THURSDAY, MARCH 18, 1897.

NEW WORKS ON BOTANY.

An Introduction to Structural Botany. Part II. *Flowerless Plants.* By D. H. Scott, M.A., F.R.S., &c. Pp. xv + 312. (London: Adam and Charles Black, 1896.)

Physiologische Pflanzenanatomie. Von Dr. G. Haberlandt, Prof. d. Bot. an d. k.k. Universität Graz. Zweite, neubearbeitete u. vermehrte Auflage, mit 235 Abbildungen. Pp. xvi + 550. (Leipzig: Verlag von W. Engelmann, 1896.)

IN these days, when new text-books of various kinds are being poured out more or less indiscriminately from the press, it is a pleasure to be able from time to time to say of some of them that their own intrinsic merits furnish a complete justification for their existence, and we can with confidence make this assertion in respect of the two books which form the subjects of this notice.

Botanists who are engaged in teaching will welcome the appearance of the second volume of Dr. Scott's text-book, for it is just the sort of work to put into the hands of the elementary student. The first volume, we happen to know, has been extremely well received, and this new one, which deals with the flowerless plants, merits an equal measure of success.

The Vascular Cryptogams are illustrated by a selection of well-chosen types, and these are fairly completely described, instead of being treated in that note-book fashion which is only too common in many elementary books. The Liverworts, amongst the Bryophytes, are illustrated by an account of *Pellia*, a type more suitable in every way than is *Marchantia*, which usually does duty in this connection. Indeed, except for the fact that the latter plant happened to have been somewhat carefully studied by Mirbel, and used later by physiologists, it is difficult to understand how it came to be elevated to the position of a Type, which its complex and highly specialised structure render it eminently unfit to occupy.

The Algæ are liberally represented by nine well-selected genera. We could, perhaps, have wished that the term *asexual*, as applied to the ordinary zoospores, might have been replaced by some other word, *e.g. non*-sexual. Students are often misled by the use of the adjective *asexual* into imagining the bodies referred to are all homologous, both mutually, and also with such structures as the spores of vascular cryptogams; whereas in many cases they are more correctly to be compared with the various forms of *vegetative* reproductive bodies occurring in these plants. A transitional form is well exemplified in the gemmæ of *Aneura*. Possibly in instances like that of the four zoospores issuing from the oospore of *Œdogonium*, these cells do really represent the asexual spores of the higher cryptogams.

The book contains far more than a mere description of a number of types; the subject-matter is kept well in hand, and a comparative and synthetic method of treatment runs through it all, thus arousing and sustaining the interest of the reader by enabling him to grasp the proper relationship of one group of facts with the rest. In short the book is deserving of the highest praise, and it will have a useful and, we hope, a successful career before it.

Twelve years have passed away since the first appearance of Prof. Haberlandt's "Physiologische Pflanzenanatomie," which was written as a protest against the one-sided way in which anatomy was commonly studied and taught. Influenced chiefly by the brilliant researches and expositions of Schwendener, his object was to show that the principles laid down by the Berlin professor could be extended and applied to all departments of the minute structure of plants—that there everywhere exists a close connection between the anatomical structure of an organ and the special functions which it may be called upon to discharge. And amongst the varied lines of development into which modern botany has broken out, few have been prosecuted with greater vigour, or explored with such fruitful results, as that one of the "biology" of plants, of which the subject-matter contained in the book before us represents one branch.

The advance here indicated is due, in a great measure, to the happily increasing custom on the part of botanists to travel in countries other than those of Europe. The differences between the vegetation of the temperate and tropical lands strike one at every turn; the strenuous conditions of competition under which the tropical plants coexist appeal at once to the senses, and enable one vividly to realise the delicacy with which each organism must be adjusted to its whole environment. And the same is none the less true when the difficulty of existence is more directly correlated with physical and climatal surroundings than with the aggressive inroads of Esau-like neighbours.

And thus it has been brought about that the study of anatomy, from a physiological or biological point of view, has come to-day to possess an interest and importance far transcending that to which it could lay claim twelve or fifteen years ago.

