THURSDAY, APRIL 12, 1888.

SOUTH KENSINGTON SCIENCE TEACHING.

WE are glad to notice that the attention of the House of Commons has at last been called to the deplorable condition of the accommodation allotted to the teaching of science at South Kensington. Our readers are aware that this subject is by no means a new one, as attention has frequently been called, not only in our columns, but in those of the leading daily political journals, to what Sir Henry Roscoe, not too strongly, termed "the disgraceful state of things." We believe, however, that Friday evening was the first occasion upon which the subject has been brought before the House of Commons.

When the House went into Committee on the Civil Service Estimates, the vote being for £9900 to complete the Science and Art Department buildings, Sir Henry Roscoe pointed out, in the first place, that the accommodation for the teaching of physics in this our only Government College for the training of science teachers, would in Germany be thought a disgrace in a third-rate town. The site of the make-shift laboratory, which, owing to the increase in the number of the students in this department, was arranged in a temporary building belonging to the French annexe, is now required for the Imperial Institute; and no substitute has yet been found, nor any suggestion offered, beyond that made by Mr. Plunket, that two of the official residences should be devoted to this purpose —a scheme which, we are not surprised to learn, did not meet with the approbation of those who know what is wanted, viz. the authorities of the Department. Mr. Mundella, as a former Vice-President, strongly indorsed the statement respecting the absolute necessity of steps being taken to place the Royal Normal School in a decent position, as far at least as its physical department is concerned. He pointed out the undesirability, to say the least, of removing the residences of the officials of the Museum from the ground, not so much on account of the immediate aid which the resident departmental heads would give in case of fire (though this we consider is important), as because their presence would insure the removal and proper care of the most valuable of the exhibits should such an accident happen. But, apart from these considerations, the idea of the Treasury suggesting that the only Government Science School in England should resort to such means for accommodating perhaps the most important of the experimental sciences is one which could only occur to the English official mind. After all, as Sir George Campbell said, "we are not a nation of paupers," and we may well demand decent accommodation for our National Science School.

The debate was not confined to this relatively small though not unimportant point. Sir H. Roscoe proceeded to explain that this opened the door to a much wider question, viz. that of the permanent housing and protection of the collection of scientific instruments and apparatus, of which he remarked that few persons were aware that we are possessed of one of the finest collections in Europe, containing not only a large number of the most delicate instruments used in physical research, but also apparatus of unique historic value. Such a collection as ours, if it existed in France or in Germany, would be appropriately housed in buildings worthy of its interest and importance; witness the industrial and scientific museums of Berlin and Vienna, or the still more palatial accommodation existing for similar collections in Paris. But in our metropolis these collections are housed in a temporary shed used by the various International Exhibitions, for which miserable accommodation the Government are actually paying a yearly rent of £2000. Reference was made during the debate to the existence of the inter-departmental Report on this subject moved for by Sir Henry Roscoe in June 1886. From this important document it is clear that the proposal to consolidate certain Government scientific institutions, to build a series of galleries on the land west of Exhibition Road, for the purpose of accommodating not only the science collections, but also the National Portrait Gallery and some other collections, met with the approval of all the members of the Committee, consisting of such men as Lord Lingen and Sir F. Bramwell, with the exception of Mr. Milford, at that time the Permanent Secretary of the Office of Works, whose opinion was apparently adverse to the possession of any national science collections at all As might be expected, no steps have, since the publication of this Report, been taken, beyond the removal of the National Portrait Gallery to Bethnal Green. Surely it is time that a state of things which would not be permitted to exist in any decently-sized town on the Continent should be amended. The buildings of the Imperial Institute are now raising their head on the site of the late International Exhibitions, and a road is being driven through from Queen's Gate on the west to Exhibition Road on the east. Plots of land, one directly south of the Imperial Institute buildings, and one north of the Natural History Museum, are now available, and can be purchased from the Commissioners of the 1851 Exhibition by the Government for a comparatively small sum. If this is not soon done, the Commissioners intend to sell their land to private individuals, to build a row of dwelling-houses fronting the road and looking on to the Imperial Institute. Will such a course of things be permitted? Is it possible that the Government, after the report from the ablest men of science and statesmen of the time, should allow this opportunity to pass? We must not; and we have good hopes that the promise of the First Lord of the Treasury, that this question will receive the attention of the Government, will not turn out to be an empty form, and that a statement will be made by the Government on this matter without unreasonable delay.

The debate was enlivened by a passage of arms between Lord Randolph Churchill and Mr. Mundella. The former, in his character of an economic reformer, repudiating what he called the excessive expenditure on buildings, told the House that it had not the remotest idea of the hundreds of thousands of pounds spent by the country in the payment of Professors' salaries, and other forms of encouraging science and art. It is a pity, for the sake of the "Professors," that the return for which Lord Randolph asked is confined to expenditure on bricks and mortar, otherwise he might have learnt how

far his statement of the existence of these luxurious professorships is borne out by fact. Still, we do not wish to quarrel with Lord Randolph's economic mood. We are not concerned to defend every expenditure on buildings or art collections in South Kensington or elsewhere; and it is quite possible that, if these matters are looked into, an extravagance in this direction may be proved. In that case, in Lord Randolph's words, "the hon. member for South Manchester may have more to spend than he has at present," or, to express this in non-Parliamentary phraseology, a larger proportion of the present grant may be devoted to the pressing and important requirements of science.

EXPERIMENTAL RESEARCHES ON HYDRAULIC CEMENTS.

Recherches Expérimentales sur la Constitution des Mortiers Hydrauliques. Par M. H. Le Chatelier, Ingénieur des Mines. (Paris: Vve. Chas. Dunod, 1887.)

THE large employment of concrete for the construction of harbour-works, for building houses, paving streets, and other purposes, has created a considerable demand of late years for hydraulic cements. Cement manufacture is one of the comparatively new industries which have taken root in Ireland. This treatise of M. Le Chatelier is so valuable an addition to our knowledge of the chemistry of a great and important manufacture, that a short abstract of its contents will be welcome to many of the readers of NATURE, especially as the work is of unusual scientific interest.

The chemical reactions which result in the baking and hardening of plaster of Paris, mortars, and hydraulic cements are treated under the following heads: (1) plaster of Paris; (2) barium silicates; (3) hydraulic mortars and cements.

The first scientific investigation of the baking and setting of plaster of Paris was made by Lavoisier, and the process is thus explained by him. There are two stages at which the water is removed from gypsum; three-fourths of the water of hydration are much more easily expelled by heat than the last fourth. When gypsum is dehydrated by heat it absorbs water again with avidity, and suddenly becomes a confused and hardened mass of crystals.

Berthier's observation that plaster of Paris ordinarily contains from 4 to 8 per cent. of water has been confirmed by Landrin. The baking and dehydrating of gypsum was investigated by M. Le Chatelier by observing the periods measured by a chronograph, during which a thermometer marked successive increments of 5° of temperature when plunged into powdered gypsum heated progressively and regularly in a test-tube standing in a bath of paraffin. The longest periods correspond with the greatest heat absorption and dehydrating effect. From 130° to 140° C. the period was 20 minutes 40 seconds, between 165° and 180° C. it was 5 minutes. Dehydration is partial at 155°, but complete at 194° C. There are two distinct phases of dehydration of the compound $CaSO_4 \cdot 2H_2O$: the first corresponds to the formation of $(CaSO_4)_2 \cdot 3H_2O$, the second with $(CaSO_4)_2 \cdot H_2O$; this is plaster of Paris. The hydration which causes the quick setting of plaster can be represented by the equation: $(CaSO_4)_2 \cdot H_2O + 3H_2O = 2(CaSO_4 \cdot 2H_2O)$.

Cause of the Hardening.—It has been shown that a solution of hydrated calcium sulphate dissolves dehydrated plaster, and this after a short interval separates out as crystals of gypsum. This action explains the setting of plaster; water hydrates the compound partially, and dissolves the hydrate to saturation; this dissolves anhydrous sulphate to supersaturation, and deposits it as a hydrate, after which more of the anhydrous salt becomes dissolved. These two opposite actions take place simultaneously at contiguous points. The more rapid the hydration, the greater is the degree of supersaturation, and the quicker the setting of the plaster. Many anhydrous salts harden when in contact with water, as for instance sodium sulphate, but in every case there is a previous formation of a supersaturated solution.

It is established that crystallization which accompanies the setting of plaster of various kinds results from the difference in solubility of the compounds which set, and those which are formed during the setting: the first occur in a state of unstable equilibrium in presence of water, and can have only a transitory existence.

The crystals which form during setting are frequently, if not always, extremely delicate prisms united by one of their ends round central nuclei so as to form little spherical groups.

The mechanics of setting and hardening can be referred to crystallization. Starting with the idea that the hardening of mortars is not an isolated phenomenon without analogy, and that it is certainly similar to, if not identical with, one or other of the known methods, M. Le Chatelier describes these as follows:—Hardening by *compression*, of powders; by *desiccation*, as with clay or gelatine; by fusion and *solidification*, metals; by *crystallization*, soluble salts.

These can be referred to two simpler and more general phenomena:—

Mutual adherence of solid particles, produced at a minute distance from each other.

Mobility of the particles, which admits of their coming together. The momentary solution of a salt which sets affords the necessary mobility of the particles. The setting of mortar evidently enters into the category of phenomena of hardening by solution and crystallization. When the solid particles have once come together the specific hardness will depend upon the internal *cohesion* of the crystals and their mutual *adhesion*.

The *cohesion* of substances varies within very wide limits, of which the extreme terms amongst substances which enter into the composition of cements are: *plaster*, which is soft enough to be scratched by the nail, and *quartz*, hard enough to scratch steel. All we know about cohesion is that it is a primordial property of matter.

Adhesion, unlike cohesion, is a very complex and consequently a very variable phenomenon. Its variations can almost exclusively serve to explain the considerable differences in resistance which are often a distinguishing property in analogous cements. It varies with the chemical nature of the bodies in contact. The adhesion of a crystal of calcium sulphate to a glass plate is *nil*; on the contrary, it is so great with barium silicate that the

crystals break rather than become detached. It also varies with physical conditions, as, for instance, the more or less polished condition of surfaces in contact. The total adhesion is evidently proportional to the extent of surfaces in contact: it will be so much the greater as (1) the volume of empty spaces due to excess of water employed in mixing is less; (2) as each crystal for a given weight of matter presents a great extent of surface (the form of elongated prisms recognized in the crystallization of plaster and of all similar products is eminently favourable to the development of adhesion); (3) as the crystals are grouped so as to increase the volume of empty spaces and so as to diminish their number and isolate them one from the other. A structure like that of pumice is particularly favourable to strength. The nature of the solvent, temperature, and nuclei of crystallization, all serve to modify considerably the growth of crystals, and consequently to influence in a like degree the strength of the mortar. A study of barium silicate has led to the conclusion that its hydration may take place in a manner denoted by the following equations:—

$$BaSiO_3 + 6H_2O = BaSiO_3 \cdot 6H_2O$$
$$Ba_2SiO_4 + 15H_2O = Ba_2SiO_4 \cdot 6H_2O + BaO \cdot 9H_2O$$
$$SiO_2 + BaO \cdot 9H_2O = BaSiO_3 \cdot 6H_2O + 3H_2O.$$

The setting of siliceous baryta cements is due to the production of the same hydrated silicate, $BaSiO_3 \cdot 6H_2O$, in whatever manner it may be formed.

Mortars and Hydraulic Cements.—Calcareous mortars are divided into two classes: air-dried mortars; hydraulic mortars and cements.

Air-dried mortar is made from quick-lime slaked with water and mixed with sand. As Vicat has shown, the first stage of its setting is caused by the desiccation of extremely fine particles of lime, and is identical with the hardening of clay. The sand acts as in the making of bricks—it prevents too much shrinkage by forming an incompressible base or body. A further degree of hardening is caused by the conversion of the lime into carbonate.

The burning of limestone, unlike the dehydration of gypsum, is the result of the phenomenon of dissociation, as was proved by Debray. Various kinds of lime all become burnt at 850° C.

Hydraulic Cements.—These are obtained by baking natural or artificial mixtures of lime and clay, containing from 21 to 27 per cent. of clay.

They are divided into *slow-setting* and *quick-setting* cements. The former are baked at a much higher temperature than the latter. The setting of the former proceeds for some hours, and much facilitates their use.

There appear to be three different anhydrous calcium silicates, of which one only, the tricalcic silicate, $SiO_2 \cdot 3CaO$, is attacked by water, and is capable of setting; there are three calcium aluminates, which all set very quickly after mixing with water; there are ferrites of lime, which slake and swell out like quick-lime, and numerous other compound silicates which are more or less unalterable by water.

The only hydrated salts which can exist in presence of an excess of lime, and which are formed from the above, are:—

Silicate, $SiO_2 \cdot CaO \cdot 5H_2O$.
Aluminate, $Al_2O_3 \cdot 4CaO \cdot 12H_2O$.
Ferrite, $Fe_2O_3 \cdot 4CaO \cdot Aq$.

A microchemical study of anhydrous cements has shown that there are colourless crystals of a pseudo-cubic or hexagonal appearance. The intervals between these crystals are filled with coloured matter without crystalline character, which has been in a state of fusion. The crystals are formed by chemical precipitation in the midst of the brown fusible matter which afterwards solidified on cooling. The composition of the crystals is that of a calcium silicate, and of the amorphous portion of silicates of alumina, iron, and lime; the first compound alone is alterable by the action of water, and is that which plays so important a part in the setting and hardening of cements.

Analyses of four different varieties of cement support the view that this substance is essentially a tricalcic silicate.

There is no free lime in Portland cements of good quality, though there may be aluminates and ferrites.

Drawings taken from microscopic thin sections serve to illustrate the appearance of hydraulic cement when anhydrous and when undergoing hydration.

Lastly, the author deals with the causes of the destruction of hydraulic mortars in the air, in fresh and in salt water.

W. N. HARTLEY.

ELEMENTARY MICROSCOPICAL EXAMINATION.

Elementary Microscopical Examination. By T. Charters White, M.R.C.S., late President of the Quekett Microscopical Club. 104 pp. (London: Roper and Drowley.)

THE author of this work tells us that he has aimed at leading "the possessor of his first microscope into the smooth path of progress, by pointing out the simplest and most elementary methods of observation, and, after so far clearing the way, leading him gradually to the higher branches of microscopical manipulation." It must be admitted that he has succeeded in doing this. His modest little volume is both sound and original, and confirms the conviction that popular treatises, to be of good effect, must be produced by those who have themselves endured the drudgery of routine work and who have acquired their experience first hand. One sees throughout this work traces of a generation which is past, but as the book is not written for the schoolmen of to-day, criticism is, from their stand-point, disarmed.

The little volume is, notwithstanding, one of considerable merit. There may be cited, as bearing testimony to the care with which the author has selected his recipes, the incorporation of the glycerine-alcohol method of preparing delicate tissues, originally introduced by Strasburger. As evidence of originality, we may cite the following: "It (glycerine) needs discrimination in its use, as it cannot be employed for calcareous tissues as bone or shell, as they would become decalcified after being exposed to its influence for some time." Hints such as these, which are the very salvation of the *dilettante*, can only be the outcome of prolonged practical experience, and they testify most powerfully to the intrinsic merit of the work in which they appear. In dealing with photo-micrography the author describes an apparatus designed by himself. He is evidently an expert in this field, and in his device he has aimed at producing a machine which may be constructed by the worker at a minimum cost. A very worthy motive this, but experi-

ence can alone show how far he has succeeded. We should doubt the efficacy of his instrument ourselves, and we certainly cannot indorse his belief that, "however scrupulous the draughtsman may be, however unbiassed he intends to be, errors may creep in, and therefore photo-micrography . . . . comes in to insure complete veracity with a saving of labour."

Woodcuts are given of some few of the accessories enumerated. Chief among them is a very monotonous array of scalpels and probes, which form the frontispiece. Strange to say, the author makes not the least mention of most of those in his text, despite a reference in the index. It is clear, however, from the context, that they are to be regarded as aids to the study of insect anatomy: we have here a superfluity, for choice among the knives represented would be so embarrassing that, by the time the operator made up his mind, the subject itself would be far advanced towards decomposition. The introduction of curved scissors is no less to be deprecated. Apparatus and accessories have a fascination for most people, but the best work has always been done with the simplest tools. It must never be forgotten that it is the head at the one end, and not the mechanical aid at the other, which does the real work.

We would take exception to the introduction of the words "mountant," "semi-hard," and one or two others which might be named. The statement that the mites are "almost the smallest class of created beings" falls very unhappily from a pure microscopist, while the definition given of the Foraminifera needs modification.

We are pleased to note that the author has been mindful of the charms of the tow-net—perhaps the most important instrument in the future of marine zoology. If Mr. White's work be divested of its bugs' heads, and other similar objects which are the mainstay of those for whom he writes, there remains a solid substratum which far excels in merit that of many more pretentious works on the subject.

OUR BOOK SHELF.

A Manual of the Geology of India. Part IV. Mineralogy. By F. R. Mallet. Published by order of the Indian Government. (London: Trübner and Co., 1887.)

WHILE the third volume of this work possessed a certain interest for the statesman and the capitalist, including as it did descriptions of the minerals of economic value, the present one will only claim the attention of scientific readers. It may be a matter of surprise that nearly all that is certainly known about the minerals of India should be capable of compression into less than two hundred pages. But, as the author points out, excavations for mining or other purposes have not, as a rule, been superintended by men possessing the knowledge requisite to enable them to record facts of scientific importance; further, there is no demand for non-economic minerals, and consequently no mercenary incentive to collect specimens.

In looking over the book we are at once struck with the meagre character of much of the information given. Numbers of questions occur which we should like to see settled, but which are unanswerable in the present state of our knowledge, or rather ignorance, of Indian mineralogy. But our author is certainly not to blame for this. He has made the most of the scanty materials at his command, and the result is a valuable contribution to mineralogical science, which will serve as a basis for a future work on the subject worthy of our Indian Empire. The classification adopted is that of Dana, as given in his "System of Mineralogy."

In the collection of materials for the book which we hope will grow out of this, English residents and educated natives might do science much service. The study of mineralogy was extensively pursued in England until displaced by the more attractive subject of stratigraphy, but as India presents such a vast field there is no reason why the subject should not become popular again. Workers in this department will find Mr. Mallet's book of the greatest service.

Through the Yang-tse Gorges. By A. J. Little, F.R.G.S. (London: Sampson Low, 1888.)

