we encountered nothing but bad weather, which put a stop to all our work until we arrived under the lee of Arorai, the southernmost of the Gilbert Islands. On our way from Tapateuea we steamed to Apamama and Maiana, which we examined, as well as Tarawa. We next examined Maraki. Both Maraki and Taritari, the last island of the Gilberts which we examined, are remarkable for the development of an inner row of islands and sand-bars in certain parts of the lagoon parallel to the outer land-rim, a feature which also exists in many of the Marshall Islands atolls.

We spent about three weeks in exploring the Marshall Islands, taking in turn the atolls of the Ralick Chain to the north of Jaluit: Ailinglab Lab, Namu, Kwajalong and Rongelab; and then the atolls of the Ratack Chain: Likieb, Wotje and Arhno. The atolls of the Marshall Group are noted for their great size and the comparatively small area of the outer land-rims, the land-rims of some of the atolls being reduced to a few insignificant islands and islets. In none of the atolls of the Ellice, Gilbert or Marshall Islands were we able to observe the character of the underlying base which forms the foundations of the land areas of these groups. In this respect these groups are in striking contrast to the Paumotus, the Society Islands, the Cook Group, Niue, the Tongas, and the Fiji Islands, where the character of the underlying foundations of the land-rims is readily ascertained. But, on the other had, these groups give us the means of studying the mode of formation of the land-rims in a most satisfactory manner, and nowhere have we been able to study as clearly the results of the various agencies at work in shaping the endless variations produced in the islands and islets of the different atolls by the incessant handling and rehandling of the material in place, or of the fresh material added from the disintegration of the sea or lagoon faces of the outer land, or of the corals on the outer and inner slopes. It has been very interesting to trace the ever-varying conditions which have resulted in producing so many variations in the appearance and structure of the islands and islets of the land-rims of the different groups.

The boring at Funafuti will show us the character and age of the rocks underlying the mass of recent material of which the land-rim, not only of that atoll, but probably also that of the other atolls of the group and of neighbouring groups, is composed, though, of course, we can only judge by analogy of the probability of the character of the underlying base from that of the nearest islands of which it has been ascertained. When we come to a group like the Marshalls, we have as our guide only the character of the base rock of the islands of the Carolines, which is volcanic; while Naru and Ocean Islands, to the west of the Gilberts and to the south-west of the Marshalls, indicate a base of ancient Tertiary limestone.

The Marshall Islands, as well as the Ellice and Gilbert, seem to be somewhat higher than the Paumotus; but this difference is only apparent, and is due to the difference in the height of the tides, which is very small in the Paumotus, while in these groups it may be five and even six feet.

From Jaluit we visited among the Carolines, the islands and atolls of Kusaie, Pingelap, Ponapi, Andema, Losap, Namu, the Royalist Group, Truk and Namonuito, obtaining thus an excellent idea of the character of the high volcanic islands of the group from our examinations of Kusaie and of Ponapi, while the others represent the conditions of the low atolls, having probably a volcanic basis, but this was not observed at any of those we examined.

The reefs of the volcanic islands of the Carolines are similar in character to those of the Society Islands, though there are some features, such as the great width of the platforms of submarine erosion of Ponapi and of Kusaie, and the development of a border of mangrove islands at the base of the volcanic islands, which are not found in the Society Islands.

The Truk Archipelago was perhaps the most interesting of the island groups of the Carolines, and it is the only group of volcanic islands surrounded by an encircling reef that I have thus far seen in the Pacific which at first glance lends any support to the theory of the formation of such island-groups as Truk by subsidence. This group was not visited by either Darwin or Dana; and I can well imagine that an investigator seeing this group among the first coral reefs would readily describe the islands as the summits, nearly denuded, of a great island which had gradually sunk. But a closer examination will readily show, I think, that this group is not an exception to the general rule thus far obtaining in all the island groups of the Pacific I have visited during this trip; that we must look to submarine erosion and to a multitude of local mechanical causes for our explanation of the formation of atolls and of barrier and encircling reefs, and that, on the contrary, subsidence has played no part in bringing about existing conditions of the atolls of the South and Central Pacific.