But just because of the seductive fascination which this aspect of the study exerts on most students of botany, it may not be out of place to emphasise the fact that there is another side to the matter. It is quite possible to attach too much weight to the consideration of the more directly *adaptive* nature of plant structure, while paying too little heed to the fact of the persistence or inheritance, often through a wide range of genera, of *types* of tissue arrangements. For anatomy has a phylogenetic as well as a physiological side, although, save in the broadest features, this is not perhaps so readily discerned in plants as it is in animals. For example, the course of differentiation of the wood in the stems of vascular plants, and the consequent relations of the protoxylem to the later formed woody elements, is astonishingly constant for even large groups of genera or species, and in many cases it affords far surer indications as to natural affinity than most of the external characters by themselves would provide. And yet it would often be difficult to indicate the special advantage which one or other arrangement confers on its possessor; indeed, it is not impossible that it is to this very indifference that its value from a taxonomic point of view is to be attributed.

No doubt, ultimately, the histological no less than the grosser external peculiarities of al plants have been evolved as the result of the selection of favourable lines of variation; and the constant need of ready adaptation has even resulted in the acquirement of a relatively large "modulus of plasticity" (if the expression may be allowed) in the case of the individual plant, both in respect of its inner and of its outer characters. And it is just this, coupled with the admittedly adaptive nature of the tissues and their elements, which renders it difficult to appeal to the results of anatomical investigations in attempting to solve questions of affinity. But enough has been said to show that anatomical characters have each and all to be judged on their own independent merits; and if proper caution be employed in their discrimination, they are found, after all, to be not different in kind from the characters which are regularly employed by systematists. At the same time, as was said at the outset, it is assuredly the biological, rather than the (perhaps no less important) phylogenetic, aspect of anatomy which most forcibly appeals to the greater number of students, and it is from this point of view that the subject is treated by Prof. Haberlandt.

The new edition is in many respects a great improvement on the old one. It contains 550 pages as against 398, and the number of illustrations has been increased from 140 to 235. As regards the latter, however, it must be confessed that new blocks would have been a very great improvement, the sadly-worn figures in the present edition comparing very unfavourably with those of 1884.

The extension of the book has been chiefly due to the incorporation of new matter; but in several places we note that whole paragraphs have been recast in order to bring their contents into line with the present state of our knowledge. The book as it stands may fairly claim to be up to date, at any rate so far as German literature is concerned. We observe, however, that for the most part reference to work done in this country is conspicuous by its absence, and the name of one of the few English authors who are referred to appears (doubtless by an overlooked printer's error) under a Germanised form. But it would be ungracious to continue to pick holes in a work which in nearly every respect is admirable, alike in its method and its matter, and which will earn for its author the gratitude of all who are seriously interested n botany.

J. B. F.

EXPLORING IN THE NEW ZEALAND ALPS.

Pioneer Work in the Alps of New Zealand: a Record of the First Exploration of the Chief Glaciers and Ranges of the Southern Alps. By Arthur E. Harper, B.A. Pp. xvi + 336. With maps and illustrations. (London: T. Fisher Unwin, 1896.)

TRAVELLING in the Alps of New Zealand is much rougher and more difficult work than in those of Europe. Inns are all but unknown, chalets and club-huts non-existent; guides, even porters, not to be obtained; the weather is more unsettled and stormy. Mr. Harper is evidently the right man for the work. He is strong and enduring, patient and resolute, not daunted by difficulties or dangers. His opportunities for obtaining a knowledge of the Southern Alps of New Zealand have been exceptional, for, after making holiday expeditions in the Tasman district, from 1889 to 1892, he was employed by the Government, in the three following years, to explore the valleys and glaciers of the west coast of the south island. Thus his book differs from that by Mr. FitzGerald, which we lately noticed, in being one of exploration rather than of mountain climbing. On this point, as we can see from the present volume, and from a correspondence in the *Alpine Journal*, some little soreness has been created, particularly in regard to a certain pass lying to the north of Mount Sefton, by which the chain can be crossed without any serious difficulty.

Mr. Harper, in the earlier part of his book, gives an excellent description of the physical geography of the Southern Alps of New Zealand. As a mountain chain they resemble the Pyrenees more closely than the Alps of Europe; they are rather more elevated than the one, but distinctly lower than the other. Mount Cook, the culminating summit (which Mr. Harper tells us ought not to be called Aorangi, for it has no native name), only reaches 12,349 feet above sea level, about the height of the well-known Cima de Jazi in the Zermatt Alps. Yet, though the higher region of the Southern Alps lies between latitudes 43° and 45° S.—say, for instance, between Turin and the north end of Corsica—the snow-line comes down to between 6000 and 6500 feet, and occasionally, under rather exceptional circumstances, it is as low as 5000 feet. The same holds with the ice streams; the Tasman glacier on the eastern side ending at 2354 feet, and the Franz Josef, on the western, at only 692 feet above sea-level. But the mean annual temperature is nearly the same in both regions, so that the difference is mainly due to greater precipitation, which in the higher part of the ranges is probably equivalent to a rainfall of at least 140 inches, for it is 126 inches at Hokitika on the western coast.