MR. LITTLE recently undertook a two months' journey from Shanghai, the metropolis of the Chinese coast, to Chung-King, the commercial metropolis of Western China. The present volume consists of the journal kept during his travels, and an admirable journal it is, full of the results of careful and minute observation, and written in a fresh, lively, and entertaining style. Few travellers, with the exception of "the ubiquitous missionary," have ascended to the highest navigable point of the Yang-tse, the only road of intercommunication between the eastern and western districts of the Chinese Empire. Most readers, therefore, will find in this book much that is new to them about the Chinese people and their country. There are many vivid descriptions of the varied scenery through which Mr. Little passed, and his notes on industries, social customs, and popular religious ideas are invariably interesting and suggestive. Upon the whole, he has no very exalted opinion of the intellectual and moral qualities of the Chinese, and he is not disposed to believe that the empire, under the influence of Western ideas, is about to enter upon a new and momentous stage of political and social development. Everywhere he found the bureaucracy intensely conservative, and bitterly prejudiced against foreigners. They are willing enough to adopt superior mechanical appliances, so far as implements of war are concerned; but in all other matters they prefer to move along the old lines, which, having been good enough for their forefathers, must, they think, be good enough for themselves.

Home Experiments in Science. By T.O'Conor Sloane, Ph.D. (London: Sampson Low, Marston, Searle, and Rivington, 1888.)

THE author of this work has produced a very readable and useful book for those who wish to employ their leisure hours in gaining knowledge and information about the elementary parts of the various branches of science. The volume consists of a collection of experiments that can be easily performed with home-made apparatus; good detailed instruction as to the necessary mechanical operations is given, together with ninety-seven woodcuts of the experiments and the apparatus employed. The branches of science included in these experiments are mechanics, general and molecular physics; the chapter on soap-bubbles contains some very interesting experiments about them; and the concluding chapter consists of hints to those who are about to begin scientific lecturing.

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.*]

Prof. Rosenbusch's Work on Petrology.

OF the great value of Prof. Rosenbusch's work on petrology, so excellently reviewed by Dr. Hatch, to which your corre-

spondent "A. B." draws attention, there can be no doubt, so far as it is regarded as a storehouse of information; but whether the system of classification proposed therein will not tend to retard rather than to further progress is a question on which I am at present more than doubtful. The two points to which Dr. Hatch and your correspondent draw attention as inherent weaknesses—viz. the "dyke rocks," and the subdivision of the "effusive rocks" into palæo-volcanic and neo-volcanic—appear to me such serious defects, that to praise a system which largely rests on them is like complimenting a viaduct by saying that it is an excellent viaduct but two of its piers unfortunately have a bad foundation.

But dismissing this as a question too large for discussion in your columns, I will confine my remarks to some defects in detail, rather serious as they appear to me, which are exhibited by the classification as tabulated by your correspondent.

(1) A mere "linear" classification fails, I believe, to represent satisfactorily the relation of the igneous rocks, because it separates too widely rocks very closely related—such, for instance, as the Dacites and Rhyolites (Liparites), and their corresponding holocrystalline representatives. Hence I believe that the branching system such as I indicated in my Presidential Address to the Geological Society in 1885 is more logical and more in accordance with the facts of Nature.

(2) In regard to the above example, I fail to understand why Dacites should be included with Andesites and Liparites separated from Trachytes, or, if we speak of their holocrystalline representatives, why we should separate Granite from Syenite, while we include Tonalite with Diorite. It is true that Granites are common and Tonalites are rare, and possibly the latter always contain some hornblende; but until it is shown that a quartz-plagioclase-biotite rock does not exist, or that the substitution of hornblende for biotite is of primary importance, there does not seem any valid reason for suppressing the group.

(3) As the term Diabase has long had a recognized meaning, I fail to see any good reason for substituting it for Dolerite, to which, as generally understood, it stands in much the same relation as do many Serpentines to Peridotites. Neither can I admit the propriety of separating Gabbro from it.

(4) The wide separation of the Leucite and Nepheline rocks from the Basalts seems also to me to be of doubtful advantage.

(5) If the term Peridotite be used in the sense in which it has generally been employed (*e.g.* by Dr. Wadsworth in his excellent "Lithological Studies")—namely, to denote a rock in which silicates of magnesia and iron abound, with some also containing lime but with little alumina—it is surely not possible to regard Limburgite as its "effusive" equivalent. That rock seems to me to be more properly associated with the Picrites, not as defined by Dr. Wadsworth (*i.e.* olivine-augite rocks), but as equivalent to the Palæopicrites of some authors—viz. pyroxenic rocks, containing a fair amount of olivine, and some feldspar, which last, however, has a very variable proportion. The true position of these rocks appears to me to be as a connecting-link between the Peridotites and the Dolerites.

There are other points in the work to which I should like to call attention, but I am writing away from books, and should have refrained for a season had not "A. B.'s" letter seemed to me to call for a word of friendly protest. No one can be more deeply sensible than I am of the value in many respects of Prof. Rosenbusch's work, but until his classification rests on a firmer foundation it will not, I fear, be really helpful to students in leading them to clearer ideas on a complicated and difficult subject.

T. G. BONNEY.

The Delicacy of the Sense of Taste.

AT the Philadelphia meeting of the American Association, in 1884, we presented a paper upon the general subject of the "Sensitiveness of the Special Senses." We have since continued our investigations,[1] and have the honour to present at this time the results of some experiments upon the sense of taste.

The object of the experiments herein described was to find out what substances, or classes of substances, are most readily detected by the sense of taste, and the relative delicacy of this sense towards these substances. For the production of familiar typical effects upon the organs of sense the following substances were selected:—

I. (bitter)	. . .	Quinine.
II. (sweet)	. . .	Cane sugar.
III. (acid)	. . .	Sulphuric acid.
IV. (alkaline)	. . .	Sodium bicarbonate.
V. (saline)	. . .	Common salt.

The attempt was made to include other substances in this list, but it was difficult to find any, not embraced in the five classes above mentioned, which would not betray their presence either by colour or odour. Indeed it is surprising, to one who has not given the subject attention, to what an extent we are accustomed to depend upon the aid of the sense of smell in the classification of tastes. The fact has been noticed by several authors that, if the nostrils are closed, the range of our taste becomes very much limited.

Our method of testing the delicacy of the sense of taste was to make solutions, of known strength, of the different substances; then, by successive dilutions, to make from these several series of weaker solutions; each one being of one-half the strength of that preceding it. All the bottles containing these substances, and several bottles of water, being placed side by side without regard to order, the person to be tested was requested to taste of each solution and place it in its proper class. In each series the lowest solution was so very dilute that it was deemed impossible to distinguish it from water. Unknown solutions were to be classed with water. As the tasters were found to be liable to mistake occasionally even the stronger solutions, an opportunity was given, at the close of the test, to correct such accidental errors. In carrying out these tests we found that the most trustworthy results were to be obtained by instructing each operator to pick out the stronger solutions, temporarily classifying with water all which were not immediately recognized; and then to go over the latter solutions a second time, properly classifying such as could further be detected.

These tests were made by 128 persons, between the ages of twelve and fifty—eighty-two men and forty-six women. The average results are given in the following table:—

Table of Averages.

I. *Quinine.*
Male observers detected 1 part in 390,000 parts of water.
Female ,, ,, 1 ,, 456,000 ,, ,,

II. *Cane sugar.*
Male observers detected 1 part in 199 parts of water.
Female ,, ,, 1 ,, 204 ,, ,,

III. *Sulphuric acid.*
Male observers detected 1 part in 2080 parts of water.
Female ,, ,, 1 ,, 3280 ,, ,,

IV. *Bicarbonate of soda.*
Male observers detected 1 part in 98 parts of water.
Female ,, ,, 1 ,, 126 ,, ,,

V. *Common salt.*
Male observers detected 1 part in 2240 parts of water.
Female ,, ,, 1 ,, 1980 ,, ,,

This table indicates only the *average* delicacy of taste for each substance included in our experiments. The tests brought to light many astonishing individual peculiarities. For instance, there were persons who could detect with certainty 1 part of quinine in 5,120,000, while others failed to notice 1 part in 160,000. How far this difference is due to education it is not possible to say. Among the tasters were quite a large number who had been accustomed for several years to the handling and recognition of drugs and chemicals. Their record was considerably above the general average, but they were, on the other hand, surpassed by a few individuals who had had no previous training.

The results of our experiments may be briefly summed up as follows:—

1. The sense of taste is much more delicate for bitter substances than for the others included in our list. (The relative delicacy for quinine and sugar is very nearly 2000 : 1.)

2. Taken in the order of their effect upon the organs of taste,

[1] See the following papers:—"On the Relative Bitterness of different Bitter Substances" (Proceedings of the Kansas Academy of Sciences, 1885); ; "On the Relative Sweetness of different Sugars" (Reports of the Kansas Board of Agriculture. 1885); "On the Sensitiveness of the Eye for Colours of a Low Degree of Saturation" (*American Journal of Science*, III. vol. xxx. p. 27); "The Sense of Smell" (NATURE, vol. xxxv. p. 74).

the classes of substances used stand as follows: (1) bitters; (2) acids; (3) saline substances; (4) sweets; (5) alkalies.

3. The sense of taste is as a rule more delicate in women than in men (in the case of all substances tried excepting salt). The number of persons experimented upon was hardly sufficient, considering the very striking individual peculiarities met with in the course of our investigation, to permit us to lay great stress upon the relative averages obtained for the two sexes. We are not inclined, however, to regard the higher degree of sensitiveness shown in the averages for female observers as accidental, and our confidence in the approximate value of the results is strengthened by the fact that in the two portions into which our data naturally divided themselves, about half the tests having been made at a different time and under different circumstances from the remainder, the averages for each set agreed very well, not only as to the relative sensitiveness to the various substances employed, but also to the relatively higher degree of delicacy exhibited by women.

4. The ability to detect a dilute bitter is very generally accompanied by inability to detect a dilute sweet, and *vice versâ*.

5. The long-continued habitual use of a substance does not seem to influence in any marked way the delicacy of the sense of taste for that substance. Our tests with quinine afforded an excellent opportunity for the investigation of this point, as some of the persons experimented upon had made long continued use of that drug as a medicine. The results obtained were entirely of a negative character. We could discover neither increase nor decrease in the ability to taste the drug on the part of those habituated to its use.

Several other questions have been raised but not answered by our experiments. How many, for instance, of these substances, each being diluted in proportion to its effect upon the organs of taste, can be detected if mixed together? If so mixed, in what order will they be recognized, and will it always be in the same order by different persons? Again, what is the influence of the temperature of the solution upon our ability to taste its ingredients?

We deplore the fact that the above tests have not been extended to a much larger number of persons, but a careful study of the results of the limited number of experiments made leads us to believe that they do not differ widely from the probable averages of a much more extended series.

E. H. S. BAILEY.
University of Kansas, July 1887. E. L. NICHOLS.

The Salt Industry in the United States.

HAVING occasion not long since to look up the statistics of the salt industry, I naturally turned to the latest edition of the "Encyclopædia Britannica" (vol. xxi.), where the following statement met my eye:—"The deposits of salt in the United States are unimportant. The country possesses no really considerable salt industry, but is supplied so far as interior consumption is concerned to a small extent by brine springs."

As this did not at all correspond with the knowledge I had gained by a somewhat casual glance over the field, I took pains to look up the subject more thoroughly, and find the above statement so radically wrong that I venture to call your attention to it; though this I should scarcely have troubled myself to do had it appeared in any publication of less acknowledged authority. To be sure, we have no means of knowing just how great an industry must be to be classed as "really considerable," but by comparing the annual product of the United States with that of other countries we may claim, at least, an attempt at an approximation.

But first as to the character of the beds in the United States. It is true there are as yet known no beds comparable in depth and extent with those of Barcelona or Galicia, but nevertheless they are amply sufficient to supply all demands for ages. As long ago as 1869, Dr. Sterry Hunt published, in the Reports of the Geological Survey of Canada, results of borings at Goderich, Canada, in which, in a total depth of 1382 feet, six successive beds of salt were passed through, varying in thickness from 6 to 34 feet, and aggregating a total thickness of 126 feet. What area is covered by these deposits is yet to be ascertained; but they are known to extend over Central and Western New York, Northern Pennsylvania, North-Western Ohio, and Southern Ontario. At Warsaw, in New York State, one of the beds has a thickness of 80 feet. The extent of the deposit at Petite Ainse, Louisiana, has also yet to be determined, but a vertical shaft 165 feet in depth lies all the way in solid salt, and does not penetrate it. The above, although but two out of many, I mention since they have been known for years, and it would seem Mr. Lyte could have informed himself regarding them had he so attempted. Concerning the many extensive beds in the region of the Great Basin, ignorance is more excusable. Statistics showing the annual output of both rock and sea salt will best show the extent of the industry. I give below statistics for 1883, 1884, and 1885, taken from "Mineral Resources of the United States," p. 474. One barrel equals 280 lbs.

	1883. Barrels.	1884. Barrels.	1885. Barrels.
Michigan	2,894,672	3,161,806	3,297,403
New York	1,619,486	1,788,434	3,304,787
Ohio	350,000	320,000	306,847
West Virginia ...	320,000	310,000	223,184
Louisiana	265,215	223,964	229,271
California	214,286	178,571	221,428
Utah	107,143	114,285	107,140
Nevada	21,429	17,857	28,593
All other States and Territories ...	400,000	400,000	250,000
Totals ...	6,192,231	6,514,937	7,038,653

Complete statistics for all countries are not available, and I have to rely to a considerable extent on Encyclopædias, whose accuracy I now have reason to question. They are as follow:—

England (1881) ...	1,854,000 tons.
France ...	300,000 ,,
Spain ...	300,000 ,,
Portugal ...	250,000 ,,
Italy ...	165,000 ,,
Austria ...	400,000 ,,

	1881.	1882.
United States ...	834,548 tons.	897,732 tons.

In regard to the above figures, I confess to feeling sceptical save with reference to those of the United States and England. Nevertheless, granting that they do not give the full amounts by one-half, even then the United States stands second in the list of salt-producing countries.

What, then, constitutes a really considerable industry?

GEORGE P. MERRILL.
U. S. National Museum, Washington, D.C.,
December 3, 1887.

Force, and Newton's Third Law.

THE point mentioned by "Nemo" in your issue of March 29 (p. 511) is undoubtedly one that troubles most students at some stage or other, but there is no room for discussion about it; the matter lies in a nutshell: *a body does not exert force upon itself.* Think, for instance, of a horse and cart. The horse pulls the cart, and the cart pulls back the horse equally; how, then, can the cart move? The only puzzle lies in the false implication that the cart's pull-back is exerted upon the *cart*. Directly it is perceived that there is only one force acting on the cart, viz. the pull of the horse, no difficulty is felt as to why it moves. The "action" of A is not exerted upon A, but upon B. The "reaction" of B is not exerted upon B, but upon A. The time-rate of change of momentum of each and every body is equal to the total force acting upon it. OLIVER J. LODGE.

Grasmere, March 31.

The New Photographic Objective.

THE letter of Sir Howard Grubb in your issue of March 8 (p. 439) appears to make some further explanation desirable on my part. The invention of the new form of photographic objective seems to have been made about the same time in America and in England. An experimental lens of this kind was constructed by the Messrs. Clark, after consultation with me, in May 1887. The 13-inch lens which they subsequently made upon the same plan was completed on July 8 of that year. My absence during the summer in Colorado, with the intention of selecting a place for the new instrument upon some mountain of considerable height, caused me to overlook the account of the English invention in the *Observatory*. Since my return, the telescope has been mounted in Cambridge, on the grounds of

this institution, where it is found to give highly satisfactory results. Photographs of η Orionis which have been made with it exhibit the elongation of the star, although the distance between its components is only about 1″. The newspaper report to which Sir Howard Grubb refers, that a patent was granted for the invention, is without foundation. The Messrs. Clark have never patented any of the improvements made by them in optics, and have had no intention of deviating from their usual practice in this instance.

EDWARD C. PICKERING.

Harvard College Observatory, Cambridge, U.S., March 26.

Life of Fleeming Jenkin.

I HAVE read with singular pain a paragraph in your notice (signed with the initials of one whom I admire and respect) of my Life of Fleeming Jenkin. To accuse a man of falsehood in private life is a strong step. But I must explain to your reviewer, I might lie to him all day long and not be so disgraced as if I put one single falsehood in a book. For the making of books is my trade by which I live; I supply them on honour, and the public gives me bread for them in confidence. Your reviewer will perhaps more readily understand what he has done (I am sure in ignorance) if I supply him with a parallel. To say that a man of science was a liar would be highly disagreeable; but if I were to say he had falsified an experiment, and to say so publicly in print, I should be curious to see the expression of his face.

I dwell upon this because it is plain your reviewer scarcely understands what literature is, and I fear others may be equally at sea. On the merely personal matter, that I am supposed to tell a deliberate falsehood on my own authority and about my dead friend, I will make but one remark. Hasty reading is the fit precursor of hasty writing; in no word have I indicated that the certificate in question was "worthy the name"; and the terms of the document are at the reviewer's service to-morrow, if he be curious.

ROBERT LOUIS STEVENSON.

March 28.

THE HITTITES, WITH SPECIAL REFERENCE TO VERY RECENT DISCOVERIES.

III.

THE conclusion has been already expressed that the Hittite inscription of the Tarkutimme seal is, in the main, ideographic, and that the phonetic element is supplementary; that, in fact, regarding the figure of the king as part of the inscription, the sense is fully given without taking into account the phonetic element. Some scholars and investigators have, however, taken a different view. This fact, together with the alleged resemblance of some of the Hittite hieroglyphs to characters of the Cypriote syllabary, has had much influence on certain recent attempts at deciphering the Hittite inscriptions. With regard to the alleged analogy of the Hittite and Cypriote characters, it may be allowed that the derivation of the latter from the former is in itself by no means impossible. As yet, however, the evidence of such derivation which has been presented is certainly inadequate: to a great extent it is little better than visionary. Moreover, if, from closeness of resemblance or otherwise, satisfactory proof of the derivation had been given, it would by no means necessarily follow that, when all or any of the Hittite inscriptions which we possess were sculptured, the Hittite writing had become already so far developed that the hieroglyphs generally, or in great proportion, had acquired distinct syllabic values. As to how far resemblances between the Hittite and Cypriote characters give evidence of essential connection or derivation, the reader may perhaps satisfy himself by inspecting the list given by Dr. Isaac Taylor ("The Alphabet," 1883) and reproduced by Prof. Sayce in Wright's "Empire of the Hittites," 1886, chap. xi. More extended lists have been given by Captain Conder (who follows to a considerable extent in the track of Prof. Sayce) in the plates of his "Altaic Hieroglyphs." But, as it seems to me, in neither case have the Hittite characters been always given with such essential accuracy as is desirable. This remark applies more especially to some of Captain Conder's figures, notwithstanding his observation in "Altaic Hieroglyphs," p. 35: "A careless reading and confusion of distinct emblems must lead us wrong; and for this reason exact copies are indispensable." But, even if this objection be waived, the evidence must still be regarded as inadequate. As to "the subject of the inscriptions," Captain Conder remarks that it "is exactly what we should have expected. They occur on statues of the gods, and they are invocations only" (*op. cit.* p. 149). Now that the inscriptions "occur on statues of the gods" is certainly not true with regard to most of those which are known to us, and as we have them. The "doorway inscription" in the British Museum and the inscriptions from Hamath are connected with no statue whatever. In other cases, where there is a statue, or large figure in relief, it is by no means to be assumed that the figure is always that of a deity. But, as a specimen of what Captain Conder finds in the Hittite inscriptions, I may give his "free rendering" of the first two lines of that very ancient inscription in the British Museum of which I have just spoken as the "doorway inscription." I give Captain Conder's "free rendering" rather than his "verbatim translation," as likely to convey a less unfavourable impression:—

"1. Prayers of the Monument of Set. Powerful words for the living fire, the Most High . . . the divine. . . .