Nowhere have we seen better exemplified than at Truk how important a part is played by the existence of a submarine platform in the growth of coral reefs. The encircling reef protects the many islands of the group against a too rapid erosion, so that they are edged by narrow fringing reefs, and nowhere do we find the wide platforms so essential to the formation of barrier reefs. The effect of the north-east trades blowing so constantly in one direction for the greater part of the year is of course very great; the disintegration and erosion of islands within its influence is incessant, and their action undoubtedly one of the essential factors in shaping the atolls of the different groups, not only according to the local positions of the individual islands, but also according to the geographical position of the groups. Thus far I do not think any observer has given sufficient weight to the importance of the action of the trades in modifying the islands within the limits of the trades, nor has any one noticed that the coral reefs are all situated practically within the limits of the trades both north and south of the equator.

The soundings made going west from Jaluit to Namonuito indicate that the various groups are, as is the case with the neighbouring groups of the Marshalls and Gilberts, isolated peaks with steep slopes rising from a depth of over 2000 fathoms. The line we ran from the northern end of Namonuito to Guam developed the eastern extension of a deep trough running south of the Ladrones. The existence of this trough had been indicated by a sounding of 4475 fathoms to the south-west of Guam made by the *Challenger*. We obtained, about 100 miles south-east of Guam, a depth of 4813 fathoms, a depth surpassed only, if I am not in error, by three soundings made by the *Penguin* in the deep trough extending from Tonga to the Kermadecs, and by three soundings made by the U.S.S. *Nero* also to the eastward of Guam.

Guam is not wholly volcanic; the northern half consists of elevated coralliferous limestone. The vertical cliffs bordering the eastern face rise from a height of 100 to 250 or 300 feet at the northern extremity, and resemble in a way similar islands in the Paumotus (Makatea), Niue, Eua, Vavau and others in the Fijis which had made their cliffs a familiar feature in our explorations. In fact, outside of Viti Levu and Vanua Levu, this is the largest island known to me where we find a combination of volcanic rocks and of elevated coralliferous limestone. The *massif* forming the southern half of the island is volcanic, and the highest ridge, rising to about 1000 feet, runs parallel to the west coast, the longest slope being toward the east.

This volcanic mass has burst through the limestone near Agaña, and the outer western extension of the coralliferous limestone exists only in the shape of a few spurs running out from the volcanic mass, the largest of which are those forming the port of San Luis d'Apra. Near the northern extremity of the island a volcanic mass, Mount Santa Rosa, has burst through the limestone and rises about 150 feet above the general level of that part of the island.

We left Guam in time to reach Rota by day, and found that this island is a mass of elevated coralliferous limestone, the highest cliffs of which reach a height of 800 feet. Perhaps in none of the elevated islands have we been able to observe the terraces of submarine elevation as well as at Rota.

It is quite probable that others of the Ladrones, like Saipan, and the islands to the south, are composed in part at least of elevated limestone, judging from the hydrographic charts and the sketches which accompany them. On many of the northern Ladrones there are active volcanoes, so that it is very possible that the volcanic outbursts which have pushed through the limestones, or have elevated parts of the islands of the group, are of comparatively recent date.

During the last part of our cruise, from Suva to Guam, the unfavorable weather greatly interfered with our deep-sea and pelagic work; in fact with the exception of the soundings made to develop as far as practicable the depths in the regions of the various coral-reef groups we visited, we abandoned all idea of carrying out the deep-sea and pelagic work planned for the district between the Gilbert and Marshall and Caroline groups. To our great disappointment hardly any marine work could be accomplished, and our investigations were limited almost entirely to the study of the coral reefs of the regions passed through.

We were everywhere received with the greatest cordiality and courtesy: by the Governor of the Paumotus, the King of Tonga, Sir George O'Brien (the High Commissioner of the Western Pacific at Suva), Mr. E. Brandeis (the Landes-Hauptmann in charge of the Marshall Islands at Jaluit), and the Governor of the Carolines, and the Japanese authorites.

The work of the expedition was divided between Drs. W. M. Woodworth, A. G. Mayer, and my son Maximilian, who accompanied me as assistants; and Mr. C. H. Townsend, Dr. Moore, and Mr. Alexander of the Fish Commission, who had also been detailed as members of the expedition.

I must also thank Capt. Moser and the officers of the *Albatross* for the untiring interest shown by them during the whole time of our expedition in the work of the ship, which was so foreign to the usual duties of a naval officer.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MR. R. S. CLAY, late lecturer in physics at the Birkbeck Institution, has been appointed principal of the Wandsworth Technical Institute.