Mr. Harper, as he regretfully admits, knows but little geology; still he is a close observer, and has placed on record some interesting facts about the New Zealand glaciers, their rate of motion and distribution. They also, as is well known, once extended far beyond their present limits; the erratics, which they have left in the Westland valleys, are often of enormous size, and the old moraines are on a great scale. One of the Cascade moraines once extended some distance out to sea. The glaciers from the mountains, in Mr. Harper's opinion, formerly debouched from the valleys, and spread out laterally on the lowland, either becoming confluent or, at any rate, covering a very large area; on their retreat they left both districts covered with huge piles of moraine débris, from which the valley terraces were cut by the rivers. The facts mentioned by Mr. Harper make this inference a very probable one. The Cascade moraine, he says, is stratified, and sea-shells are found in some of the layers well inland. A few more particulars about this stratification would have been welcome, especially as to its nature and height above the present sea level. Stratification, no doubt, is sometimes exhibited by the older moraines in the Swiss Alps; but this, so far as we have seen, is always faint. All talus heaps have a slight tendency to assume this structure, owing to a kind of sorting process which goes on among their materials; but the occurrence of marine shells seems to indicate a submergence, during which the ice terminated actually in the sea; for in this case the most enthusiastic glacialist can hardly summon an ice-sheet from the "vasty deep" to scrape shells from the sea-bottom, and deposit its collections at the foot of the New Zealand Alps.

Mr. Harper had ample opportunities of studying the natural history of the country, and of these he has made good use. The birds, especially the wekas (a kind of rail) and the keas (a mountain parrot), are still very common in some valleys, and are amusing on account of their insatiate curiosity. But from others they have disappeared almost entirely. Man is their destroyer, though not directly; for this has happened in districts which have hardly ever been visited. But the miner often keeps a cat, and, like the Londoner, is apt, when quitting an abode, to leave the animal behind; so it has to feed itself, and becomes a bush-ranger. Weasels also have been introduced into the island; so the birds of New Zealand, especially those which are poor flyers, are having a bad time. The shepherd will view with satisfaction the disappearance of the kea, since it destroys sheep. Mr. Harper explains how the bird has acquired carnivorous habits. The shepherds hang up the skins of sheep to dry, and the kea is an embodiment of inquisitiveness, and tries its beak on everything. If the skin has not been carefully cleaned, it tastes the fat, and "when once a kea tastes fat he is a ruined bird, and would sell his soul—if he had one—to get more." Apparently it is wise enough to know the exact position of the most savoury morsel, for the bird settles on the sheep's back, and bites down to the fat about the kidneys. But if some native birds are disappearing, black swans, an importation from Australia, have become abundant, and the rabbit, in certain districts, is getting to be as great a pest as in Australia. Let well alone, is a maxim often as sound in nature as it is in politics. But we must leave Mr. Harper's very interesting and abundantly illustrated volume. It is a valuable addition to our knowledge of the New Zealand Alps, and a well-told story of difficulties overcome and hardships endured with no little pluck and determination.

T. G. BONNEY.

OUR BOOK SHELF.

Lehrbuch der Erdkunde für höhere Schulen. Von Dr. Willi Ule. II. Teil: Für die mittleren und oberen Klassen. Mit 12 farbigen und 79 Schwarzdruckabbildungen. Pp. viii + 404. (Leipzig: G. Freytag, 1896.)

THE author of this excellent little text-book has already made his mark in practical geographical work amongst the younger generation of German geographers. He marshals the facts and enforces the descriptions with a firm grasp of general principles which no mere theorist can attain. But he claims no novelty in method, and states that his book is out and out a child of Alfred Kirchhoff's school.

The perspective in which the world's surface is viewed from the German standpoint of Dr. Ule is somewhat interesting, as the following analysis of the space devoted to the different departments shows:—German Empire, 19 per cent.; Europe outside Germany, 31; Asia, 9; Africa, 7; North America, 3; South America, 3; Australasia and Oceania, 3; physical and general geography, 25 per cent. The small space devoted to North America is remarkable, considering the vast importance of the United States for German trade and as a centre for emigrants.