"2. . . . to . . . (pour?) Tammuz, Āa, living fire, Most High descending (propitious?) Thee strong Set . . ." ("Altaic Hieroglyphs," p. 194).

With respect to utterances of this kind it is not necessary to say much more than that they certainly have not the claim to consideration which would result from a connected and congrous rendering. Such a rendering might have been adduced as giving some answer to the position that evidence is wanting as to the Hittite hieroglyphs representing, in the main, syllables either in the Accadian or Altaic language, or in any other language whatever. Then, as to the inscriptions being concerned mainly or exclusively with theological prayers and invocations, the analogy of the Assyrian inscriptions—which the Tarkutimme seal with its cuneiform legend itself suggests—would rather lead us to expect that the subject-matter of the inscriptions is usually success in war, with allusions to the gods, and prayers and thanksgivings, chiefly in relation to such success. And this more realistic view is in accordance with the heads of oxen and of asses, with the clubs and the swords, and other symbols of equally materialistic character which appear on the inscriptions. Moreover, somewhat more than a year ago, the British Museum fortunately obtained an engraved stone of unquestionable antiquity, giving evidence in accordance with that of the seal of Tarkutimme, and tending to show that the Hittite inscriptions are in the main ideographic or pictorial.

The allusion just made has reference to a circular hæmatite seal from Yuzgât, in Asia Minor, which was added to the antiquarian treasures of the Museum in October 1886. Yuzgât is not very far from both Boghaz-Keui and Eyuk; therefore the discovery in this locality of an important Hittite antiquity can scarcely excite surprise. For the present, the seal is named, most conveniently, from the place where it was found, "the Yuzgât seal." This seal resembles the seal of Tarkutimme in being circular; and the two seals agree also with reference to there being an inner circle which divides the figures or characters round the circumference from those in the central space. The seals differ, however, in size, the Yuzgât seal being much the smaller. The latter seal, moreover, is not bilin-

[1] Based on Lectures delivered by Mr. Thomas Tyler at the British Museum in January 1888. Continued from p. 540.

gual, and it has not a convexity of surface, like the seal of Tarkutimme. The Yuzgât seal, in fact, is flat, with the exception of the central space, which is concave, and which consequently causes a central convexity in the impression. On careful observation it may be perceived that the figures on the circumference divide themselves into three groups. In the centre of the first group is the winged solar disk supported on a cone. It seems not unlikely that this cone is essentially identical with the "king"-symbol already discussed in connection with the Tarkutimme seal. Here it may point to the prominence and pre-eminence of the sun-god as ruler of the world, all things animate and inanimate being subjected to his sway. The solar king in the centre, with the two figures, one half-kneeling and one standing, on each side, constitute the first group. These two figures on each side present features of very great interest. Nearest to the solar emblem are two horned ox-headed figures, apparently masculine, with the palms of the hands uplifted, in the act of adoration. The ox's head is not here presented in profile, as is usually the case on the Hittite monuments, but the horns and ears and the tapering muzzle are depicted with sufficient clearness. These figures may be taken as representing the moon-god, and recalling in

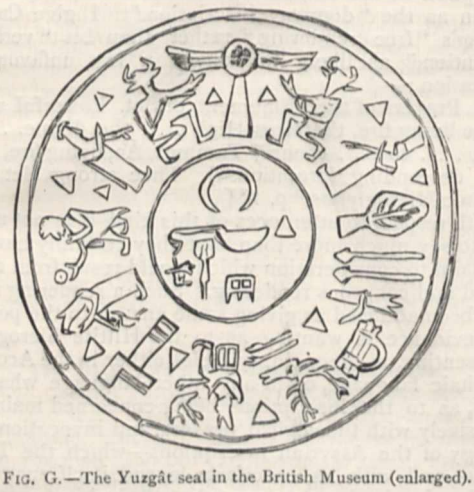

FIG. G.—The Yuzgât seal in the British Museum (enlarged).

their masculinity the Babylonian moon-god Sin. This seeming masculinity should be remembered if a comparison is made with other ox- or cow-headed figures of deities, as, for example, those found by Dr. Schliemann, and about which there was not very long ago some discussion. More distant from the solar emblem are two draped figures which we may regard as types of the female deity Ashtoreth, viewed as a moon-goddess. There is tolerably clear evidence that one of these draped figures is horned, and probably also ox-headed. In the case of the other, on account of a flaw in the seal, this is not equally manifest. Though the attitude is different, these female lunar deities appear also to be worshipping the sun-god. The lunar deities, like other figures on the seal, appear all to have turned-up toes, indicating probably the so-called "Hittite boots."[1] With these figures of lunar deities may be compared a symbol of Ashtoreth as a moon-goddess on the longest Hamath inscription, giving a crescent moon with the head of an ox above and within it, while beneath is an equilateral triangle or else a cone.[1]

If we strike a diameter across the seal from the solar disk, it will come, towards its extremity, to what is apparently a king seated on his throne and wearing a cap with a horn in front. Between the king and the group of sacred figures already described, there is on each side a distinct group, making up altogether the three groups which I have mentioned. Of the two groups not yet described the more interesting, on account of its resemblance to what may be seen on the inscriptions, is the group behind the king. There appears strong reason to believe that in this group we have a genuine example of picture-writing, in which the successful chase of a stag is represented. There is first (most remote from the king) a tree, indicating the forest, where the hunt occurred. Then come two javelins, used no doubt by the hunters of the stag, and next after these there is a sort of trident, employed, I should suppose, to give the *coup de grâce*, and of this trident I shall have an additional word to say directly. Next to the trident we find a bundle, or basket with a handle, which naturally suggests the idea of carrying. Then there is a stag's head with large antlers, and beneath it two arms with hands pointing towards the king. As the king is sitting with his face towards the group of figures in front of him, the engraver, in order to denote the king's acceptance of the stag's head (which may represent the whole

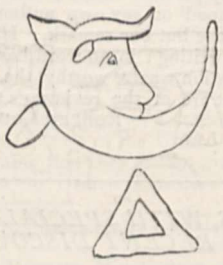

FIG. H.—Symbol of Ashtoreth, on Hamath inscription.

stag), has given on the other side, and above the king's arm outstretched to receive it, the stag's head a second time, of smaller size and consequently somewhat less artistically rendered. In the third group, beginning with the figure most distant from the king, we have what is very likely a tributary king, bringing a gift or tribute. Before him is what I take to be a woman veiled after the Oriental fashion, and with probably a baby suspended from her arm. With this appendage she may possibly have been regarded as likely to prove more acceptable to the king. Between the woman and the king is what I have regarded as a conventional symbol of a castle, indicating that the presents were received by the king in his castle. The symbol is difficult to determine; but I cannot find any more probable explanation. What it is particularly important to observe is, that the other two groups on the circumference of the seal being pictorial or ideographic, it is scarcely possible to escape the conclusion that the third group—that which I have regarded as representing the successful chase of a stag—is of the like character.

Of the objects in the central space I am unable to speak with any confidence. They may be so placed as objects of interest merely, or, taken phonetically, they may denote a name. There is a crescent, beneath it a nearly semicircular knife with a handle (if it is not possibly a ladle seen in profile), a mace or club, a sort of grating, and a trident smaller than that in the outer

[1] It is worthy of note here that about a third of the circumference is occupied by these sacred figures. From this fact may be derived a probable explanation of the vacant space over the king's head in the seal of Tarkutimme (*supra*, p. 537). The engraver, we may suppose, when he commenced engraving the king's name, intended to devote a third of the circumference to sacred objects, or at least to leave it vacant as usually so devoted. He, however, miscalculated the space at his disposal. Resolved, however, to leave some vacant space at the top, and especially over the king's head, he was compelled to leave a space in the middle of a word. Prof. Sayce has given a different explanation (*Zeitschr. für Assyriologie*, November 1886.)

[1] Mr. Rylands's drawing of the inscription gives the former, and this may possibly be right, though the cast of the inscription in the British Museum does not make this altogether clear. The original is unfortunately at Constantinople.

circle. Besides these objects, there is an equilateral triangle, like eleven others among the symbols in the outer circle. I was inclined to think that these triangles might perhaps in some way modify the meaning of the other symbols, till I noticed that not only does their size differ, but also that the vertex of the triangle, usually directed upwards, may be directed downwards to suit better the shape of the surrounding area. This is clearly seen in the space between the larger stag's head and the king. We cannot, however, come to the conclusion that these triangles are employed merely for artistic effect, and to fill up vacant spaces, even if these objects were not wholly disregarded. The recently-discovered Tarsus seal gives important evidence in favour of the sacredness of the equilateral triangle. We must conclude that the triangle is employed on the Yuzgât seal as a sacred symbol, and that as such its vertex is usually directed upward, but that this position is sometimes varied in accordance with the exigencies of space.

With regard to the group on the seal, concerned with the chase of a stag, I have spoken of its resemblance to what may be seen on the Hittite inscriptions. This is especially noteworthy with regard to the group represented in Fig. I, from the so-called doorway inscription in the British Museum. Progress in decipherment is not as yet sufficiently advanced to enable us to determine the precise significance of all the symbols, but of the general meaning there seems no room to doubt. Beginning from the end of the figure to the reader's right, the meaning

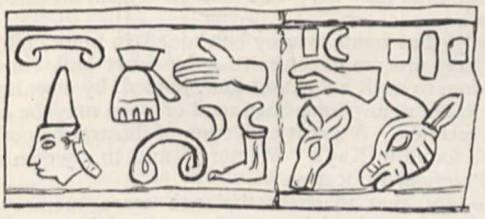

FIG. I.—Group of symbols from Jerablûs monument in the British Museum.

intended to be conveyed appears to be that booty in the shape of many oxen, asses, and other treasure, which had been obtained by the powerful assistance of the gods, was presented to the king. The parallelogram with a square on each side I regard as indicating "many." That this was the sign of plurality was the opinion of my distinguished friend, the late Dr. Birch. The head of the ox and of the ass do not seem to require remark; but above the latter is a massive and powerful right hand, with fingers clenched, and with part of the fore-arm. This would be a very appropriate symbol of strength or power.[1] Close above the right hand, and at the top, are a straight stroke, or parallelogram, with a crescent beside it. These symbols combine to form the usual symbol of deity on the Jerablûs monuments. I can only assert this now; but the evidence is abundant, and I hope to prove it fully in the sequel. Next after the closed fist with the symbol of deity comes part of an arm with the hand open and pointing towards the king. The analogy between this hand and those beneath the stag's head on the Yuzgât seal is almost too obvious to require remark. Of the value of the two crescents, which are, so to speak, back to back—a symbol not uncommon on other inscriptions—I cannot speak with any confidence.[2] At the bottom is a foot, which would very appropriately denote the act of going to the king. Next to the open hand at top is a symbol

[1] Cf. "The saving strength of his right hand" (Psalm xx. 6), and "his right hand, and his holy arm, hath gotten him the victory" (Psalm xcviii. 1). But the figurative use of the right hand as a symbol of strength presents no difficulty.

[2] It seems not unlikely, however, having regard to the symbols which the two crescents accompany here and elsewhere, that they distinguish a particular kind or class of persons.

the origin of which Mr. Rylands, to the best of my recollection, formerly referred to a bag grasped and pressed together a little below its mouth, by a hand. If this view is correct, this symbol has become, like many others, somewhat conventionalized. The bag is depicted so as to enable us to see within it at the bottom. Here are three objects, probably pieces of gold or silver used as uncoined money; and the number three may, as elsewhere, denote a great many. Beneath the bag is what has been regarded as a yoke; and, having regard to the bundle or basket on the Yuzgât seal, this may very well denote the carrying to the king. Last comes the head of the king himself, with conical cap and "pig-tail," and above him is a symbol which is perhaps best regarded as derived from the idea of a canopy above the king. As on the Yuzgât seal, the king's face is turned away, but this is because the inscription is intended to be read *with the faces*—that is, in the direction towards which the faces point—and not, as some have asserted, *against the faces*. The former arrangement is the more natural, and would have *a priori* the greater probability, but the latter is commonly, though, as Dr. Birch once said with reference to this point, not invariably, observed on the Egyptian monuments. In support of the latter view it is alleged that there is usually, at one end of the first line of the inscriptions, part of a figure with the face turned away from the other characters in the line, but with the fingers pointing towards the face or mouth, as though indicating "I have something to say." This figure, it is

FIG. K.—Figure from Jerablûs monument in the British Museum.

urged, must mark the beginning of the inscription, and, as the face is turned away, the characters must be read against the faces. But, in the first place, the figure referred to occurs elsewhere, and not solely and invariably at one end (to the reader's right) of the first line. The significance of the figure is, in all probability, as stated, but, as the figure is evidently that of a servant or minister, and not that of the king or other great personage with whose doings the inscription may be supposed to be concerned, we should expect in the first place, and before the particular message, or the subject-matter of the inscription, is entered upon, a statement of the name and titles of the person from whom the message proceeds. At the commencement of the Assyrian inscriptions there is often a very copious statement of this kind. And in fact on three of the Hamath inscriptions there is what appears to be a name immediately before the figure with the hand towards the mouth. The group of symbols discussed just above gives pretty strong evidence as to the direction in which the inscription in which they occur is to be read; and I hope to give some further evidence on this point in the sequel.

A word must be here added with respect to the trident on the Yuzgât seal. The trident is more usually associated with the sea and the sea-god than with warfare on land, or the chase. It was employed, indeed, in the Roman arena; but, as the gladiator using it was furnished also with a net, there may seem to be still some reminiscence of the sea. With regard to the trident being employed in the chase, I may adduce the evidence of a curious seal-impression which I obtained some time ago from Mr. Ready, of the British Museum. The objects

depicted are apparently the head of an animal, probably some kind of goat or ibex, parts of the animal's carcass, and a trident essentially similar to those on the Yuzgât seal. Mr. Ready is unable to tell me in what

FIG. I.—Seal with figures (enlarged).

collection this curious seal, which is very small, is to be found. So far as I am aware, it is not in the British Museum.

PRACTICAL EDUCATION.

PLAINLY speaking, it must be admitted that to an impartial observer the great problem of anthropology is this: Is the mind, or soul, a mysterious and supernatural, yet at the same time a definite limited *quantity*, with certain set "spiritual" functions, or is it, being of material growth, capable of infinite development? The former is the metaphysical view of the subject, the latter that of the evolutionary physiologist. Without deciding which is the true school, it may be remarked that the metaphysicians have long ceased to teach anything new, while physiology gives us, almost daily, facts of an astonishing nature. Here and there in the works of Darwin, Carpenter, Haeckel, Huxley, Bain, Maudsley, Spencer, and David Kay, we find what would have been "conclusions most forbidden," even to a Rosicrucian or Cabalist, in days of yore. And these are that man may develop his memory and other faculties in the simplest and most practical manner, as a bee builds its combs, grain by grain, until he shall far surpass what he has ever been. These discoveries as to man are in exact step with the stupendous revelations of the spectrum analysis, and the scientific reduction of the elements.

I recently published a work, the result of many years' labour, entitled "Practical Education," in which I endeavoured to give the results of experiments with nearly two thousand pupils, combined with the suggestions in the works of the writers above alluded to.[1] Having long been occupied with investigating the problem of technical education, I offered to the School Board of Philadelphia, in 1880, to devote myself entirely to the experiment of ascertaining *exactly what children could do*. That boys and girls from eight to fourteen years of age could *not* set type, make shoes, execute heavy carpenters' work, &c., had already been ascertained in Pennsylvania at a cost of about £200,000. I had, however, learned in Egypt, South Germany, and other places, that the very young can execute the decorative work which is known as that of the minor arts, and that so well that it had a market value.

Walter Smith, now of Bradford, had published a system by which design was taught at the same time with drawing. I had, two years before I met with Smith's system, which is now much employed in America, set forth the same idea in a work entitled "The Minor Arts." It soon became apparent that, by beginning with design, the youngest child developed—with invention—interest, attention, and intelligence. The results went far beyond my anticipation. It was found by the most careful inquiry that the pupils who attended the art classes had the highest "averages" in other studies, such as arithmetic, geography, and composition. This fact is the more striking from this—that the School Board, having made inquiries unknown to me, found that among 110,000 pupils the 200 who attended the Industrial Art School were among the first in *everything*.

An immediate inference from this fact is that visual perception or eye-memory (as set forth by Francis Galton) and attention or interest (as explained by Dr. Maudsley) are also factors which enter into the training of the constructive faculty. These, as is clearly explained and very fully illustrated by David Kay in his admirable work on "Memory," lead us to the conclusion that memory, by a simple process of accretion and repetition, may be developed to an incredible extent even in children. Practically, this was nothing new. Before the invention of printing, men by millions, among Druids and Brahmins and Northmen, Red Indians and mediæval scholars, Chinese and Japanese, had shown that an individual could remember perfectly what is now represented by a library. Max Müller has proved this. I myself have known a graduate of Pekin who fully illustrated it.

Memory is not "mind" or intelligence. Yet the works of Homer, the "Mahabharata," and the great scientific grammar of Pānini, were taken down and preserved for centuries by memory alone. The great history of Japan, by Hirata Atsune, was composed without the author's taking a note, and written from recollection, without reference to an original work. What man has done man may do. The deduction from all this is as follows:—

Firstly, that memory may be trained in mere children, by an easy process of committing by heart and constant reviewing, to such an extent that, guided by attention or determination, anything once read or seen may be accurately recalled. A great collection of illustrations of this may be found in Kay's "Memory," and in my own work on "Practical Education."

Secondly, that to counterbalance mere memory the mind must be trained by exercises in quickness of perception. These, in the beginning, may be merely mechanical. There are steps from inducing an infant to notice an orange on the floor up to simple games, from games to mental arithmetic or mental geography and grammar, to problems requiring the highest intelligence. The process is like that in developing memory—*little by little with constant reviewing*. And, as is the case with memory, all this has been established by innumerable practical examples. But with the one, as with the other, there should be no endeavour to cultivate thought or intellect or imagination until *both* are fairly mastered.

Thirdly, memory and quickness of perception blend and are developed in the awakening of the constructive faculty or in design, and its application to modelling, embroidery, wood-carving, and similar easy arts. And to those who object that all this does not awaken the higher faculty of intelligence or thought, it may be replied that experience or experiment have demonstrated the contrary. It is true beyond denial that a boy or girl who remembers readily and perceives quickly, and who has been trained to invention by designing, *does* think. Call them, if we will, only the tools of the great trade of thought, and a training to their use, is there no difference between two children of equal capacity, brought into a shop, when one knows what everything around is meant for, and how to handle it, when the other is yet to be taught? But the fact is beyond all dispute that children, even if trained to design alone, begin to think in every way. The experience of the Philadelphia school, and more or less that of every well-conducted Kindergarten, prove it. The trouble is, according to the requirements of a late review, that people ask for genius at once from an infant. "Teaching children to remember is not training them to think." But it is the foundation-stone.