THE Secondary Education Bill was read a second time in the House of Lords on Monday, after a discussion in which objection was raised to the limited character of the measure, and the large powers reserved for the Board of Education. It is not proposed to carry the Bill beyond the second reading this year.

THE first response to Mr. Chamberlain's appeal for further funds for the scientific department of the Birmingham University has been received from Sir James Chance, who has given the sum of 50,000*l.*, subject to conditions to be arranged with the University Council. The endowment fund of the University now amounts to about 400,000*l.*

THE Pass List for the 1900 D.Sc. Examination of the University of London contains the following names:—Experimental Physics: Reginald Stanley Clay, Richard Smith Willows, Harold Albert Wilson. Chemistry: Thomas Slater Price. Botany: Miss Maria Dawson. Zoology: Edgar Johnson Allen, Charles William Andrews.

SOME interesting particulars with regard to chemical and technical education in the United States were given by Prof. Chandler, of New York, in his presidential address to the Society of Chemical Industry last week. The most striking feature of the American system of higher and technical education is the fact that most of the institutions have been founded and maintained by liberal gifts of money from wealthy citizens, in many cases made during the donor's lifetime, and that only a small number have been endowed or supported by the public funds. Thus in 1899 over 33 million dollars were given in this way, the largest sum being the 15 million dollars given by Mrs. Leland Stanford, together with large tracts of land, to which as yet no precise value can be attached, to complete the endowment of the Leland Stanford Junior University. There are in all 174 donors, averaging 190,000 dollars each. Schools of chemistry are now so numerous in the United States that it is almost impossible to state their exact number, but Prof. Chandler said it is more than 100. In all there are 480 universities and colleges, and 43 technical schools. In 1899 there were 9784 students pursuing professional courses in the schools of engineering, while 1487 graduated that year, receiving the degree of civil, mechanical, electrical, or mining engineer. The value to the industrial development of the United States of such an army of thoroughly-trained engineers and chemists cannot be too highly estimated.

THE operations of the Technical Instruction Committee of the Cheshire County Council are extensive and satisfactory. All the sums received under the Local Taxation (Customs and Excise) Act of 1890 have been devoted to the promotion of technical instruction in Cheshire from the commencement. The Technical Instruction Committee has framed a scheme of work which has gradually embraced the whole county, and has provided for the various and special requirements of the different districts, as well as of the county at large. The annual report just received records a year's work of steady progress and development, more especially in regard to relatively advanced instruction, and improved methods of carrying on the classes. During the year ending March 31, 1900, the grants made for purposes of technical instruction amounted to nearly 17,000*l.*, and this sum will be considerably increased during the ensuing year. A number of secondary schools receive grants from the Committee, and it is proposed to increase the payments to such schools. As has been before remarked in these notes, assistance thus given is having a very important effect upon the character of the education in secondary schools; for a condition of the grant is that scientific subjects should be taught, and proper laboratory accommodation provided. We read, for instance, in the present report: "All the schools to which grants for building and equipping laboratories and lecture rooms were made have completed these additions, hence they are in a much better position to give sound instruction in science subjects, and especially in the practical stage, than they were formerly." It is well to bear in mind the beneficial influence which Technical Instruction Committees have thus had upon the curricula of Grammar Schools and others of the old-fashioned type. Among other matters dealt with in the report are experiments on tuberculosis in cattle, for which the Committee made a grant of 250*l.*, and experimental work in agriculture.

SOCIETIES AND ACADEMIES.

PARIS.