It would be too much to say that the revival of serious geographical study in this country has largely influenced the form of Dr. Ule's book, but it is a fact that his method of treatment approaches that of the most recent English text-books in several particulars. The illustrations are for the most part old friends, but the sketch maps introduced in the text are original and good.

A Manual of Elementary Seamanship. By D. Wilson-Barker. Pp. xii + 120. (London: Charles Griffin and Co., Ltd., 1896.)

THIS book will be found most useful and handy to the young sailor; for throughout its pages the subject is treated in a thorough manner.

The author does not limit himself to a description of the more general type, but enters into details respecting most parts of a ship, such as hull, rigging, sails, &c.; and not only are sailing ships dealt with, but steamers are treated in the same manner. Several Parts (ii. to iv.) are devoted to the art of rope splicing, knots, lead, log, rigging, anchors, sail-making, sails, and the handling of boats under sail; these, we may add, are also profusely illustrated, thus enabling the reader to more easily grasp some of the explanations given.

A large figure is also inserted, showing the rigging and sails of a full-rigged ship. Part v., on the rule of the road and signalling, includes two excellent coloured plates of flags, and the semaphore, and Morse alphabets; the last two, we are sorry to say, are as yet seldom used in the mercantile marine, although their importance cannot in any way be overrated. The diagram also contains a scheme by which these can be easily remembered.

A useful glossary of sea terms and phrases is also added.

Researches upon the Antiquity of Man in the Delaware Valley and the Eastern United States. By Henry C. Mercer. Pp. 178. (Publications of the University of Pennsylvania, vol. vi. 1897.)

IN this monograph, Mr. Henry C. Mercer, curator of the museum of American and Prehistoric Archæology at the University of Pennsylvania, brings together the results of his investigations of an Indian stone blade quarry in the Delaware Valley, a mortuary deposit of Indian skeletons in Maryland, certain shell heaps on the coast of Maine and at the Durham Cave, and a rock-shelter in the Delaware Valley.

The caves explored failed to give conclusive evidence of pre-Indian or geologically ancient man. It is held that nothing has as yet been found anywhere in the Delaware Valley to corroborate the alleged antiquity of the chipped blades from Trenton. Support is given to Mr. W. H. Holmes' contention that the flint specimens from the Trenton gravel are not true implements, but "wasters" or "rejects" cast away by modern Indians whose village sites occupied the surface above the gravel.

Numerous illustrations of specimens from the caves explored accompany the monograph.

The Universal Electrical Directory (J. A. Berly's). Pp. 1114. (London: Alabaster, Gatehouse, and Co., 1897.)

THIS well-known Directory contains the names of the members of the electrical and kindred industries throughout the world. It is thus invaluable for finding the addresses of electricians, manufacturers, and dealers. The total number of distinct names in the Directory is 22,658, of which 9933 belong to British individuals and firms. For simplicity and facility of reference the names are divided into four groups—namely: British, Continental, American and Colonial, which are again sub-divided into alphabetical and classified sections; in the case of the British, a Geographical Section has been added, making in all nine sub-divisions.

Photography as a Hobby. "The Popular Photographic Series." By Matthew Surface. Pp. 60. (London: Percy Lund, Humphries, and Co., Ltd., 1897.)

THIS little book is intended for those who amuse themselves with photography. The author shows how many a pleasant hour may be spent with the camera, and describes rambles he himself has made. These are very well illustrated, and the reader will gather from them that it is not necessary to go very far afield for subjects, as these are always close at hand if one only has the capacity for picking them out. The author describes also how, during unfavourable weather, the "hobby" may be carried on in the house. The book is very neatly got up, and will afford those who indulge in photography as a hobby with a pleasant hour's reading.

First Records of British Flowering Plants. Compiled by William A. Clarke, F.L.S. Pp. 103. (London: West, Newman, and Co., 1897.)

TO satisfy commendable curiosity, it is often required to know who first observed a particular plant, when and where it was first found, and how long it has been known as a British plant. The answers to these questions will be found in Mr. Clarke's handy little volume. The earliest notice of each distinct species of British flowering plants has been found by searching through printed botanical works published in Great Britain, and the extracts thus obtained have been brought together in this work. The list contains altogether 1440 species, the nomenclature of which is based upon the eighth edition of the "London Catalogue." The earliest records referred to are from William Turner's works, ranging from 1538 to 1568.

On Human Nature. By Arthur Schopenhauer. Translated by T. Bailey Saunders, M.A. Pp. 132. (London: Swan Sonnenschein and Co., Ltd., 1897.)