[1] "Practical Education" (London: Whittaker and Co., Paternoster Square).

It is the giving them the faculty to collect material to employ thought. Quickness of perception is the next stage of the building. It awakens a sense of the relations which things remembered bear to one another. But the most illiterate man would not deny that a boy with a good memory, who is "sharp to notice everything," is not far off from being clever. Does not this, indeed, constitute about all the cleverness which practical life requires? But it is most unfair that any man, who has not examined the evidence, or read the facts which have been accumulated to show that extraordinary quickness of perception of every kind can be induced by proper training, should at once declare it to be impossible. It is a question not for metaphysical *a priori* assumption, but for scientific research, experiment, and test.

To render what I have said clearer, I would add that, if we begin by memorizing *mere words*, and nothing else, without any special effort to attach meaning to them, or only just so much as will aid in the work, the pupil will, in a short time, acquire a mechanical faculty for remembering. As soon as this becomes habitual, easy lessons which, so to speak, explain themselves, are introduced, and so, step by step, with great care the learner is led to acquire that which involves intelligence. Now, the whole system lies in this: that what a boy or girl perfectly remembers is easier to understand than when it is only half grasped. As it is, we begin in teaching a language by requiring a child to learn all at once to remember words, to pronounce them, and to master their grammatical structure and relations. I never knew of but one instance in my life in which anybody over twenty-five years of age ever learned to speak French like a native. This was a lady, who, before learning the meaning of a word, passed several months in mastering the pronunciation. Schliemann, the excavator of Hissarlik, who for many years learned a language every six months, advocates this system. By learning one thing at a time, at first, we are far better able to acquire several things at once in a more advanced stage. In acquiring quickness of perception, as in memorizing, the processes are identical—they begin by the simplest mechanical methods, and advance to the most refined.

The same development in a commensurate manner is observed in teaching industrial art. To give a child, or even a dull adult, some idea of design, I would allow him or her to group cardboard leaves into a pattern, and trace round them with a pencil till the fingers became familiar with the implement. There are not many cases in which this is advisable, but, having tried it many times, I can assure those who have not that it does not in the least degree prevent beginners from acquiring the boldest freehand practice. The more pains we take with the rudiments of every kind of culture, the easier is the acquisition of advanced branches.

The age is now being called on to face a great problem. It is that of over-pressure. From every side we hear in every newspaper of a thousand things which everybody is assumed to know. A certain great thinker —or writer—was said to have tested in vain "the American mind," by asking everyone he met in the United States, "Have you read Obermann?" It was not true, but it was truthful because it might have been, and because it truly represents the current pedantry of requiring, as a proof of culture, a knowledge of every German, Swiss, or French introversial- transcendental- or sentimental-ist. It is as true of society as of the school. "Shall the meeting-house be moved away from the growing dung-hill, or the dung-hill from the meeting-house?" Such was the great problem which was discussed by a Yankee town council. Shall we go on increasing the branches of popular education, or reduce them? Why not try the experiment of ascertaining whether the pupil will not learn more by first acquiring the art of learning? That is the problem which we are all bound to discuss sooner or later. It cannot be evaded. It is forcing itself upon us from every side. A perusal of all the London reviews or magazines for a month is enough to make any polyhistor—if such a man exists—feel like an ignoramus. It is becoming a clear case of *non possumus*, as the Chicago Professor declared when he recognized the impossibility of shooting two 'possums with only one ball. Either the capacities must be increased, or the contents diminished. And that the powers of memory, perceptiveness, and construction can, by a very easy system of rudimentary culture, be developed to what would seem to be miraculous, is in accordance with the teachings of the most advanced men of science, and is established by innumerable facts. All that is needed now is to combine into a single system the truths which have hitherto been scattered, and to make that a subject of general education which has been illustrated only by separate examples.

It was seriously objected, when I for the first time undertook to make industrial art a regular branch of instruction in public schools, that the number of children who had any capacity or *gift* for such a study, or enough to make it advantageous, was so limited that it would not be worth while to try the experiment. The result of several years' teaching was that while among nearly two thousand pupils only one or two were found who had this "gift," there was not one single child who was not abundantly capable of learning decorative design, and mastering the minor arts. Precisely the same thing is being said as regards teaching memory and perception. "It will succeed with *geniuses*, but not with all." Now, it is an extraordinary thing, and one to be specially noted, that the antecedent proofs and probabilities that every child can become a clever artistic artisan were very few and far between compared to those which illustrate the truth that the other faculties in question may be as generally acquired. Secondly, it was urged against the one, as it is now being urged against the other, "Where will you find teachers?" They were speedily found in the art school, for we soon developed them from among our pupils, while I had in addition a class of grown-up ladies who were specially educated as instructors. But the great objection, and the one which to this day perplexes the majority of people, is, "What profit is there in teaching pattern drawing, modelling shoes or leaves, carving patterns or hammering brass? *Will it pay?* Can a boy make a living by it?" This is precisely the problem proposed by Sam Weller's school-boy, who had indeed learned the alphabet, but doubted whether it was worth while going through so much to learn so little. "Is it not better to teach *boys* a *trade?*" is heard on every side in answer to the assertion that boys and girls of tender age should be prepared to begin to study one. In exactly the same spirit a reviewer declares that "we shall do well to ask ourselves whether it is not more important to teach our children to *think* than to remember, and whether a great deal of the matter with which children are expected to load their memories is not lumber." This is quite equivalent to declaring that it is much more sensible to teach boys algebra than have them waste time in learning the numerals or simple arithmetic. If the writer in question had ever read even a little in physiology, he might have learned that it is estimated that there are from 600,000,000 to 1,200,000,000 of nerve-cells in the brain for the generation of nerve force, and the moulding and storing up of our ideas, each having a separate existence, while Prof. Bain gives the number of fibres which transmit impressions at about 5,000,000,000. Now, if any of the objectors to "overloading" the memory do so because they find they are themselves already perilously near to possessing one thousand two hundred million ideas, and really cannot hold any more, nothing remains to be said. Truly, it has been carefully calculated that for the most retentive and richly endowed minds there are only about 200,000

acquisitions of the assumed types, but the amount of genius which a reviewer must possess must far transcend this if he can prove that people should learn to think before they can remember anything.

Ten years ago the training of children to work while studying was deemed chimerical. "It had been tried," we were told, "and it had failed." But it had not been tried properly or sensibly. Ten years hence memory and quickness of perception will also be taught to classes of pupils as a preparation for thought. What man has been we all know, but what man may be no one can tell. This only is certain, that Science now holds in her hand, at last, the key to Nature, and that ere a decade shall pass there will be such revolutions as no supernaturalist ever dreamed of. CHARLES G. LELAND.

TELEGRAPHS IN CHINA.

THE progress of China is by no means so rapid as some interested persons would have us believe, but beyond doubt the empire is at last moving in a direction favourable to the adoption of Western arts and sciences. The simple fact that telegraphs are being provided there is in itself evidence of the wonderful change which has taken place in the past few years in the attitude of the ruling body, and which not even the most sanguine among us could reasonably have anticipated, to go no farther back than the period of the Chefoo Convention in 1877.

When, however, we find it announced that a complete network, as it were, of telegraphic connections is in course of formation there, it may be worth our while to ascertain whether the foundation of this statement is sound and trustworthy; and in making an examination we shall find it convenient to refer to the substantial progress made and the elaborate system which exists, not merely upon paper, but in absolute perfection, no farther away from China than thirty-six hours' journey by steamer.

Japan may indeed lay claim to the possession of a network of telegraphs; and to obtain an idea of the work to be done in China before a similar claim can be established there, we need only reflect that taking mileage and population into consideration the whole of the Japanese Empire could conveniently be deposited within the boundaries of even one of the eighteen provinces of the Flowery Land. To arrive at a basis of calculation, therefore, we should have to multiply the total length of the existing Japanese telegraph lines at least ten times before any comparison could be instituted. If we were to contrast the East and West, which, however, would be scarcely fair, we should find that a telegraphic system as the term is understood in Europe means something yet immeasurably more extensive and intricate.

Casting aside, then, the extravagant impressions which are often conveyed by the brief telegraphic intelligence which reaches us periodically from the Far East, it is matter for congratulation that the outlying provinces of China are gradually being brought into communication with the capital by the aid of electricity. Yunnan, on the extreme south-western border, has recently been connected, and other equally remote provinces will doubtless be reached without loss of time. With millions of labourers ready to work, the guiding and controlling forces, if present in sufficient numbers, might carry on operations simultaneously, if necessary, in all the eighteen provinces. And undoubtedly there will be a decided advantage in throwing up the lines in almost any fashion so long as they can be made to convey a message, if even, as is most probable, the entire system has to be reconstructed at no distant date. The main object is to so familiarize the natives of the interior with the aspect of these intrusive posts and wires, that they will combine to protect rather than destroy them. And here we are reminded of one point in which the Chinaman differs essentially from his near neighbour the Japanese. When first telegraphs were introduced in Japan, in 1871, the most violent opposition was encountered in the more remote regions at the hands of the agriculturists, who were by no means disposed to acquiesce in all the regenerative projects of the Government of "Benevolence and Light." In China the opposition emanated from the Government itself, inasmuch as considerable diplomatic pressure had to be brought to bear ere the introduction of a telegraph of any kind could be sanctioned, and it is tolerably safe to assume that in the peaceful interior of that vast empire nothing like strenuous objection will be raised to the formation of the line if only it be the aim of the engineers to wound the susceptibilities of the farmers as little as possible in selecting sites for the poles. In Japan the Government was very willing, but the people in many instances were not: in China it has been difficult to convince the Government, whilst the people are eminently docile.

The attitude of ready submission to law and order which characterizes the Chinese farming class affords reasonable ground for the belief that, unless there be a false step on the part of local officials, the telegraphs of China will enjoy an immunity from half the evils which have attended the introduction of the system into other lands. But something will certainly depend upon the policy pursued by the mandarins: it must be one of conciliation. Cultivated land is so exceedingly precious to the Chinese farmer that he can ill afford to have his property disturbed and partly occupied, even if it be to the extent of a square foot or two only, in order that posts may be planted to carry the wires. The system of farming adopted tends to the cultivation of a few acres merely by any one individual, but by diligence and attention a small plot is made to yield practically two and even three crops where one only would be raised in an equal space with us. This is the reason why the good will of the local residents, officials or farmers, will have to be secured.

When these initial difficulties have been overcome, a glorious field will await the development of the telegraphic system. Instead of following in the track of the railway, or journeying side by side therewith, the telegraph will be the forerunner and instigator of improved means of locomotion throughout this immense, almost unknown, region. Even if its effects were limited to the comparatively handy centres of the tea and silk trade there would, in a twelvemonth, be ample justification for its establishment.

It is one thing, however, to have erected a line of telegraph and another thing to provide adequately for its maintenance in efficient working order, without which it would be better not to construct it at all. When communications are interrupted for days together, as must inevitably occur in the absence of a thoroughly complete maintenance organization, the public confidence must be shaken anywhere, and certainly this will apply in full force to China. It is to this most important consideration that early attention should be directed, for the trouble begins the moment the lines are thrown open to the public. When once the merchant has experienced the sensation of being able to complete a bargain on the instant, he is apt to resent fiercely any curtailment of his privileges. It may not be out of place, therefore, to allude to the experience of the pioneers of telegraphy in Japan as evidence of the paramount necessity for establishing this branch of the service on the soundest basis possible. To begin with, testing stations ought never to be farther apart than a day's march on ordinary roads, and trained men are needed at these stations to be held in readiness to set out, on a word from head-quarters, with the necessary tools. Herein is

contained the one essential principle of systematic maintenance. Moreover, it is not enough that breakages of wire be promptly repaired, but the efficient performance of a lineman's duty demands that he should at stated periods patrol his district and remove the possible causes of interruption in the shape of branches of trees and other obstacles to perfect communication before they have time to bring about disaster. His must be the duty of making minute examination of the supports, lest rapid decay at the ground line render even a single post too weak to withstand a sudden shock, and the chain of communication be abruptly severed. He must paint and otherwise preserve these posts, and secure them by the attachment of ample stays against normal or exceptional strains. In a word, a man will find abundant work to fill up his allotted time in a district no more extensive than a day's walking will suffice for him to cover.

Now all this is not mere theorizing, but the relation of what has been done and is being daily carried into effect in Japan, and it is for these reasons that we assert that the Government of that country may claim to possess a telegraphic system worthy the name. At the present time the telegraphic organization extends to every town of any importance within the Mikado's dominions. In the majority of cases these stations are distinguished as being the head-quarters of the local government or prefecture, and all are thus brought into instantaneous communication with the departmental offices at the capital. The four islands are connected by submarine cables, and the Great Northern Telegraph Company's lines form a medium of communication between Nagasaki and the Western world. The Japanese engineer their own service, educate their operators and travelling linemen, manufacture their own apparatus, even of the most complex character, their own batteries, and the galvanized iron fittings for their poles. The insulators in use are of Japanese porcelain, the finest in quality ever produced, capable of withstanding the most severe tests that it is possible to subject them to. Iron poles are not used, because the pine and cedar flourish everywhere, and are obtainable on short notice; moreover, it is often cheaper to replace them, if decay sets in, than to invest in iron, which is costly at the outset, and heavy to transport inland. The rates for telegrams are sufficiently low to bring the convenience within the reach of all classes. Messages are transmitted in either Japanese or foreign languages with equal facility. Finally, the finances of the department are administered in such a way as to show a substantial balance at the end of the fiscal year.

When may we look for this in China?

With the advantages the pioneers of the service there possess we trust we shall not now have to wait long. But it will inevitably be discovered, if the maintenance of the lines be not provided for efficiently from the outset, that a mighty engine of Western civilization is being hampered and thwarted in its progress, and that among the mercantile classes, who ought to be its principal supporters, there will spring up a feeling of distrust which years of success will not entirely counterbalance. There is no reason why China should not manufacture for herself almost everything she requires in the way of apparatus and material, as Japan is now doing; for men of more deft and skilful touch, combined with high intelligence, than the Chinese do not exist. But all their perfection of workmanship will avail the State little if it be not supported by strict perseverance in those duties which appertain to efficient maintenance. Long lines hastily set up across country, with stations few and far between, and without competent workmen to look after them, under substantial control, will soon cease to convey an electrical current. As suggested before, it is one thing to build a line, but quite another matter to preserve it in working order, and it is to be hoped the example of the Japanese will not be lost upon their near neighbours. J. M.

FLORA OF THE BAHAMAS.

AT the Manchester meeting of the British Association a Committee was appointed, with a grant of £100, for the purpose of exploring the flora of the Bahamas. The vegetation of this group has long been known to present some very peculiar features, but it is poorly represented in European herbaria. The Committee were fortunate in securing the assistance of Baron Eggers (sometime Commandant at the Danish colony of St. Thomas), who had lately returned from an important botanical exploration in St. Domingo.

Baron Eggers started at the end of last year, and the following letter gives an interesting account of the progress which he had made up to the time of writing.

W. T. THISELTON DYER.

Royal Gardens, Kew, February 25.

"*Fortune Island, Bahamas, February* 6, 1888.

"I finally succeeded in reaching here, and as this part of the Bahama Archipelago most likely is less known still than the islands nearer Nassau, I propose to explore this group (Fortune, Crooked, and Acklins Islands), which are not far from the centre of the whole, and which, especially the two latter, are of a good size and fairly wooded. From the day of my arrival I have been exploring this island, which is of a longitudinal form, 9 miles long by 1 to 2 miles broad, highest elevation 110 feet, entirely covered with a low forest or scrub about 10 to 16 feet high. The largest trees do not exceed 25 feet, and that height is rare.

"Partly on account of the season of the year, partly from the protracted dry weather, some of the shrubs and trees have neither flower nor fruit, whilst at the same time the herbaceous vegetation is almost absent. Yet I have succeeded in finding a good number of most interesting plants in flower or seed, and have made, besides, collections of woods and seeds. Cycads I have seen none of here in this island. *Guaiacum sanctum* seems to be common here. Some very curious composite shrubs I have met with. On the shore *Ambrosia crithmifolia* seems very common, as also *Passiflora pectinata*.

"Of palms are found *Sabal umbraculifera*, and another, probably *Sabal Palmetto*, called palmetto here by the inhabitants, which is common and used for making hats. A shrubby *Phyllanthus* is very common, as also a very small-leaved *Erythroxylon*. *Croton Ujalmarsonii* is frequent. Several species of *Cassia* are found, as also some acacias. One *Psychotria*, a *Phoradendron*, growing on *Byrsonima lucida*, *Swietenia Mahagoni*, two species of *Coccoloba*, a large-leaved *Euphorbia*, a *Cordia*, and a number of other shrubs and small trees. Of Epiphytes I have seen two Tillandsias and an *Epidendrum*, which latter grows among rocks. No mosses, but some lichens.

"Among common trees is to be noted chiefly *Hippomane Mancinella*, as also *Conocarpus erecta* in two forms, the glabrous and the silvery-haired ones, both growing indiscriminately together in small woods.

"Almost the whole surface of the island is covered with a layer of limestone, coarse, mixed with sand, about 6 inches thick, which appears to have formed a smooth cover over the whole whilst under water. It is now generally broken to pieces, but the pieces are still close together, and only separated by fissures, in which trees and shrubs grow, sending their roots down into the sandy, and sometimes marly, soil beneath. In many places there are hollows, in which a light red soil has been accumulated, and where a few attempts at cultivation are made.

"As a rule, the only cultivation here is on the sandbank that forms the western shore, and on which also the little town is situated. Here is raised some Guinea corn (*Sorghum*) and sweet potatoes, as well as cocoa-nut trees, which seem to thrive remarkably well. This whole north-

western shore, for at least 6 or 7 miles, might be one vast forest of cocoa-nut trees. The small plantations of fifty or sixty near the dwellings present a very healthy appearance, and are in full bearing.

"Otherwise the population of the place, amounting to about 500 I should suppose, support themselves by trading, sailing, collecting sponges, and going abroad as labourers for steamers in the West Indian trade. Some salt is made from an extensive salt-pond that stretches for 4 to 5 miles just inside the north-western shore. Another smaller pond is found on the south-eastern shore.

"The town is a decent little village, with a good church, school, post-office, jail, and very creditable dwellings. The people are very well behaved and decent on the whole. Among cultivated plants around dwellings I can mention *Poinciana regia*, *Casuarina equisetifolia*, *Terminalia Catappa*.

"It is very gratifying to see the spirit of neatness and order that pervades everything in the English islands, and which forms such a contrast to the squalor and utter wretchedness that marks much richer islands, like Hayti, Porto Rico, and Cuba. As the coloured population is of the same race in all these places, it can only be ascribed to the example set by the governing race in this case.