Academy of Sciences, July 16.—M. Maurice Lévy in the chair.—On the uranium radiation, by M. Henri Becquerel. By mixing uranium chloride with barium chloride and precipitating with sulphuric acid, a precipitate of barium sulphate is obtained which is more or less radio-active according to the quantity of barium salt introduced. The radio-activity of the uranium salt remaining undergoes a corresponding diminution. It cannot be settled from these experiments whether uranium salts possess a radio-active power of their own, or whether this property is due to an admixture of an impurity.—Preparation and properties of two borides of silicon, by MM. Henri Moissan and Alfred Stock. By heating together, with special precautions, in a tube of infusible material a mixture of silicon and boron in the electric furnace, two new borides of silicon are produced, SiB_3 and SiB_6, which can be separated by taking advantage of the facts that SiB_3 is more readily attacked by fused potash, and SiB_6 is more readily destroyed by concentrated nitric acid. Both compounds resist the attack of most reagents and are very hard, scratching ruby with facility.—On the crystallisation of gold, by M. A. Ditte. Gold leaf, heated with a mixture of salt and sodium pyrosulphate or ferrous sulphate, is attacked, and shows traces of crystalline structure, although the temperature has been far below that of the fusion of gold. Platinum gives rise to similar phenomena under the same treatment.—On the solubility of calcium phosphate in the water of soils in presence of carbon dioxide, by M. Th. Schlœsing. Neutral $Ca_3(PO_4)_2$, obtained free from sodium salts, is practically insoluble in water free from dissolved carbon dioxide. The solubility increases with the amount of dissolved carbonic acid, but if this is accompanied in solution with the corresponding amount of calcium bicarbonate, the solvent action is practically destroyed.—New researches on double fertilisation in angiosperms, by M. L. Guignard. In addition to the cases previously given of double fertilisation in monocotyledons, this has now been observed in *Narcissus poeticus* and *Scilla bifolia*. In dicotyledons, *Anemone nemorosa* has been most completely studied.—The movements of the air on encountering surfaces of different forms, by M. Marey.—Observations of the planets (F.G.) and (F.H.) made with the large equatorial of the Observatory of Bordeaux, by MM. G. Rayet and F. Féraud.—On the formation of coal basins, by M. Grand'Eury. Remarks on the mode of formation of the Loire basin.—M. Lipschitz was nominated a correspondent in the section of Geometry.—On the instability of certain periodic solutions, by M. Levi-Civita.—On the ternary bilinear forms of Hermite, by M. Louis Kollros.—On the law of corresponding states, by M. Daniel Berthelot. After discussing various modifications that have been suggested for bringing Van der Waals' formula into closer agreement with experiment, the author concludes that the three constants f_c, v_c, T_c are not sufficient to rigorously define the function $f(p, v, T)$ of a substance. It is necessary to add two new constants, T_m and v_m, corresponding to the displacements of the zeros of volume and temperature.—On the temperature of maximum density of aqueous solutions of ammonium chloride and lithium bromide and iodide, by M. L. C. de Coppet. The molecular lowering of the temperature of maximum density varied from 7·16 for ammonium chloride to 8·31 for lithium iodide.—On the electrolytic estimation of bismuth, by M. Dmitry Balachowsky. It is possible to get a coherent metallic deposit of bismuth allowing of washing, provided the following conditions are observed: slight acidity of the solution, absence of large quantities of halogen ions, matt electrodes, and low current density.—On the amalgams of sodium and potassium, by MM. Guntz and Férée. Four amalgams of mercury and sodium were isolated and analysed, Hg_8Na, Hg_6Na, Hg_5Na, Hg_4Na. Similar amalgams, although less clearly defined, were obtained with potassium.—On the reduction of tungstic anhydride by zinc: preparation of pure tungsten, by M. Marcel Delépine. Tungsten of a purity varying from 98·5 to 100 per cent. is obtained by heating zinc with tungstic anhydride or with ammonium tungstate.—Action of reduced nickel upon acetylene, by MM. Paul Sabatier and J. B. Senderens. Acetylene does not react upon reduced nickel in the cold if precautions have been taken to remove all traces of hydrogen from the metal by heating it in a current of nitrogen.—Action of cyanacetic esters with substituted acid radicles upon diazobenzene chloride and tetrazodiphenyl chloride, by M. G. Favrel.—On the limits of grafting in plants, by M. Lucien Daniel.—Action of dry and moist air upon plants, by M. Eberhardt. Compared with dry air, moist air increases the development of the plant, both leaves and stem, the diameter of the latter being reduced. It tends to exaggerate the leaf surface and to diminish the quantity of chlorophyll contained in the leaves.—The volcanic rocks of the Somali Protectorate, by MM. A. de Gennes and A. Bonard.—On a marine formation at the bottom of the Cañon of Regalon, by M. David Martin.—On certain substances specific in pellagra, by MM. V. Babès and E. Manicatide.

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