HUMAN nature as understood by that most pessimistic of philosophers, Schopenhauer, is here presented in English dress by Mr. Saunders. The essays which make up the book have been selected and translated from Schopenhauer's *Parerga*. They deal with human nature in various aspects, and their tendency is to make a man suspicious of all people, distrustful of all motives, and doubtful whether civilised life is real or only a big masquerade.

Tabellen für Gasanalysen, gasvolumetrische Analysen, Stickstoffbestimmungen, &c. By Prof. Dr. G. Lunge. (Braunschweig: Friedrich Vieweg und Sohn, 1897.)

THESE tables will be found of service in chemical laboratories in which gas analyses, and volumetric determination of gases, are made. One of the tables is for the reduction of the observed volume of a gas to the temperature of 0°, and the other enables the observed volume to be reduced to a pressure of 760 mm. Together the tables thus furnish the means for reducing volumes of gases to standard temperature and pressure.

The Larvæ of the British Butterflies and Moths. By the late William Buckler. Vol. vii. Edited by Geo. T. Porritt, F.L.S. Pp. 176. 22 plates. (London: Ray Society, 1897.)

THE first volume on the larvæ of the British butterflies and moths appeared in 1885; the present volume contains the first portion of the Geometræ, and this group will be completed in vol. viii. The twenty plates illustrating the larvæ described are extremely fine, and the whole volume is a worthy addition to an invaluable series.

LETTERS TO THE EDITOR.

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

The Measurement of Pressures in the Bore of Guns.

IT has been stated that many gunpowders which have given fairly satisfactory results in a small bore, have developed dangerous pressure when tried in cannon; and also that similar experiments with cordite showed no signs of any approach to such a "critical point." Further, cordite is said to burn quietly when thrown in boxes of 100 lbs. upon a bonfire, and yet to be as suitable for ordnance as for small arms. But cordite did not prove so tractable on its late trial in Plumstead Marshes. It is plain, therefore, that explosive forces of all powders depend very much upon the conditions under which they are ignited.

Hence arises a pressing necessity for some satisfactory method of determining the maximum explosive force which every adopted powder is capable of exerting when fired in *rifled* guns of small and large calibre. The chronoscopic method of solving the problem was brought forward thirty years ago, under the then Ordnance Select Committee, but I have never met with a single example fairly worked out for a *rifled* gun, so as to show precisely what could be found by that method. My difficulty was stated in NATURE (March 14, 1895), but hitherto without result, except that the President of the British Association, in his address at Ipswich (September 1895), stated that—

"In the gun, by means of electrical contacts arranged in the bore, a *time-curve* of the passage of the shot can be determined. From this the mathematician constructs the velocity-curve, and from this, again, the *pressures* producing the velocity are *estimated* (?) and used to check the *same indications* obtained by other means (p. 29)."

Now, beside the "pressures producing the velocity" of the shot in *rifled* guns, there is an additional force arising from friction, &c., which greatly adds to the pressure of the powder gas tending to burst the gun. Hence, if we denote by P this pressure of the powder gas on the base of the shot, and by F the retarding pressure of friction, &c., at the same instant, then the resultant driving pressure acting on the shot will be denoted by $(P-F)$ at that instant. If now the projectile be made to trace an *accurate* time-curve, it will be possible to deduce from this time-curve the value of the driving pressure $(P-F)$ acting on the shot at every point. But the grand object is to find P, the pressure of the powder gas tending to burst the gun, and not $(P-F)$ the pressure driving the shot, which is given by the chronoscope. Therefore the chronoscopic method of experimenting fails to give the whole pressure of the powder gas, which tends to burst the *rifled* gun; and this method gives nothing which can be "used to check the same indications obtained by other means," simply because $(P-F)$ is not given by other means. The chronoscopic method of experimenting fails when any part of the pressure (F) of the powder gas is not instrumental in producing motion. From what has been said, the chronoscopic method must fail, even under the most favourable circumstances, when *rifled* guns are used.

But the *perfect accuracy* in experiment we have assumed cannot be secured practically. The most critical point is at the instant the shot begins to move. But no chronoscope which registers by *points* can make the smallest pretence to give the initial time-curve accurately.

The only way to find the pressure of the powder gas at any point in the bore of a *rifled* gun is to use a modification of Rumford's or Rodman's method, which measures directly the pressure in the bore at any point.

The vast importance of this subject to the nation at this time must be my excuse for troubling you a second time.