"As you may imagine, the vegetation of this, as of most of these islands, possesses a strong uniformity and sameness, as there are no elevations of any extent to produce variety, and partakes in fact of the character of the vegetation of the sea-shore. I therefore can hardly expect to add much to my collections in this place now, and therefore intend to pass to Crooked or Acklins Island as soon as an opportunity offers.

"In a certain sense, of course, locomotion is easy enough from one island to another, yet you must always wait for an opportunity if you do not want to hire a vessel or a boat for your own use.

"After I have finished this group I propose to go to Nassau, and from there to pass over to Andros, which, from what I have been able to gather, is somewhat different from the other islands, especially on account of its being full of swamps and fresh-water lakes, which ought to give the vegetation a somewhat different character. Andros, too, is heavily wooded, both with pine forests as also with other trees, of which many are cut and exported for timber.

"As the season advances I also expect to find a greater proportion of plants in blossom than at present, so as to make my collections from these islands as complete as possible. Still a number of trees will most likely be represented by their leaves only or at best in fruit, which of course cannot be avoided, unless the exploration were continued through the year, and this, as you may imagine, cannot be done for the amount at my disposal, of which necessarily a part has already been consumed by the voyage hither.

"From what I have collected already, I think, however, I am able to say that I shall get together a considerable herbarium, which I hope will contain no few novelties, and give a fair representation of the flora of this archipelago. I need hardly add that I make copious general notes on the vegetation, as well as on the natural history and physical conditions of the islands in general.

"Yours very faithfully,

"EGGERS."

NOTES.

WE understand that, in accordance with the arrangement made on March 24, an important deputation, consisting of Sir Henry Roscoe, Sir Lyon Playfair, Sir John Lubbock, and Mr. Howorth, met Mr. Stanhope and Lord Harris on Monday last, to discuss the regulations for the selection of Woolwich cadets, so far as they relate to natural science. We believe that the proposals submitted by the deputation will receive favourable consideration.

THE late Mr. Thos B. Curling, F.R.S., has bequeathed £200 free of legacy duty to the Scientific Relief Fund of the Royal Society.

A FRESH case of specimens from the borings in the Delta of the Nile has just been received at the Royal Society.

PROF. HOFMANN, the chemist, celebrated his seventieth birthday on Monday. The Emperor Frederick sent him a patent of nobility, and among many other birthday gifts were portraits of Queen Victoria and the German Empress. From the Prince Regent of Bavaria Prof. Hofmann received a high decoration.

DR. EMIL HOLUB, the African traveller, intends to open a South African Exhibition in the old Exhibition building known as the Rotunde, in Vienna, in May 1889. The industries, exports, and dwellings of the natives will be exhibited, as well as the collections made by Dr. Holub.

A YEARLY pension of 800 roubles has been granted by the Russian Government to M. Potanin in recognition of his work as an explorer in China and Mongolia.

THE question as to the best means of promoting technical education is being earnestly discussed in Russia. A Congress, summoned by the Permanent Committee for Technical Education, is about to meet at St. Petersburg for the consideration of the subject. The sum of £500 has been granted by the Government for the expenses of the Congress.

A RUSSIAN zoological station has been established at Villafranca, a few miles from Nice. The Bay of Villafranca is well known for the work that has been done there by some of the most prominent Continental biologists, and it certainly offers great advantages for the study of marine fauna. An old Italian prison, which was formerly sold to the Russian Government, and used as a kind of naval station for repairs of ships of the Russian Navy, has now been transformed into a zoological station, supported by the Russian Naval Ministry. It has two spacious and well-lighted halls for microscopical work, five smaller rooms, and accommodation for men of science who may wish to carry on biological investigations. It is under the direction of Dr. Korotneff.

WE regret to learn that Captain Temple has been compelled to discontinue the issue of his most interesting and valuable periodical, *Indian Notes and Queries*. His duties at Mandalay, where he is playing an important part in the work of reorganization in Upper Burmah, so occupies his time that he is quite unable to put together periodically the notes sent to him by many contributors. His other periodical, the *Indian Antiquary*, is to be maintained, and contributions to the now defunct serial will be diverted to it.

A DEPUTATION from the "Australian Natives' Association" waited recently on the Minister of Education of Victoria to urge that an Australian series of school-books should be published, so that fuller information on purely Australian subjects should be made available to the children in State schools. It was argued that there was virtually no special information about Australian geography in the books used. The Minister was asked to bear in mind that 650,000 of the total population of Victoria were native born, and that the vast majority were growing up in ignorance of the geography of their native land. Australian literature, like Australian geography, was neglected by the Education Department. The deputation laid particular stress on the argument that the Government would stimulate the Federal sentiment by giving Australian subjects prominence in the State schools.

THE death is announced at Yokohama, on February 17, of Mr. Henry Pryer, an old resident there, who had devoted much attention to the study of Japanese entomology and ornithology. The writer of an obituary notice in the *Japan Weekly Mail* states that, except for a short time, when engaged in arranging natural history collections in the Tokio Museum, Mr. Pryer was occupied in business pursuits, his spare time being given to the study of Japanese fauna; "and it is no exaggeration to state that he had become the authority *facile princeps* on all questions connected with the birds, butterflies, and moths, whilst at the same time he had acquired a most extensive knowledge and store of facts in connection with all the other branches of the zoology of Japan." Mr. Pryer was the author of papers in various English scientific journals, and the Transactions of the Asiatic Society of Japan. In November 1886 he published Part I. of a description of the butterflies of Japan, under the title "Rhopalocera Nihonica," and Part II. is said to be in the printers' hands, and almost ready for publication. It is to be hoped that the third and concluding part may be found in such a state of preparation as will insure the completion of the work. Mr. Pryer, who was the brother of Mr. Pryer of the North Borneo Company's service, like himself an enthusiastic student of Nature, was only thirty-nine years of age at the time of his death.

RUSSIAN zoology has sustained a heavy loss by the death of Prof. M. N. Bogdanoff. He died at St. Petersburg on March 16. His first work, published in 1867, was on the life and the geographical distribution of the *Tetrao urogallus*. Four years later he published a most elaborate and suggestive work, "The Mamma'ls and Birds of the Black-earth Region of the Volga," in which he treated in detail the present geographical distribution of animals in connection with the climate and soil of Russia during the Post-Pliocene period. In 1873 he took part in the expedition to Khiva, and returned with a rich geological collection, now at the St. Petersburg University. The results of this journey were embodied in a capital work on the Khiva Oasis and the Sands of Kyzyl-kum. His next work was on the fauna of the Aral-Caspian basin, which he described in the *Mémoires* of the Society of Naturalists at the St. Petersburg University. In 1875 he began the exploration of the Caucasus, and published the results of his labours in a work, "The Birds of the Caucasus," which has become the foundation-stone of the ornithology of the region. In 1880 he visited a part of the coast of the Arctic Ocean, and the results of his journey were published in the *Mémoires* of the Society at St. Petersburg University. In 1881 he published another excellent work, "The Russian Magpies." Finally, in 1885, he began the publication of his life-work, "The Ornithology of Russia," of which only the first part has been issued. Prof. M. N. Bogdanoff's popular zoological sketches, published in a Russian review, were widely read. All the above-mentioned works, as also many smaller monographs, have been published in Russian.

THE Russian Geographical Society has lost one of its most active ethnographers, V. N. Mainoff, whose works on the Erzya-Mordvinians—their anthropological features and customs—are well known. His knowledge of the Finnish language gave a special value to his works on the remnants of paganism among the Mordvinians, and to his descriptive work on Karelia and the Onega region. He had already published a Finnish grammar in Russian, and was engaged in the compilation of a Finnish and Russian dictionary. The latter task was intrusted to him by the Senate of Finland. He had brought the dictionary up to the letter K.

ANOTHER masterly contribution to the fundamental principles of chemistry, leading us still further into the intensely interesting region of the hitherto unknown, will be found in the current number of the *Berichte*, from Profs. Victor Meyer and Riecke. We have from time to time in these columns noticed the progress of the development of the now famous "position-in-space" theory first formulated by Van t' Hoff, and it will perhaps be remembered that a short account was recently given of the remarkable results obtained by Prof. Meyer from the study of certain complex organic compounds. The main result consisted in the discovery of two new properties possessed by carbon atoms: first, that the four valencies may be deviated from their positions at the corners of a regular tetrahedron; and second, that two carbon atoms united by single bonds may be attached to each other in two ways—one in which they are free to rotate, and another in which rotation is prevented. Recognizing that the chemist must not tread this unbroken ground alone, but that he must go hand in hand with his co-worker the physicist, Profs. Meyer and Riecke have brought together evidence afforded by both physics and chemistry, and have thereupon formulated a theory which appears likely to be the germ of a grand generalization. They suppose the carbon atom to be a sphere surrounded by an ether shell, that the atom itself is the carrier of the specific affinity, while the surface of the ethereal envelope is the seat of the valencies. Each valency is conditioned by the existence of two oppositely electrified poles, situate at the ends of an imaginary straight line, short in comparison with the diameter of the envelope. Such a system of two poles is termed a di-pole. The four valencies of the carbon atom would thus consist of four such di-poles. The middle point of the line joining each pair of poles is further supposed to remain always in the surface of the envelope, but freely movable in that surface, and the di-pole itself would be able to rotate freely round this central point. It is then supposed that the carbon atom possesses a greater attraction for the positive than for the negative ends of the di-poles, so that, owing to the possibility of free rotation, the positive ends would turn towards the centre of the atom. At the same time the valencies of the same atom would repel each other, and take up their positions at the four corners of the regular tetrahedron, from which, however, they could be, as experiment shows they occasionally are, deflected. Thus the molecules of marsh gas, CH_4, or any carbon compound of the type Cx_4, would naturally be symmetrical, but when the four valencies are attached to groups of different weights their positions would probably be altered. A strikingly natural explanation is then given of the nature of single, double, and triple linking of carbon atoms, showing how the first can occur in the two ways previously indicated. It is a matter for sincere congratulation to those who have been labouring so long in building up the now immense fabric of organic chemistry, that it is by reason of the large accumulation of data concerning the carbon compounds that these important principles have been arrived at; and it is to be hoped that before long the data may be sufficient to permit of like investigations of the atoms of other elements.

SO many interesting reports relative to waterspouts, sighted during January and February in the western portion of the North Atlantic, have been received by the Hydrographer of the United States Navy, that he has plotted them in a supplement to the Pilot Chart of the North Atlantic Ocean for March, together with the tracks of storms coincident with some of them. The positions of the spouts are given for fourteen days between January 12 and February 29. To specify a few cases:—On January 12 four spouts were seen in lat. 36° 41′ N., and long. 72° 27′ W., and on the 19th several were seen a little farther to the eastward. And again, on January 22, several large spouts were seen in lat. 31° 47′ N., long. 74° 33′ W. The most interesting of all are those seen on January 26–28, for the reason that they were clearly associated with a low barometer area

which moved across the great lakes on the 25th. One of these, seen on January 28, in lat. 39° 30′ N., long. 57° 20′ W., is estimated to have been a mile in diameter. On February 11 the ship *Reindeer* was completely dismasted by a spout in lat. 32° 4′ N., long. 76° 6′ W. The weather was clear at the time, and the whole affair was over in a few minutes. Generally speaking, the rotation was, as in the case of tornadoes, in the opposite direction to that of the hands of a watch, but, in some cases, in the same direction. It is suggested that if instantaneous photographs were taken of some of these remarkable phenomena they would be of great value to the science of meteorology.

AT the meeting of the French Meteorological Society, on March 6, M. Renou stated that the observations at Parc St. Maur showed that the month of February last was colder than it had been since 1855. The temperature of 5° F., observed on February 2, was the lowest on record in that month. On March 1 the minimum, 16°·2, was the lowest recorded in March since 1847. The Society is encouraging the registration of regular observations at the seminary at Port-au-Prince (Hayti). The thermometers, which are now better exposed, show that the temperatures are lower than formerly reported. Very few observations from this district have been published, so that a regular bulletin such as is hinted at by M. Renou would be very welcome. M. Hauvel read a communication on the "Tides of the Sun's Photosphere," due to planetary action. In classifying the planets according to their influence on the photosphere, he places Mercury first and Jupiter second, and he argues that at certain positions Mercury causes storms in the photosphere, giving rise to abnormal variations of temperature in our atmosphere, according to the relative position of the earth.

THE German Meteorological Office has published the results of its meteorological observations for the year 1886 (Berlin, 1888, lvi. + 223 pp.). The stations of the second and third orders now number 256, several new ones having been recently established. A regular system of thunderstorm observations has been commenced, and much attention is paid to rainfall; it is proposed eventually to increase these stations to 2000. In addition to the usual data, the maximum falls in twenty-four hours are given for all stations. The system includes several mountain stations, the highest being the Schneekoppe (nearly 5250 feet). The difficulties experienced in mountain meteorology may be judged of from the fact that in the winter the anemometer on the Schneekoppe has to be abandoned, owing to the accumulation of snow, and in the summer the earth thermometer has to be removed, owing to repeated interference by tourists. The history and outfit of the stations are given in many instances, and will be continued in subsequent reports.

THE Bureau of Ethnology, Smithsonian Institution, lately issued a full and useful bibliography of the Eskimo language, by Mr. J. Constantine Pilling. Now it has published an equally good bibliography of the Siouan languages, by the same scholar. The material for both of these catalogues has been gathered during personal visits to the more prominent public and private libraries of the United States, Canada, and France, and by correspondence with missionaries, Indian agents, publishers, and printers of Indian books, and owners of Americana.

AN interesting paper on the use of gold and other metals among the ancient inhabitants of Chiriqui, Isthmus of Darien, by Mr. William H. Holmes, has just been issued by the Bureau of Ethnology, Smithsonian Institution. The objects described by Mr. Holmes were obtained from ancient graves, of which no record or trustworthy tradition is preserved. They are all ornaments, no coin, weapon, tool, or utensil having come to Mr. Holmes's notice. The great majority of the objects were formed by casting in moulds. The work exhibits close analogies with that of the mainland of South America, but these analogies are found in material, treatment, and scope of employment rather than in the subject-matter of the conceptions. The sum of the art achievements of these peoples seems to Mr. Holmes to indicate a lower degree of culture than that attained by the Mexicans and the Peruvians, the ceramic art alone "challenging the world in respect to refinement of form and simplicity and delicacy of treatment."

THE Report, for the year 1886–87, of the Colonial Museum and Laboratory of New Zealand has been issued. It is the twenty-second annual report of these institutions. The attendance of visitors at the Museum was very large, being considerably above the average of former years, especially on Sunday afternoons, when the very limited passage-room often caused inconvenient crowding. The total number of additions to the collections during the year was 10,708. Among these additions were eleven photographs of the wonderful stone carvings and inscriptions found on Easter Island. In the Colonial Laboratory 345 analyses were performed during the year. These are classified as follows: coals and oils, 22; rocks and minerals, 117; metals and ores, 43; examinations for gold and silver, 81; waters, 36; miscellaneous, 46. In the report all the results of these analyses which have a general or special interest are rendered in full.

A SERIES of papers, entitled "Studies in Biology for New Zealand Students," is being issued by the Colonial Museum and Geological Survey Department of New Zealand. We have received the third paper of the series. It is by Mr. Alexander Purdie, Science Master at the Wellington Training College, who has chosen as his subject the anatomy of the common mussels (*Mytilus latus*, *edulis*, and *magellanicus*). Mr. Purdie points out that, as a subject for study, the mussel has the advantages of being readily procurable at most points of the New Zealand coast, and also of not being so small as to embarrass the tyro in the art of dissection.

WE have received the Report of the Marlborough College Natural History Society for the year ending Christmas 1887. During the year the numbers of the Society largely increased; its meetings were well supported; and the work of the Sections was in most cases considerable. Among the contents of the volume are interesting papers on Aristotle on birds, by Mr. W. Warde Fowler; the migration of birds, by Mr. A. H. Macpherson; and spiders and their allies, by the Rev. O. Pickard-Cambridge, F.R.S.

THE second number of the *Internationales Archiv für Ethnographie* contains the first instalment of a paper, in German, by J. Büttikofer, on the natives of Liberia. This contribution is accompanied by two finely coloured plates representing implements and weapons. Dr. B. Langkavel has an interesting article on the uses to which horses are put by races at an early stage of development.

A LITTLE controversy is going on in the *Internationales Archiv* about the northern limit of the regions within which the boomerang is used in Australia. Prof. Gerland, of Strasburg, in his map of the races of Oceania, has drawn the line about 15° 30′ S. lat. In the first number of the *Archiv*, Prof. Ratzel expressed his belief that the line ought not to be drawn so far north, and that it really extends only to about 18° 30′. In the second number, Prof. Gerland maintains his position, pointing out that Leichardt found the boomerang near the Macarthur River, while Edward Palmer, one of the highest authorities on all subjects relating to the North Australians, found it to the north of Mitchell River. The tribes of these northern districts have independent names for the weapon, which they use more frequently in the chase than in war.

A BOOK entitled "Mœurs et Monuments des Peuples préhistoriques," by M. de Nadaillac, is about to be published in Paris. The text will be fully illustrated.

THE *Selborne Magazine* will in future be published by Mr. Elliot Stock.

THE new number of *Mind* opens with an article on the conditions of a true philosophy, by Mr. S. H. Hodgson. There are also articles on the nature and functions of a complete symbolic language, by Mr. S. Bryant; on Dr. Martineau and the theory of vocation, by the Rev. H. Rashdale; and on the unity of consciousness, by Mr. A. F. Shand.

WE have received a little pamphlet by Dr. G. Y. Cadogan-Masterman, Medical Officer of Health, Stourport, entitled "Dermepenthesis: Animal Skin-Grafting," in which the author gives several interesting cases of successful grafting of the skin of rabbits on wounds on the human body.

AN International Exhibition of farmyard poultry, rabbits, game raised for reserved shooting, machinery and engines for bird-culture, hunting-dogs, and sporting apparatus allowed by law, will be held in Rome, at the Botanical Garden, from April 25 to May 10. The Exhibition is being organized by a Committee of the Agricultural Society of Rome.

ACCORDING to the *Naturforscher*, Herr von dem Borne-Berneuchen has succeeded in breeding, in his piscicultural establishment, specimens of the fish known in America as the black boss.

THE additions to the Zoological Society's Gardens during the past week include two Striped Hyænas (*Hyæna striata*) from Algeria, presented by Capt. E. B. Pusey, R.N.; an Ortolan Bunting (*Emberiza hortulana*), British, presented by Mr. W. H. St. Quintin; a Moorish Gecko (*Tarentola mauritanica*) from Cannes, South France, presented by Mr. J. C. Warbury; two Poiret's Newts (*Molge poireti*) from Algeria, presented by Mr. G. A. Boulenger; a Greater Sulphur-crested Cockatoo (*Cacatua galerita*) from Australia, deposited; a Central American Agouti (*Dasyprocta isthmica*) from Central America, purchased.