Minting Vicarage, March 4. F. BASHFORTH.

A Powerful and Efficient Means of Driving X-Ray Tubes.

DURING the last few months the limitations of the present induction coil, especially as a means of driving X-ray tubes and vacuum tubes in general, have been so clearly brought before us that we have given the subject considerable attention. It is true that with some of the new forms of circuit breakers and storage batteries, an induction coil can be made to work fairly well during prolonged runs; but storage batteries are troublesome, and a break that will work on voltages ordinarily supplied for lighting is yet to be made.

The following method of driving an induction coil not only does away with its former disadvantages, but gives a much more powerful means of exciting X-ray tubes. A condenser of considerable capacity is first charged by connecting its terminals to the ordinary lighting mains; it is then disconnected, and discharged through the primary of an induction coil. Any good induction coil can be used in this way with a single change, viz. a new primary. The primary should be a few turns of heavy wire on a finely laminated core.

A six-inch Ritchie vertical coil with a new primary winding of about thirty turns of heavy wire (6 B.S. gauge) gives, when a condenser of 27 micro-farads charged at 220 volts is discharged through its primary, a long thin zig-zag spark, resembling that from a static machine with small condensers. If now some form of rotary commutator be used to charge and discharge the condensers, and this be run at sufficient speed, a continuous discharge of sparks will take the place of the single discharge at the secondary terminals.

The commutator used has six segments. If this is run at 2000 revolutions per minute by a small fan motor, there will be 12,000 discharges through the coil per minute, or 200 per second. At this speed there is a continuous discharge of zig-zag sparks a little over six inches long. We have not yet run the commutator above 2000 revolutions, but there is no indication that we are near the limit of speed. Sparking on the commutator is slight, and the power taken from the mains is but a few ampères.

It is necessary to have the primary of the coil well insulated, not only from the secondary, but its own turns must be well insulated from one another and the core. An easy and effectual way in the case of a vertical coil is to place the laminated core in a glass tube, upon this wind the primary, then place the whole in a large heavy tube closed at the bottom, and fill with oil. Without insulation there is a tremendous brush discharge within the primary. Undoubtedly the efficiency of the coil would be considerably increased by using an oil insulated secondary, but it is questionable whether the gain would be enough to off-set the trouble and dirt of oil insulation.

An X-ray tube of the focus type and proper resistance connected to the terminals of the coil lights up brilliantly, and with a spark gap in series, the length of which seems to make very little difference, shows no indication whatever of anything but a unidirectional discharge through the tube.

Fluorescent screens become brilliantly illuminated. In a darkened room all the bones of the hand and forearm can be distinctly seen on a calcium tungstate screen at a distance of eight feet from the tube. The penetration seems to be unusually strong. The whole of the trunk can be examined with the greatest ease with the tube several feet distant. The hand can be distinctly seen through the abdomen, the most opaque part of the body.

Photographically, X-rays obtained in this way are no less powerful. Excellent fully-timed photographs of the hand can be taken in twenty-five seconds with the tube twelve inches from the plate, photographs not merely showing the outline of the bones, but showing the details of the bones, the finger-nails, tendons, &c. Forty-five seconds is an over-exposure. One of the best photographs of a small object—a pocket-book—we have seen, was taken in less than a second.

It seems apparent that we have a simple method for exciting X-ray tubes that is far more powerful and efficient than any that has yet been used. It is a method that ought to be particularly adapted to the needs of the physician, and requires no more skill or knowledge of physics than the ordinary practitioner can supply.

CHARLES L. NORTON.
RALPH R. LAWRENCE.
Rogers Laboratory of Physics, Mass. Inst. Technology, Boston, February 20.

Semi-Permeable Films and Osmotic Pressure.

LORD KELVIN's very interesting problem concerning molecules which differ only in their power of passing a diaphragm (see NATURE for January 21, p. 272), seems only to require for its solution the relation between density and pressure for the fluid at the temperature of the experiment, when this relation for small densities becomes that of an ideal gas; in other cases, a single numerical constant in addition to the relation between density and pressure is sufficient.

This will, perhaps, appear most readily if we imagine each of the vessels A and B connected with a vertical column of the fluid which it contains, these columns extending upwards until the state of an ideal gas is reached. The equilibrium which we suppose to subsist will not be disturbed by communications between the columns at as many levels as we choose, if these communications are always made through the same kind of semi-permeable diaphragm as that which separates the vessels A and B. It will be observed that the difference of level at which any same pressure is found in the two columns is a constant quantity, easily determined in the upper parts (where the fluids are in the ideal gaseous state) as a function of the composition of the fluid in the A-column, and giving at once the height above the vessel A, where in the A-column we find a pressure equal to that in the vessel B.