OUR ASTRONOMICAL COLUMN.

THE PARIS CATALOGUE.—The first two volumes of the great work undertaken by Leverrier a third of a century ago,—the re-observation of the stars of Lalande's catalogue,—have recently been published. The first volume contains the first instalment of the catalogue, viz. stars from 0h. to 6h. of R.A. observed during the years 1837 to 1881, whilst the second gives the separate observations. That this great undertaking has advanced so far towards completion is chiefly owing to the energy which has characterized the Paris Observatory under the directorship of Admiral Mouchez, and to the strength it has derived from the School of Practical Astronomy which was for several years connected with it. When Admiral Mouchez succeeded to the direction in 1878, barely one-third of the necessary observations had been secured, and the annual number of observations obtained was only about 6000 or 7000, a total which, however considerable in itself, was very inadequate in view of the 300,000 required to complete the original programme of a minimum of three observations in each element for the 47,390 stars of Lalande's catalogue. The gift by M. Bischoffsheim of the fine Eichens meridian-circle, and the assistance furnished by the pupils of the astronomical school have, however, raised the yearly average to 25,000 or 28,000 observations, and rendered it possible to commence the publication of results. As the observations include not only those made since Leverrier became Director, but also some 20,000 or 30,000 made between 1837 and 1854, under Arago's superintendence, but left unreduced by him, they have been divided into three periods, viz. 1837–53, 1854–67, and 1868–81, and severally reduced to the mean epochs 1845, 1860, or 1875. Observations subsequent to 1881, about one-fourth of the entire number, will be published separately, and a separate supplementary catalogue will also be formed of those stars which it has been found necessary to re-observe owing to the disproportion between the number of observations secured in the two elements, due to the R.A.'s in so many cases having been observed with the transit instrument, whilst the declinations were taken with the mural circle, the transit circles having been erected only in 1863 and 1877 respectively. The present section of the catalogue contains 7245 stars, and represents about 80,000 observations in both elements. It gives for each of the three periods the number of observations, the mean date, the R.A. and N.P.D. reduced to the mean epoch, and a comparison with Lalande. The precessions for 1875 are also added. The introduction, by M. Gaillot, who has superintended the reduction, contains a discussion of the probable errors of the observations, and is followed by a comparison of the present catalogue with Auwers' Bradley, and an important investigation by M. Bossert of the proper motions of a large number of stars, followed by a table of errors in Lalande's catalogue, which the present and other catalogues have brought to light.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1888 *APRIL* 15–21.

(FOR the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on April 15

Sun rises, 5h. 5m.; souths, 11h. 59m. 53·6s.; sets, 18h. 55m.: right asc. on meridian, 1h. 36·2m.; decl. 10° 1′ N. Sidereal Time at Sunset, 8h. 32m.

Moon (at First Quarter April 19, 12h.) rises, 7h. 23m.; souths, 15h. 9m.; sets, 23h. 4m.: right asc. on meridian, 4h. 46·0m.; decl. 18° 18′ N.

Planet.	Rises.	Souths.	Sets.	Right asc. and declination on meridian.
	h. m.	h. m.	h. m.	h. m. ° ′
Mercury..	4 41 ...	10 38 ...	16 35 ...	0 13·8 ... 1 21 S.
Venus.....	4 34 ...	10 36 ...	16 38 ...	0 12·6 ... 0 20 S.
Mars.....	18 6 ...	23 39 ...	5 12*...	13 16·9 ... 5 55 S.
Jupiter....	22 26*...	2 40 ...	6 54 ...	16 15·1 ... 20 14 S.
Saturn....	10 33 ...	18 31 ...	2 29*...	8 8·5 ... 20 46 N.
Uranus...	17 40 ...	23 17 ...	4 54*...	12 55·3 ... 5 10 S.
Neptune..	6 28 ...	14 10 ...	21 52 ...	3 46·6 ... 18 15 N.

* Indicates that the rising is that of the preceding evening and the setting that of the following morning.

Occultations of Stars by the Moon (visible at Greenwich).

April.	Star.	Mag.	Disap.	Reap.	Corresponding angles from vertex to right for inverted image.
			h. m.	h. m.	° °
16 ...	χ^2 Orionis ...	... 6 ...	21 27 ...	22 26	... 139 300
19 ...	θ Cancri ...	... 6 ...	19 34 ...	20 45	... 70 308

April. h.
19 ... 13 ... Saturn in conjunction with and 1° 5′ north of the Moon.

Variable Stars.

Star.	R.A. h. m.	Decl. ° ′		h. m.	
U Cephei	0 52·4	81 16 N.	Apr. 17,	3 41	*m*
Algol	3 0·9	40 31 N.	,, 18,	21 4	*m*
R Canis Majoris...	7 14·5	16 12 S.	,, 20,	22 14	*m*
δ Libræ	14 55·0	8 4 S.	,, 17,	22 30	*m*
U Coronæ	15 13·6	32 3 N.	,, 17,	3 31	*m*
U Ophiuchi... ...	17 10·9	1 20 N.	,, 16,	3 44	*m*
		and at intervals of		20 8	
X Sagittarii... ...	17 40·5	27 47 S.	Apr. 15,	4 0	*M*
Z Sagittarii... ...	18 14·8	18 55 S.	,, 15,	0 0	*m*
β Lyræ...	18 46·0	33 14 N.	,, 18,	22 0	m_2
R Lyræ	18 51·9	43 48 N.	,, 17,		*M*
S Vulpeculæ ...	19 43·8	27 1 N.	,, 20,		*M*
R Sagittæ	20 9·0	16 23 N.	,, 18,		*m*
T Cephei	21 8·1	68 2 N.	,, 16,		*M*
δ Cephei	22 25·0	57 51 N.	,, 19,	3 0	*M*
R Aquarii	23 38·0	15 54 S.	,, 17,		*M*

M signifies maximum; *m* minimum; m_2 secondary minimum.

Meteor-Showers.

	R.A.	Decl.		
Near β Serpentis	232°	17° N.	Very swift.	
From Hercules...	255	37 N.	April 12-25	Very swift.
	268	33 N.	*Lyrids*, April 18-20	
	272	20 N.	April 18-24	
From Vulpecula	300	24 N.	April 19-20. Swift.	

GEOGRAPHICAL NOTES.

THE Russian Geographical Society elaborated at its last meeting the following programme of work for the next summer. M. Kuznetsoff will continue his geo-botanical work on the northern slope of Caucasus, and M. Rossikoff will continue his survey of the Caucasian glaciers on the little-known southern slope of West Caucasus. M. Listoff will also resume his exploration of the caves containing layers of ice in Crimea. Pendulum measurements will be done by Prof. Sokoloff in Poland and West Russia; and an Expedition of three persons will be sent out for the exploration of the Kola peninsula.

THE following details of the Brazilian Expedition, headed by Dr. von Steinen, have been received from Dr. Ehrenreich, one of the members of the Expedition. Their object was to investigate the Kuluene River, a tributary of the Xingu. Dr. Ehrenreich gives the following as the chief results of the Expedition: (1) the discovery of great Caribbean races in the centre of South America, named respectively the Bakairi and the Nahugua; (2) the discovery of the Kanayura and Anite tribes, who still speak the ancient Tupi language, and use remarkable weapons, amongst which is the very peculiar arrow fling. Surveys of the Kuluene were made and many ethnographical specimens have been collected, forming a complete picture of the original culture of these Indians, who, even to-day, do not know the use of metal, but are still in the period of implements made of flint, bone, and fish teeth.

OUR ELECTRICAL COLUMN.

J. T. BOTTOMLEY showed that the temperature of a wire conveying electric currents varied with the air-pressures surrounding it, and that a wire which remained dull at ordinary atmospheric pressure incandesced when a moderate vacuum was obtained. M. Cailletet has been working in the opposite direction. He has shown that a current which would fuse a wire under ordinary pressure will scarcely raise it to redness when the pressure is sufficiently great. These experiments show how essential free convection as well as radiation is to the incandescence of filaments in glow-lamps, as well as to the heating of conductors.

LECHER (*Rep. der Physik*, xxiii. p. 795) has experimented on the much-vexed question of the counter-electromotive force of arc lamps, and he finds that its existence is not proved, that the observed difference of potential which is expressed by the formula $a + bl$ varies with temperature, and that it is probably due to discontinuity in the current.

CONSIDERABLE attention has lately been devoted to the potential difference between the various constituents of a voltaic cell by direct measurement, an operation facilitated by Helmholtz's capital observation that this difference between an electrode of mercury flowing in drops through a capillary tube and an electrolyte is *nothing*. The mercury thus acquires the potential of the electrolyte, and can be measured. Moser (*Beiblätter*, xi. p. 788) has thus measured the Daniell and Clark cells, and Miesler has been following it up. Thus in the Daniell cell—

$Zn \mid ZnSO_4$	= + 1·06	volt
$ZnSO_4 \mid CuSO_4$	= + ·22	,,
$CuSO_4 \mid Cu$	= − ·22	,,
Total PD ...	1·06	,,

In the Grove cell—

$Zn \mid H_2SO_4$	= + 1·06	volt
$H_2SO_4 \mid HNO_3$	= + ·36	,,
$HNO_3 \mid Pt$	= + ·20	,,
Total PD ...	1·62	,,

He makes the PD—

$C \mid HNO_3$	= + ·38	volt
$C \mid H_2CrO_4$	= + ·62	,,
$H_2SO_4 \mid H_2CrO_4$	= + ·5	,,
$PbO_2 \mid H_2SO_4$	= + 1·3	,,
$H_2SO_4 \mid Pb$	= + ·9	,,

all the measurements, except that of the Grove cell, according fairly well with known and accepted measurements.

HERTZ, WIEDEMANN, AND EBERT have been experimenting on the influence of rays of high refrangibility on electrical discharges, and M. Hallwachs has been verifying their results. He finds that a well-insulated disk of zinc charged with electricity rapidly loses its charge when the rays of an arc lamp fall upon it. It is more rapid with negative than with positive charges.

PENDULUM SEISMOMETERS.

PENDULUM SEISMOMETERS are among the oldest forms of instruments employed to record earthquake motion upon a stationary plate. In 1841 crude forms of such seismometers were used to record shocks at Comrie in Scotland. The objections to the older forms of these instruments are that they are not provided with any arrangement to magnify the motion of the earth, the writing indices are not sufficiently frictionless, and the value of the records are destroyed because the pendulums almost invariably swing (see "Experiments in Observational Seismology," by J. Milne, Trans. Seis. Soc., vol. iii. p. 12). The first pendulum seismometer with which I am acquainted which has a multiplying index is the one described, constructed, and successfully employed by Dr. G. Wagener (see Trans. Seis. Soc., vol. i. p. 55). From Dr. Wagener's account of this instrument it was the inventor's intention to counteract any tendency of the pendulum bob to swing by the inertia of the multiplying index, and from his experience with the instrument, owing to frictional resistance or otherwise, it seems that even if the pendulum was set in motion it quickly came to rest.

The multiplying arrangement, or "indicating pendulum," in Wagener's instrument was a lever, which we will call *a b c*, 25 inches in length (Fig. 1); the upper end of this at *a* geared

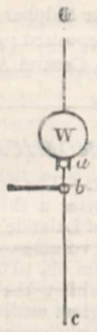

FIG. 1.

in the base of the main pendulum bob W by a ball-and-socket joint. One inch below, at *b*, a second ball-and-socket joint connected the lever with the earth. Now if *a* remained at rest, and *b*, being connected with the earth, moved backwards and forwards, a multiplied representation of this movement was produced at *c*, 24 inches lower down. The question which arises is whether W tends to remain at rest, and what effect the jointed system *a b c* exerts upon it.

Imagine that an impulse is received towards the right, so that the point of suspension of W at *a*, and the point *b*, move to the right. The tendency of W is therefore to move to the right. If the centre of oscillation of *a b c* relatively to *b* as a centre of percussion is *below b*, then *a* will move to the right and assist W in its swing; if, however, the centre of oscillation is *above b* then W will be retarded in its motion. In Dr. Wagener's instruments the centre of oscillation was below *b*, and hence the index retarded W by its inertia and friction only. Still, the instrument was the first one where there was an attempt to use an "indicating

pendulum," first as a multiplying index, and secondly as a means to check the motion of a large pendulum. In pendulum seismographs, which I have largely used in Japan (see Trans. Seis. Soc., vol. iv. p. 91), *a b* was loaded with a brass ball, and thus the centre of oscillation raised above *b*. The moment that *a b* exerted on W was not, however, sufficient to prevent W from swinging, and its movements were retarded and rendered "dead beat" by frictional resistance directly applied to the surface of W, which was a disk of lead suspended horizontally. During the last two years I have had several seismographs constructed in which *a b* was long; and, as near to *a* as possible, a weight sufficiently large to render W feebly stable was placed. This important suggestion of loading *a b* originated with Mr. T. Gray. Later, Mr. Gray drew attention to the necessity of rendering an ordinary pendulum, for small displacements, absolutely astatic, and he suggested various means by which this might be accomplished (Trans. Seis. Soc., vol. iii. p. 145).

In the same publication, vol. v. p. 89, Prof. Ewing, attacking the same problem, described a duplex pendulum, a modified form of which he described in vol. vi. p. 19. In vol. viii. p. 83, Prof. Sekiya described an improved form of Prof. Ewing's instrument (see also NATURE, vol. xxxiv. p. 343). In the duplex pendulum seismograph an ordinary pendulum is rendered astatic for small displacements by placing an inverted pendulum beneath it, and so uniting the bobs of the two pendulums that any horizontal motion is common to both, and the jointed system so proportioned that neutral or feebly stable equilibrium is obtained. Although these instruments are, for seismometrical work, theoretically good, in practice such of them as I have had, which are the best to be obtained in this country, present many serious objections. Among these objections I may mention the following: (1) the difficulty of adjustment; (2) the difficulty of inserting and removing smoked glass plates; (3) the fact that the pointer being cranked at its upper end it does not give so satisfactory a record in directions at right angles to the plane of the crank as is desired; (4) their incapability of recording an earthquake of greater amplitude than 5 mm.

By introducing arrangements for adjustment, alteration in the form of the recording index, &c., these instruments might be improved. Possibly in the instrument recommended by Prof. Ewing for use in Observatories (see NATURE, vol. xxxiv. p. 343), although it appears to be practically similar to those I have in Tokio, the objections may not be so serious.

The instrument of this class which I have in all respects found the most satisfactory is, in its essential features, shown in Fig. 2,

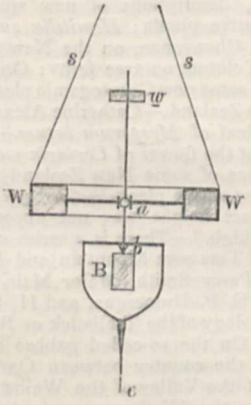

FIG. 2.

in which W represents a lead ring about 7 inches in diameter, with a small tube, *a*, fixed in a plate at its centre. W is supported by three strings or wires, *s*. The indicating pointer is *w a b c*, prolonged downwards, at the lower end there being a needle as a writing-point sliding in a small tube. *w a b* is a light steel rod with a ball forming a universal joint on the tube at *a*, and a point, *b*, pivoting in the fixed steel bar B. The stability of the system is readily altered by raising or lowering the *small* weight *w*. For small displacements neutrality is obtained when $\frac{w}{W} = \frac{p^2}{Ll}$ where $p = ab$, L the length of the main pendulum, and *l* the length of the inverted pendulum.

The whole is carried on a tripod about 2 feet 3 inches high, stiffened in the centre by a small transverse table which carries the bar B. W is so suspended that it can be readily shifted laterally or vertically. Below there is a small shaft which carries the smoked plate. By means of a wedge this can be raised or lowered, and the plate brought to any degree of contact with the sliding pointer. This portion of the apparatus is so simple that a record-receiving surface is instantly adjusted or removed by the movement of a handle connected with the wedge. The instrument is an outcome of instruments which have preceded it, and it may be regarded as a modification of an old type where *a b c* has been prolonged upwards and the balance load placed above *a* instead of being between *a* and *b*. Its chief recommendations are: (1) its smallness; (2) the simplicity and fewness of its parts; (3) the ease with which it may be used; (4) its large range of motion; (5) the accuracy of its diagrams. The test for accuracy has been made by placing the instrument upon a specially designed shaking table, the absolute movements of which are recorded by a multiplying lever.

Comparing the diagrams given by the machine with those given by the table, it is found that for all small displacements, whether in right lines or complicated curves, the diagrams, 20 or 30 mm. in length, are practically identical. For diagrams 50 mm. in their greatest dimensions, composed of a complication of curves if anything greater in complexity than those yielded by ordinary earthquakes, some differences occur, the extent of which may be judged of by the accompanying diagram, Fig. 3. Figs. 4

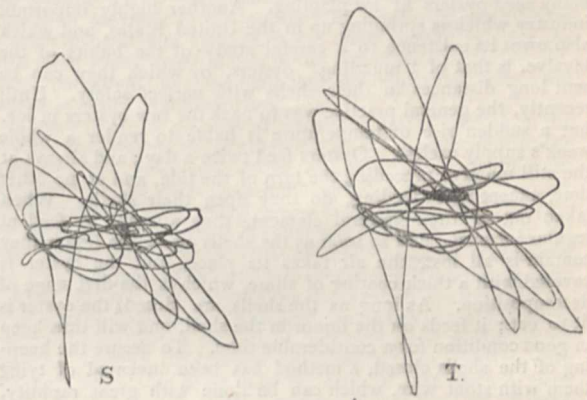

FIG. 3.

and 5 are examples of the diagrams obtained for small displacements. These diagrams are fair specimens, but have not been selected as particularly good examples. The multiplication of the table diagram, marked T, is 6·3, while that of the seismograph, marked S, is slightly over 6.

Diagrams of the old type of seismograph with the weight on *a b* have also compared favourably with the table motion. I regret, however, to say that the diagrams given by one of Prof.

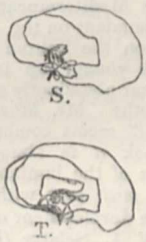

FIG. 4.

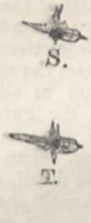

FIG. 5.

Ewing's duplex pendulums, with the exception of their amplitude, in no way resembled the table motion. This instrument was adjusted to have extremely feeble stability. With a second of Prof. Ewing's instruments, which was adjusted by Prof. Sekiya's assistant, who understood the machine, the distortion was not so great, but the diagrams were complicated by the swinging of the pendulum after the shaking had ceased. The pendulum in this instance had a period of about two seconds, which was much too short.

JOHN MILNE.

THE CULTIVATION OF OYSTERS.

A REPORT from the British Consul at Baltimore on the oyster-fisheries of Maryland, which has just been laid before Parliament, contains much interesting information respecting the cultivation of oysters. The method of farming most successful in America consists in depositing clean oyster-shells upon the bottom, just before the spawning-season, to which the young attach themselves, and then placing among the shells a few mature oysters to furnish eggs and young. As soon as the young oysters caught in this manner are large enough to handle, they are distributed over the bottom. Another system is by artificial propagation, properly so called—that is, by producing the seed-oyster itself, or procuring it by methods less simple than the shell-sowing process. This method is due to a discovery by Dr. W. K. Brooks that the *Ostrea virginiana*, or American oyster, is not, like the *Ostrea edulis*, or oyster of Northern Europe, hermaphrodite, but is exclusively male or exclusively female. The eggs of the European oyster are fertilized within the valves of the parent, while in the case of the American oyster, fertilization takes place in the broad and open waters. By experiment Dr. Brooks discovered how artificial fertilization could be procured, and the next great step of finding a simple and practical method of rearing the young oysters which have been hatched artificially was the work of M. Bouchon Brandslé, the French naturalist, who experimented with Portuguese oysters, which, like the American variety, are of distinct sexes. He succeeded in rearing many seed-oysters fit for planting. Another highly important industry which is springing up in the United States, and which also owes its existence to a careful study of the habits of the bivalve, is that of "muzzling" oysters, by which they can be sent long distances in their shells with perfect safety. Until recently, the general practice was to pack the raw oysters in ice, but a sudden rise of temperature is liable to render a whole week's supply useless. Oysters feed twice a day; and always at the still moment preceding the turn of the tide, and at no other time, except when feeding, do they open their shells. When taken out of their natural element, they attempt to feed at regular intervals, and so soon as the shells open, the liquor they contain is all lost, the air takes its place, and the oyster is covered with a thick coating of slime, which is the first stage of decomposition. As long as the shells are closed, the oyster is fit to eat; it feeds on the liquor in the shell, and will thus keep in good condition for a considerable time. To secure the keeping of the shells closed, a method has been invented of tying them with stout wire, which can be done with great rapidity, and now arrangements are being made for despatching American oysters in their natural condition all over the civilized world.

SCIENTIFIC SERIALS.

The Quarterly Journal of Microscopical Science, February, 1888, contains:—On the Photospheria of *Nyctiphanes norvegica*, G. O. Sars, by Rupert Vallentin and J. T. Cunningham (Plate 23). The authors give an account of their examination of the luminous organs of this little crustacean; it is a distinctly northern form, being absent from the Mediterranean and the warmer parts of the Atlantic. It is abundant on the west coast of Norway; the adults seem to live on the bottom and never swim far from the ground, while the young, up to half or three-quarters the size of the adult, occur abundantly at the very surface, and at all intermediate depths. Mr. Murray found swarms in the Faroe Channel, and it seems common in the the Clyde sea-area; the authors took it in abundance off Brodick Bay. The histological details of the luminous organs are given in detail, and agree for the most part with those of G. C. Sars.—On the early stages of the development of a South American species of Peripatus, by W. L. Sclater (Plate 24). These details are worked out from a species found by Mr. Sclater in Demerara, and called by him *P. imthurni*; the early stages present great differences when compared with those described by M. Sedgwick in *P. capensis*.—On the anatomy of *Allurus tetraëdrus* (Eisen), by Frank E. Beddard (Plate 25). The specimen described came from Teneriffe; there are several structural differences between this genus and Allolobophora.—On the development of the Cape species of Peripatus; Part iv. the changes from the G stage to birth, by Adam Sedgwick, F.R.S. (Plates 26-29).—On the occurrence of numerous Nephridia in the same segment of certain earthworms, and on the relationship between the excretory system in the Annelida and in the Platyhelminths, by Frank E. Beddard (Plates 30 and 31).—On the anatomy of the Madreporia, iv., by Dr. G. Herbert Fowler (Plates 32 and 33). The author gives the result of his investigations of the species of seven more genera of the Madrepores, which, among other important results, seem to establish a relationship between the external body-wall and the corallum, which depending on the presence or absence of cœnenchyma may yield a distinctive morphological character. In all those genera in which a cœnenchyma is found, whether they belong to the Perforata or Imperforata, the body-wall rests on the little spikes or echinulations which stud the surface of the corallum. A new species of Seriatopora is described as *S. tenuicornis*; it was found by Dr. S. J. Hickson at the Celebes; it comes near *S. caliendrum*.

Transactions and Proceedings of the New Zealand Institute for 1886, vol. xix. (Wellington, May 1887).—The principal contents of this volume, edited as usual by Sir James Hector, are as follow:—*Zoology*: E. Meyrick, monograph of New Zealand Noctuina, describes sixty-three species.—W. M. Maskell, on the "honeydew" of Coccidæ, and the Fungus accompanying these insects; Further notes on New Zealand Coccidæ; On the freshwater Infusoria of the Wellington district. In the second paper a new genus and two new species are described; in the last many new species are described, and several well-known British forms are recorded; all these papers are illustrated.—G. V. Hudson, on New Zealand glow-worms.—T. W. Kirk, notes, double earth-worm; New species of Ixodes; *Zootoca vivipara*, in New Zealand; New species of Alpheus.—A. Purdie, *Pasiphila lichenodes* sp. nov., and descriptions of larvæ of three species of the genus.—A. T. Urquhart, on new species of Araneidea; On the work of earth-worms.—W. W. Smith, notes on New Zealand earth-worms, gives some very interesting details.—W. Colenso, deformed bill of a Huia; New species of Hemideina; Gestation of a species of Naultinus.—T. Jeffery Parker, on *Patinurus lalandii* and *P. edwardsii*, decides that there are constant though slight differences between the two species; *P. edwardsii*, Hutton, being the New Zealand form, the other being the Cape of Good Hope form.—C. W. Robson, new giant cuttle-fish (*Architeuthis kirkii*).—J. A. Newell, anatomy of *Patinella radians*.—T. F. Cheeseman, Mollusca of the vicinity of Auckland.—J. Adams, land Mollusca of the Thames gold-fields.—A. Reischek, Hauturu Island and its birds; Ornithological notes.—S. Weetman, Moa remains on the Great Barrier Island.—R. Haeusler, Foraminifera from Hauraki Gulf.—P. Goyen, descriptions of new spiders.—*Botany*: J. Buchanan, new native plants; *Hemitelia smithii*, a branching specimen.—T. F. Cheeseman, on the New Zealand species of Coprosma.—W. Colenso, on tree ferns; On some new Phænogamic plants; On some new Cryptogamic plants; Fungi recently discovered in New Zealand.—Catherine Alexander, on the glands in the stem and leaf of *Myoporum lætum*.—T. W. Rowe, on the development of the flower of *Coriaria ruscifolia*.—J. Baber, medicinal properties of some New Zealand plants.—D. Petrie, descriptions of new native plants.—*Geology*: J. Park, ascent of Ruapehu, the exact height was not apparently determined, "about 9000 feet high."—There is a series of important papers on the eruption of Tarawera Mountain and Rotomahana, by J. A. Pond and S. Percy Smith, Major Mair, L. Cussen, Archdeacon Williams, E. P. Dumerque, and H. Hill.—Prof. F. W. Hutton, on the geology of the Trelissick or Broken River Basin, Selwyn County; On the so-called gabbro of Dun Mountain; On the geology of the country between Oamaru and Moeraki; On the geology of the Valley of the Waihao in South Canterbury.—A. McKay, the Waihao greensands and their relation to the Ototara limestone.—Sir J. von Haast, notes on the age and subdivisions of the sedimentary rocks in the Canterbury Mountains, based upon the palæontological researches of Baron von Ettingshausen.—W. S. Hamilton, notes on the geology of the Bluff District.—J. Goodall, on the formation of Timaru Downs.

Reale Istituto Lombardo, March 8.—This number is mainly occupied with E. G. Celoria's determination of some new orbits of the double stars OΣ 298 in the constellation of Boötes and β Delphini. The results of thirty-nine distinct observations are tabulated, and compared with previous more or less approximate determinations of these orbits by Burnham, Dawes, Dembowski, Dunér, Engelmann, Asaph Hall, Perrotin, Schiaparelli, Seabroke, Struve, and Wilson.

Rivista Scientifico-Industriale, March 31.—Influence of magnetism on the electric resistance of solid conductors, by Dr. Faè. In this paper the author explains the conclusions already announced for cobalt and antimony, and describes his further researches on other bodies in connection with the influence of magnetism on their electric resistance. He concludes generally that the resistance of the principal solid conductors undergoes modifications in the magnetic field, such modifications being perceptible enough in the highly magnetic or diamagnetic metals, but most conspicuous in bismuth. In all other metals it is very slight, and at times quite inappreciable. Under like conditions the resistance in the direction of the lines of force increases both for the magnetic and diamagnetic metals, while in the direction normal to the lines of force it diminishes in the first and increases in the second, although under special conditions iron and steel behave exceptionally. These variations of resistance make it probable that Hall's phenomenon depends in effect on a transitory change produced by the magnetism in the structure of the metals, and causing a rotatory variation in the electric resistance.—Dr. Luigi Fritsch describes an industrial product of the nitrate of ethyl.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 2.—"On the Voltaic Circles producible by the mutual Neutralization of Acid and Alkaline Fluids, and on various related Forms of Electromotors." By C. R. Alder Wright, D.Sc., F.R.S., Lecturer on Chemistry and Physics, and C. Thompson, F.I.C., F.C.S., Demonstrator of Chemistry in St. Mary's Hospital Medical School.

About the beginning of the present century it was noticed that when platinum plates are immersed respectively in an acid and an alkaline fluid (*e.g.* diluted sulphuric acid and caustic potash solution), and connected with a galvanometer, a much stronger current flows at first than after passing awhile: which circumstance may be explained by supposing that in virtue of the chemical action taking place between the two fluids a current is generated, the flowing of which necessarily causes electrolysis of the liquids, so that the plates become "polarized" by the evolution thereon of hydrogen and oxygen respectively, whereby an inverse E.M.F. is set up, gas battery fashion. It was shown subsequently by Becquerel that when *nitric* acid is thus used in conjunction with caustic potash a much more powerful continuous current can be generated, the passage of which is accompanied by a continuous evolution of oxygen from the plate immersed in the alkali, whilst the nitric acid is simultaneously reduced, forming lower oxides of nitrogen: whence the term "pile à oxygène" applied to the combination. In this arrangement the hydrogen supposed to be formed electrolytically can never actually make its appearance in the free state, being oxidized whilst nascent by the nitric acid; so that as the gas battery inverse E.M.F. is not developed, the continuous current passing is not so much weakened; the oxygen set free by electrolysis consequently passes off continuously at the other plate.

It occurred to the authors that, if this reasoning be correct, firstly, other oxidizing acid liquids besides nitric acid should be able to act in the same way, causing continuous oxygen evolution at the plate immersed in the alkali. Secondly, by parity of reasoning, if ordinary dilute sulphuric acid be used on the one side opposed to an alkaline fluid also containing some readily oxidizable substance dissolved therein, continuous *hydrogen* evolution should, under favourable circumstances, be produced at the plate in the acid, the oxygen evolved at the other plate being acted upon while nascent by the oxidizable substance present, so as to be suppressed just as the hydrogen is in Becquerel's "pile à oxygène." Thirdly, whether oxygen or hydrogen be continuously evolved, the quantity liberated should be proportionate to the current passing; so that, if a silver voltameter be included in the circuit, for every milligramme-equivalent (108 mgrms.) of silver deposited 1 mgrm.-equivalent of gas should be liberated; *i.e.* 8 mgrms. of hydrogen occupying at 0° and 760 mm. 5·6 c.c.; or 1 mgrm. of hydrogen occupying 11·2 c.c.

A number of cells were arranged, consisting of two porcelain basins or beakers, one containing the acid and the other the alkaline fluid united by a siphon tube, or by a thick wick, containing or wetted with a strong solution of the salt formed by the union of the acid and alkali (*e.g.* sulphate of soda when sulphuric acid and caustic soda were used, and so on). A plate of platinum foil was placed in each fluid attached to a platinum wire, and arranged under an inverted graduated tube filled with the liquid pertaining to that side of the cell, so that any evolved gas could be collected and measured, loss of gas from evolution at the surface of the wire outside the tube being avoided by coating the wire with gutta percha or paraffin wax. A small silver voltameter with a gold plate as negative electrode was always included in the circuit, so as to permit of the deposited silver being determined. Numerous experiments thus made are described, the results of which were always in sensible accordance with the above previsions, a considerable variety of acid oxidizing fluids and alkaline oxidizable solutions being employed.

These results render it probable that, if, instead of a platinum plate and an oxidizable substance in solution, there be used simple caustic soda or ammonia, and an oxidizable metal, the oxide of which is soluble in the alkaline fluid, continuous currents might be set up (in certain cases at least), even though the metal used have of itself no visible action on the alkaline fluid, apart from its absorbing oxygen dissolved therein or in contact therewith; for instance, metallic tin or lead in contact with caustic soda, or copper immersed in ammonia solution. On trying such experiments, continuous evolution of hydrogen from the surface of the platinum plate immersed in the acid was found in many instances to be readily brought about, the amount evolved being (as might *a priori* be anticipated) proportionate to the current passing, *i.e.* to the quantity of silver deposited in a silver voltameter included in the circuit. By employing an alkaline solution of potassium cyanide, it was found easy to produce the same result when certain metals of the non-oxidizable class (gold, silver, palladium, and mercury, but *not* platinum) were used instead of really oxidizable ones.

In most cases the quantity of metal taken into solution in the alkaline fluid was practically identical with that equivalent to the current passing, calculated on the assumption that the nascent oxygen due to the electrolysis combined with the metal *to form the lowest oxide* thereof, in the various cases respectively. In some few instances a slight excess of metal was dissolved, obviously due either to local action or the effect of small quantities of dissolved air. Two well-marked exceptions to the general rule, however, were noticed: one was *tin*, which when dissolved in caustic soda invariably went into solution to an appreciably less extent than corresponded with SnO; instead of fifty-nine parts of tin being dissolved for every 108 of silver deposited in the volameter, only quantities amounting to 93 to 97 per cent. of that amount were dissolved, indicating that some little quantity of SnO_2 was formed as well as SnO, although the latter largely predominated. The other exception was *mercury*, which in contact with potassium cyanide dissolved to only half the extent due to formation of Hg_2O, *mercuric* potassio-cyanide being produced. Copper, whether in contact with ammonia or with potassium cyanide, on the other hand, always dissolved in proportions corresponding with Cu_2O, a little excess instead of deficiency being usually noticeable through the secondary action of dissolved air.

In all these experiments, the results obtained are precisely those due to electrolysis of the salt formed by the neutralization of the acid and alkali in accordance with the scheme (for sulphuric acid and soda)—

$$\left\{\begin{array}{l} H_2SO_4 \mid Na_2SO_4 \mid Na_2SO_4 \mid 2NaOH \\ H_2 \mid SO_4Na_2 \mid SO_4Na_2 \mid SO_4Na_2 \mid H_2O + O\,; \end{array}\right.$$

where either the hydrogen or the oxygen is suppressed, whilst nascent, by combination with the fluid in contact with which it is evolved, or with the metal in the case of oxygen in the cells last described.

Accordingly it might be expected that in all actions of this kind a quantity of acid on the one hand, and of alkali on the other, proportionate to the current passing, will disappear as such on account of the mutual neutralization thus indirectly brought about. The authors have made a number of titration experiments with a view to obtaining numerical evidence on this point, with the general result of finding that such neutralization always takes place. It may be noticed that if cells be constructed with platinum electrodes immersed respectively in an alkaline fluid containing an oxidizable substance dissolved therein, and an acid fluid containing an oxidizing agent (*e.g.* caustic soda solution of pyrogallol, and sulphuric acid solution of chromic anhydride), continuous currents of very considerable power may be obtained when the internal resistance is diminished sufficiently by using cells of considerable magnitude; *e.g.* when made of

the stoneware and inner porous vessels usually employed for Grove's cells, the porous vessel being cemented into the outer stoneware vessel (by paraffin wax or other unattacked material) in such a fashion as to divide it into three compartments separated one from the other by porous dividing walls; the acid and alkaline fluids being placed in the two outermost compartments, and the innermost one being filled with a solution of a neutral salt, *e.g.* sodium sulphate.

March 1.—"On Electrical Excitation of the Occipital Lobe and adjacent Parts of the Monkey's Brain." By E. A. Schäfer, F.R.S., Jodrell Professor of Physiology in University College, London.

The following are the results of my own observations:—Electrical excitation of the posterior limb of the angular gyrus, of the upper end of the middle temporal gyrus[1] (which is continuous with it), of the whole cortex of the occipital lobe, inclusive of its mesial and under aspects and of the quadrate lobule, causes conjugate deviation of the eyes to the opposite side. The movement is not, however, in all cases a simple lateral deviation, but the lateral movement may be combined with an upward or downward inclination according to the part stimulated. Thus—

(1) Excitation of a superior zone which comprises on the external surface the posterior limb of the angular gyrus, the upper (posterior) end of the middle temporal gyrus, and the part of the occipital lobe immediately behind the external parieto-occipital fissure and on the mesial surface the quadrate lobule immediately in front of the upper end of the internal parieto-occipital fissure and the occipital lobe for a short distance behind the upper end of that fissure, produces, besides the lateral deviation, a downward inclination of the visual axes which is sometimes—especially when the stimulation is applied at or near the mesial surface—so marked as greatly to obscure the lateral deviation.

(2) Excitation of an inferior zone comprising the whole of the inferior surface of the lobe, the lower part of the mesial surface, and the posterior or lowermost part of the convex or external surface, produces, besides the lateral deviation, an upward inclination of the visual axes, which, like the downward movement resulting from stimulation of the superior zone, may be so marked as partly to obscure the lateral deviation.

(3) Excitation of an intermediate zone which comprises the greater part of the external surface (where it gradually broadens out laterally) and extends over the margin of the great longitudinal fissure to include a narrow portion of the mesial surface, produces neither upward nor downward inclination of the visual axes, but a simple lateral movement.

If, as is highly probable, the movements of the eyes, which occur on excitation of the occipital lobe and adjacent parts, are the result of the production of subjective visual sensations, these effects of excitation of the several parts of that lobe and the adjoining portions of the brain would appear to indicate—

1. A connection of the whole visual area of each hemisphere with the corresponding lateral half of each retina. (This has already been ascertained to be the case from the result of removing the whole of the area on one side, bilateral homonymous hemianopsia being thereby produced.)

(2) A connection of the superior zone with the superior part of the corresponding lateral half of each retina.

(3) A connection of the inferior zone with the inferior part of the corresponding lateral half of each retina.

(4) A connection of the intermediate zone with the middle part of the corresponding lateral half of each retina.

"A Comparison of the Latency Periods of the Ocular Muscles on Excitation of the Frontal and Occipito-Temporal Regions of the Brain." By E. A. Schäfer, F.R.S., Jodrell Professor of Physiology in University College, London.

Conjugate deviation of the eyes to the opposite side is produced by excitation of entirely different regions of the cerebral cortex.