In fact, we have in either column

$$dp = -g\gamma dz,$$

where the letters denote respectively pressure, force of gravity, density, and vertical elevation. If we set

$$\frac{1}{\gamma} = F'(p),$$

we have

$$F'(p)dp = -gdz.$$

Integrating, with a different constant for each column, we get

$$F(p_A) = -g(z - C_A)$$
$$F(p_B) = -g(z - C_B)$$
$$F(p_A) - F(p_B) = g(C_A - C_B).$$

In the upper regions,

$$F'(p) = \frac{1}{\gamma} = \frac{at}{p}$$

$$\therefore \quad F(p) = at \log p,$$

where t denotes temperature, and a the constant of the law of Boyle and Charles. Hence,

$$at \log p_A - at \log p_B = g(C_A - C_B).$$

Moreover, if $1 : n$ represents the constant ratio in which the S- and D-molecules are mixed in the A-column, we shall have in the upper regions, where the S-molecules have the same density in the two columns,

$$\gamma_A = (1 + n)\gamma_B \qquad p_A = (1 + n)p_B$$
$$g(C_A - C_B) = at \log (1 + n).$$

Therefore, at any height,

$$F(p_A) - F(p_B) = at \log (1 + n).$$

This equation gives the required relation between the pressures in A and B and the composition of the fluid in A. It agrees with van 't Hoff's law, for when n is small the equation may be written

$$F'(p_A)(p_A - p_B) = atn$$

or

$$p_A - p_B = atn\gamma_A.$$

But we must not suppose, in any literal sense, that this difference of pressure represents the part of the pressure in A which is exerted by the D-molecules, for that would make the total pressure calculable by the law of Boyle and Charles.

To show that the case is substantially the same, at least for any one temperature, when the fluid is not volatile, we may suppose that we have many kinds of molecules, A, B, C, &c., which are identical in all properties except in regard to passing diaphragms. Let us imagine a row of vertical cylinders or tubes closed at both ends. Let the first contain A-molecules sufficient to give the pressure p' at a certain level. Then let it be connected with the second cylinder through a diaphragm impermeable to B-molecules, freely permeable to all others. Let the second cylinder contain such quantities of A- and B-molecules as to be in equilibrium with the first cylinder, and to have a certain pressure p'' at the level of p' in the first cylinder. At a higher level this second cylinder will have the pressure which we have called p'. There let it be connected with the third cylinder through a diaphragm impermeable to C-molecules, and to them alone. Let this third cylinder contain such quantities of A-, B-, and C-molecules as to be in equilibrium with the second cylinder, and have the pressure p'' at the diaphragm; and so on, the connections being so made, and the quantities of the several kinds of molecules so regulated, that the pressures at all the diaphragms shall have the same two values.

It is evident that the vertical distance between successive connections must be everywhere the same, say l; also, that at all the diaphragms, on the side of the greater pressure, the proportion of molecules which can and which cannot pass the diaphragm must be the same. Let the ratio be $1 : n$. If we write γ_A, γ_B, &c., for the densities of the several kinds of molecules, and γ for total density, we have for the second cylinder

$$\frac{\gamma_A + \gamma_B}{\gamma_A} = 1 + n.$$

For the third cylinder we have this equation, and also

$$\frac{\gamma_A + \gamma_B + \gamma_C}{\gamma_A + \gamma_B} = 1 + n$$

which gives

$$\frac{\gamma_A + \gamma_B + \gamma_C}{\gamma_A} = (1 + n)^2.$$

In this way, we have for the rth cylinder

$$\frac{\gamma}{\gamma_A} = (1 + n)^{r-1}.$$

Now the vertical distance between equal pressures in the first and rth cylinders, is

$$(r - 1)l.$$

Now the equilibrium will not be destroyed if we connect all the cylinders with the first through diaphragms impermeable to all except A-molecules. And the last equation shows that as γ/γ_A increases geometrically, the vertical distance between any pressure in the column when this ratio of densities is found, and the same pressure in the first cylinder increases arithmetically. This distance, therefore, may be represented by $\log (\gamma/\gamma_A)$ multiplied by a constant. This is identical with our result for a volatile liquid, except that for that case we found the value of the constant to be at/g.