Of these parts, excitation of which produces this result (conjugate deviation of the eyes to the opposite side), one, viz. the frontal area, is distinguished from the rest by the fact that its removal produces paralysis of that movement. This fact has been seized upon by Ferrier as indicating an important functional difference, the movements in the one case being probably caused by the direct action of this part of the cortex upon the centre of origin of the nerves to the ocular muscles; but in all other cases by indirect action, the movement when, *e.g.*, the visual or auditory region is stimulated being the result of visual or auditory impressions (subjective sensations) being provoked in the brain by the excitation, and these impressions producing indirectly the action in question. Others have supported the view that in all cases the movement is the result of the setting up of subjective sensations, but that in the case of the frontal area these are tactile or are connected with the muscular sense.

It seemed to me that light would be thrown upon the question if the period of latent stimulation of the ocular muscles were accurately determined under exactly the same conditions for the frontal and posterior (temporal and occipital) areas respectively. The result of this determination, which I have made in a number of monkeys, is to show that the latent period is longer by some hundredths of a second in the case of stimulation of the occipital lobe, or of the superior temporal gyrus than when the frontal area is stimulated; thus indicating that in the former case the nervous impulses must be transmitted through at least one more nerve centre than in the latter.

[1] Excitation of the upper end of the superior temporal gyrus gives a similar result. Since this is commonly accompanied by a movement of the opposite ear, it is usually considered that subjective auditory sensations have been called up by the excitation.

Geological Society, March 28.—Dr. W. T. Blanford, F.R.S., President, in the chair.—The following communications were read:—On some eroded agate pebbles from the Soudan, by Prof. V. Ball, F.R.S. The majority of the pebbles in a collection made by Surgeon-Major Greene in the Soudan, and presented by him to the Science and Art Museum in Dublin, are of very similar character to the agate and jasper pebbles derived from the basalts of India. It may be concluded inferentially that they came originally from a region in which basaltic rocks occur to a considerable extent. A certain number of them are eroded in a manner unlike anything noticed in India, though it is probable that similar eroded pebbles will eventually be found there. Throughout India, wherever there is a deficient subsoil-drainage or excessive evaporation and limited rainfall, salts are apparent either in supersaturated subsoil-solutions or as crystallizations in the soil. They are most abundant in basaltic regions, and in a lake occupying a hollow in the basalt in Berar carbonate of soda is deposited in abundance from the water, which becomes supersaturated during the summer. The author commented on the efficacy of such a liquid as a solvent of silica, and noticed the selective action of the agent which had affected the Soudan pebbles and had corroded some layers more than others; he suggested that, while this might be to some extent due to differences in composition, it was more probably owing to differences of nodular constitution. He considered it unnecessary to refer to the action of humic acid, because, while the salt to which the solvent action is attributed would be capable of doing such work, and would be probably abundant in the region referred to, we could not expect any great amount of humic acid in the same area. This paper gave rise to a discussion, in the course of which remarks were made by the President, Mr. Whitaker, Mr. Irving, Mr. De Rance, and Sir Warington Smith.—On the probable mode of transport of the fragments of granite and other rocks which are found embedded in the Carboniferous Limestone of the neighbourhood of Dublin, by Prof. V. Ball, F.R.S.—The Upper Eocene, comprising the Barton and Upper Bagshot formations, by J. Starkie Gardner and Henry Keeping, with an appendix by H. W. Monckton.

Royal Microscopical Society, March 14.—Dr. R. Braithwaite, Vice-President, in the chair.—The Rev. A. H. Cooke exhibited a number of photomicrographs of the odontophores of Mollusca, as an attempt to illustrate this group of objects by photography; he also referred to the valuable results obtained in the definition of species by the application of the method.—Mr. E. M. Nelson exhibited and described a new form of mechanical stage, in which two points were moved by milled heads in rectangular directions, carrying the slide with them, the slide being pressed against them, when they were withdrawn, by the hand.—Mr. C. L. Curties exhibited a new combination condenser, which, in addition to the condenser, also contained an iris diaphragm, a spot lens, and a polarizing prism.—Mr. Crisp exhibited a Collins's aquarium microscope which could be fixed by suction to the glass side of the tank; also Klonne and Müller's aquarium microscope for examining objects in a small aquarium or trough specially constructed for the purpose, and fitted with movable diaphragm slides; also a new form of Thury's 5-tube microscope for class purposes, having a reflecting prism made to rotate, so as to exhibit the object upon the stage alternately to

each of five observers.—Mr. G. Massee read a paper on the type of a new order of Fungi, Matuleæ.—Mr. J. Rattray gave a *résumé* of his paper, "A Monograph of the genus *Aulacodiscus*," the subject being illustrated by diagrams, and by a tabulated list of groups of allied species.—The Chairman announced that the date of the next *conversazione* had been fixed for April 25.

Entomological Society, April 4.—Dr. D. Sharp, President, in the chair.—Mr. H. Goss exhibited a large number of insects lately received from Baron Ferdinand von Mueller, F.R.S., of Melbourne, which had been collected by Mr. Sayer on Mount Obree, and the adjoining ranges in New Guinea, during Mr. Cuthbertson's recent expedition there under the direction of the Royal Geographical Society of Australia. The collection comprised Coleoptera, Lepidoptera, Hemiptera, Diptera, Hymenoptera, and Orthoptera. The Lepidoptera included twenty species of butterflies belonging to the genera *Calliplæa*, *Chanapa*, *Hamadryas*, *Melanitis*, *Mycalesis*, *Hypocysta*, *Tenaris*, *Hypolimnas*, *Cyrestis*, *Neptis*, *Acræa*, *Danis*, *Pithicops*, *Appias*, *Ornithoptera*, and *Eurycus*.—Mr. Osbert Salvin, F.R.S., exhibited, and made remarks on, about sixty specimens—no two of which were alike—of a species of butterfly belonging to the genus *Hypolimnas*, all of which had been caught by Mr. Woodford near Suva, Fiji, on one patch of Zinnias.—Mr. H. T. Stainton, F.R.S., exhibited, on behalf of Mr. G. C. Bignell, cases of *Thyridopteryx ephemeræformis*, collected near Charleston, U.S.A. Mr. Stainton said he hoped Mr. Bignell would not introduce this pest into England.—Mr. W. F. Kirby exhibited, and read notes on, about twenty species of South African dragon-flies lately received from Mr. Roland Trimen, F.R.S., of Cape Town. The collection included some new species.—Mr. Goss read a letter from Mr. Bignell, correcting a statement made by Mr. Poulton at the March meeting of the Society, to the effect that the variety *Valezina* of the female of *Argynnis paphia* did not occur in Devonshire. Mr. Bignell said that the variety *Valezina* was included in Mr. Reading's "Catalogue of Devonshire Lepidoptera"; and he had himself taken specimens of this variety in Bickleigh Vale, Devon.—Mr. Waterhouse read a paper entitled "Additional Observations on the Tea-bugs (*Helopeltis*) of Java," and exhibited a number of specimens of these insects. He said that the species infesting the Cinchona in Java was supposed to have been introduced from Ceylon in tea, but that he had discovered that the species on the tea and on Cinchona in Java were distinct, and that both species were distinct from *Helopeltis antonii* of Ceylon.—Herr Jacoby read a paper entitled "New, or little-known, species of Phytophagous Coleoptera from Africa and Madagascar."—A letter was read from Mr. E. C. Cotes, of the Indian Museum, Calcutta, asking for the assistance of British entomologists in working out certain groups of Coleoptera, Neuroptera, Orthoptera, Diptera, and Hymenoptera in the Indian Museum. A discussion ensued, in which Mr. McLachlan, F.R.S., Dr. Sharp, Mr. Waterhouse, Herr Jacoby, and Mr. Distant took part.

PARIS.

Academy of Sciences, April 3.—M. Janssen, President, in the chair.—A new theory of the equatorial *coudé* and of equatorials in general (continued), by MM. Lœwy and P. Puiseux. In the present paper the authors deal with the new processes for determining the position of the polar axis, concluding with some remarks on the bend of the arm. Six distinct methods are given for determining the constant n, and five for λ.—Results of comparisons of the standard Peruvian unit of measure and the international metre made by M. Benoit, presented by M. Wolf. From these comparisons, which have been made at the International Bureau of Weights and Measures, it appears that the Peruvian standard is substantially in the same condition as when it was constructed by Langlois in 1735. But it is also made evident that the Peruvian arc, measured with this standard, has been hitherto incorrectly compared with the other terrestrial arcs. In fact it is somewhat shorter than was supposed, and in a future paper the author will point out the consequences to be drawn from this error as affecting the form of the globe.—On the relations of atmospheric nitrogen with vegetable soil, by M. Th. Schlœsing. The author here deals with an objection that might be raised against the results of his previous experiments. The objection is based on the consideration that vegetable humus, like all dead organic matter, is a prey to two different kinds of microbes, one working in the absence, the other in the presence, of oxygen. But the conclusions previously arrived at do not appear to be materially affected by this circumstance.—On the blizzard of March 11 and 12 in the United States, by M. H. Faye. Comparing the public reports with the remarks of Dr. G. Hinrichs, Director of the Iowa Weather Service, the author concludes that a blizzard is a local snowstorm accompanied by an extremely sudden fall of temperature, and controlled by a general cyclonic movement passing over regions subject to great extremes of climate. The phenomenon is analogous to such atmospheric disturbances as the Russian *bora* or *buran*, the *khamsin* or sandstorms of the Sahara, the *föhn* of the Alps, all of which are modified by the different local conditions.—Remarks accompanying the presentation of a work on the Elasmotherium, by M. Albert Gaudry. From the specimens obtained from Russia a more correct idea can now be formed of this huge pachyderm than was hitherto possible. It flourished in the Quaternary epoch, and, notwithstanding several aberrant features, appears on the whole to have somewhat closely resembled the rhinoceros. Surviving till the close of the Glacial period, it became gradually modified, like the elephants and ruminants, to the altered climatic conditions, under which a subtropical vegetation was replaced by herbaceous plants.—On a disposition, by means of which powerful objectives may be employed in meridian observations, by M. G. Bigourdan. By the arrangement here described the great meridian instruments, such as those of Greenwich and Paris, which at present can scarcely observe stars beyond the twelfth magnitude, may be placed on a level with the equatorials.—Observations of the Sawerthal Comet made at the Observatory of Nice with the 0·38 m. Gautier equatorial, by M. Charlois. These observations, covering the period from March 14 to March 21, give the right ascension, polar distance, and other data for the comet and three comparison-stars.—On the velocity of sound, by MM. J. Violle and Th. Vautier. From the experiments here described it is placed beyond doubt that the velocity of the sound-wave diminishes with its intensity; also that the pitch of the sound has no influence whatever on the velocity of its propagation. The slight differences observed appear to be due solely to the different intensities of the sound-wave in the respective cases.—Photographic experiments on the penetration of light in the waters of the Lake of Geneva, by M. F. A. Forel. Comparing his present researches with those of previous years, the author finds that for the chloride of silver the limits of absolute darkness range from 45 metres in July to 110 in March; that the variations in these limits run parallel with those of the limits of visibility; and that the water of the lake is much more limpid in winter than in summer, the difference being mainly due to the greater abundance of organic matter held in suspension during the latter season.—On the latent heats of vaporization for some extremely volatile substances, by M. James Chappuis. The author points out that his own previously announced conclusions have been substantially confirmed by those recently announced by MM. Cailletet and Mathias.—On the laws of chemical equilibrium, by M. H. Le Chatelier. In connection with the discussion on the theory of the thermodynamic potentials, the author here shows how, starting with the hypothesis of MM. Gibbs and Duhem, and employing the same methods, the general formula indicated by M. Van t' Hoff may be established in an extremely simple way.—On the active crystallized matter of the poisoned arrows used by the Somali people, by M. Arnaud. This is an extract from the Wabaio plant, a species of *Carissa*, the poisonous extract from which (wabain) is shown by analysis to be a compound of carbon, hydrogen, barium, and oxygen, with the formula $C_{30}H_{46}O_{12}$.—On the adulteration of olive oils, by M. R. Brullé. A mixture of ordinary nitric acid and the albumen of jerked beef is shown to be an excellent chemical reagent for rapidly detecting the presence of one or more vegetable oils in the olive-oil of commerce.—On a simple and practical method of detecting and analyzing the impurities contained in the alcohols of commerce, by M. L. Godefroy. The reaction here described is extremely sensitive and accurate, detecting a millionth part, or 1 c.c. of impurities in 1000 litres of alcohol.—M. Eugène Dupuy describes some interesting experiments on dogs, cats, and rabbits, in connection with the motor functions of the brain. The results seem to be at variance with the theory usually advanced to explain the mode of production of movements or paralysis originating in the brain.

Astronomical Society, March 7.—M. Flammarion, President, in the chair.—M. Valderrama sent a drawing of a sunspot with white spots in its interior on January 15. M. Schmoll showed a drawing of the same on January 14. According to M.

Trouvelot, this appearance may be explained by a bridge crossing the spot, and sufficiently thin in some parts to escape detection.—MM. Giovannozzi, at Florence, and Bruquière, at Marseilles, sent some observations on the zodiacal light, which has been very bright; M. Gourdet, observations on 66 Ceti; and M. Guiot on Mira Ceti and ν Leporis.—M. Dumenil, at Yebleron, observed a meteor on February 19 whose trace remained visible for five or six minutes.—Observation of a fine meteor at Paris on February 24 by M. Mabire at 7 p.m.—M. de la Fresnaye submitted a plan of binocular telescope with total reflecting prisms to bring the two oculars within convenient distance for the two eyes.—M. Armelin, writing upon the calendar reform, said that it was perhaps entering on a practical phase.—The meeting thanked Mr. Holmes for his letter published in the *English Mechanic*. His observation of the *comes* to Polaris with a 1½-inch is thought remarkable.—M. Flammarion read a paper on a probable connection between the movements of our sun and those of α Centauri.—General Parmentier, reading a paper on the asteroids, remarked that the new planets discovered do not fill up the gaps to which he formerly called attention.—Various communications: on the lunar eclipse of January 28, by M. Moussette; a drawing of Plato, by M. Schmoll; observations on the aurora borealis, by M. Trouvelot; on a natural classification of double and multiple stars, by M. Flammarion; Vogel's chart of stellar spectra, presented by M. Secretan.

BERLIN.

Physical Society, March 16.—Prof. von Helmholtz, President, in the chair.—Doctor Koepsel demonstrated two energy-meters constructed on different principles by Messrs. Siemens and Halske, and explained the arrangements of the same.—Prof. Lampe spoke on a deficiency in elementary text-books of mechanics—namely, that they do not employ the elliptic functions so fully treated of by Gauss and Schellbach. The speaker then showed by a series of examples how easy it is to solve a number of mechanical problems by the use of these functions.—Prof. Helmholtz next showed how the nature of elliptic functions can be made clear to persons unacquainted with them by means of the movement of a pendulum.—He then briefly communicated the results of an investigation by Prof. Töpler, of Dresden, which he had yesterday laid before the Academy of Sciences: it contains a new method for the measurement of the magnetism and diamagnetism of gases. An index drop of petroleum is placed in a glass tube bent at a very obtuse angle; on one side of the index is the gas which is to be investigated and on the other side is atmospheric air. When placed between the poles of a powerful electro-magnet, the index is moved according as the gas is more or less strongly attracted than the air: the amount of displacement is measured by a microscope. The delicacy of the method is extremely great. It was in this way observed that oxygen is most magnetic, then come air and nitric oxide; nitrogen, hydrogen, carbonic oxide, carbonic acid gas, and nitrous oxide, on the other hand, are diamagnetic. The method employed in the above research can also be applied to the solution of various other problems, as, for instance, the determination of the pressure of small columns of gases.

Physiological Society, March 23.—Prof. Munk, President, in the chair.—Dr. Benda spoke on the structure of ganglion-cells, demonstrating at the same time, by means of specimens, his method of hardening the brain and spinal cord, which consists in treating them with nitric acid and potassium chromate. His further communication dealt with certain differences, now largely reconciled, in the results obtained by the speaker and by Prof. Flesch, of Bern, who was present at the meeting. The two observers now agree that certain ganglion-cells readily take up colouring-matter, while others do not, and to these Prof. Flesch attributes a difference in physiological function. Both observers further admit the existence of dark granulations in the protoplasm of the cells, but opinions differ as to the significance of the same.—Dr. Claude du Bois Reymond stated that he had long ago planned an investigation of the pupil when in darkness, and that this intention had only become realizable since the introduction of instantaneous photography by means of the momentary illumination produced by magnesium. Miethe, the discoverer of the method of momentary illumination with magnesium, has in this way taken a photograph of his own pupil after it had been exposed to complete darkness for forty minutes. As shown by the two photographs which were exhibited the result was most surprising: the diameter of the pupil was 9 to 10 mm., while the iris was at the same time reduced to a width of 1½ to 2 mm.—Prof. Gad gave an account of experiments which had been made by Sawyer, at his suggestion, with a view to determining whether the separation of irritability and conducting power, which is so often observed by neuropathologists, has any real physiological existence. When a part of the sciatic nerve, in accordance with Grünhagen's method, was exposed for some time to the action of a current of carbonic acid gas, it was found to be capable of conveying impulses generated by stimuli applied to parts of the nerve more centrally situated, but was itself insensitive to electrical stimulation applied directly to it, as Grünhagen had already found. When that part of the nerve inclosed in the chamber was exposed to the action of diluted vapour of alcohol, the result was exactly the opposite, the conducting power being lost but the irritability retained.—Prof. Gad demonstrated on prepared skulls and on living animals, the curious and scarcely known movements of chewing which may be observed in rats. The incisors of the lower jaw are capable of lateral movement in two halves united together by ligaments, and the larger part of the work done in gnawing is carried on by means of the scissor-like movement of the two incisors. The above has recently been very fully brought to notice by Künstler.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

Reports of Geological Explorations during 1885-86-87 (New Zealand).—Système Silurien du Centre de la Bohême, vol. vii. Part 1, Cystidées: J. Barrande (Prague).—Watt's Dictionary of Chemistry, vol. i.: Morley and Muir (Longmans).—A Treatise on Electricity and Magnetism, vol. ii.: Mascart and Joubert, translated (De La Rue).—Elementary Chemistry: W. S. Furneaux (Longmans).—Natural Laws and Gospel Teachings: Rev. H. W. Morris (R.T.S.).—Early Prose and Poetical Works of Taylor, the Water Poet (Hamilton).—Noctes Ambrosianæ: Prof. J. Wilson (Hamilton).—First Lessons in Geometry, 2nd edition: B. H. Rau (Madras).—Abhandlungen der k. b. Gesellschaft der Wissenschaften Math. Naturw. Classe, vii. Folge, 1 Band (Prag).—Perforated Stones from California: H. W. Henshaw (Washington).—Work in Mound Exploration of the Bureau of Ethnology: C. Thomas (Washington).—Education in Bavaria: Sir P. Magnus (New York).

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