The following demonstration of van 't Hoff's law, which is intended to apply to existing substances, requires only that the solutum, *i.e.* dissolved substance, should be capable of the ideal gaseous state, and that its molecules, as they occur in the gas, should not be broken up in the solution, nor united to one another in more complex molecules.

It will be convenient to use certain quantities which may be called the *potentials* of the solvent and of the solutum, the term being thus defined:—In any sensibly homogeneous mass, the *potential* of any independently variable component substance is the differential coefficient of the thermodynamic energy of the mass taken with respect to that component, the entropy and volume of the mass and the quantities of its other components remaining constant. The advantage of using such *potentials* in the theory of semi-permeable diaphragms consists partly in the convenient form of the conditions of equilibrium, the potential for any substance to which a diaphragm is freely permeable having the same value on both sides of the diaphragm, and partly in our ability to express van 't Hoff's law as a relation between the quantities characterising the state of the solution, without reference to any experimental arrangement (see *Transactions of the Connecticut Academy*, vol. iii. pp. 116, 138, 148, 194).

Let there be three reservoirs, R′, R″, R‴, of which the first contains the solvent alone, maintained in a constant state of temperature and pressure, the second the solution, and the third the solutum alone. Let R′ and R″ be connected through a diaphragm freely permeable to the solvent, but impermeable to the solutum, and let R″ and R‴ be connected through a diaphragm impermeable to the solvent, but freely permeable to the solutum. We have then, if we write μ_1 and μ_2 for the potentials of the solvent and the solutum, and distinguished by accents, quantities relating to the several reservoirs,

$$\mu_1'' = \mu_1' = \text{const.}, \qquad \mu_2'' = \mu_2'''.$$

Now if the quantity of the solutum in the apparatus be varied, the ratio in which it is divided in equilibrium between the reservoirs R″ and R‴ will be constant, so long as its densities in the two reservoirs, γ_2'', γ_2''', are small. For let us suppose that there is only a single molecule of the solutum. It will wander through R″ and R‴, and in a time sufficiently long the parts of the time spent respectively in R″ and R‴, which for convenience we may suppose of equal volume, will approach a constant ratio, say 1 : B. Now if we put in the apparatus a considerable number of molecules, they will divide themselves between R′ and R″ sensibly in the ratio 1 : B, so long as they do not sensibly interfere with one another, *i.e.* so long as the number of molecules of the solutum which are within the spheres of action of other molecules of the solutum is a negligible part of the whole, both in R″ and R‴. With this limitation we have, therefore,

$$\gamma_2''' = B\gamma_2''.$$

Now in R‴ let the solutum have the properties of an ideal gas, which give for any constant temperature (*ibid.* p. 212)

$$\mu_2''' = a_2 t \log \gamma_2''' + C,$$

where a_2 is the constant of the law of Boyle and Charles, and C another constant. Therefore,

$$\mu_2'' = a_2 t \log (B\gamma_2'') + C.$$

This equation, in which a single constant may evidently take the place of B and C, may be regarded as expressing the property of the solution implied in van t' Hoff's law. For we have the general thermodynamic relation (*ibid.* p. 143)

$$v dp = \eta dt + m_1 d\mu_1 + m_2 d\mu_2,$$

where v and η denote the volume and entropy of the mass considered, and m_1 and m_2 the quantities of its components. Applied to this case, since t and μ_1 are constant, this becomes

$$dp'' = \gamma_2'' d\mu_2''.$$

Substituting the value of $d\mu_2''$ derived from the last finite equation, we have

$$dp'' = a_2 t d\gamma_2''$$

whence, integrating from $\gamma_2'' = 0$ and $p'' = p'$, we get

$$p'' - p' = a_2 t \gamma_2'',$$

which evidently expresses van 't Hoff's law.

We may extend this proof to cases in which the solutum is not volatile by supposing that we give to its molecules mutually repulsive molecular forces, which, however, are entirely inoperative with respect to any other kind of molecules. In this way we may make the solutum capable of the ideal gaseous state. But the relations pertaining to the contents of R″ will not be affected by these new forces, since we suppose that only a negligible part of the molecules of the solutum are within the range of such forces. Therefore these relations cannot depend on the new forces, and must exist without them.

To give up the condition that the molecules of the solutum shall not be broken up in the solution, nor united to one another in more complex molecules, would involve the consideration of a good many cases, which it would be difficult to unite in a brief demonstration. The result, however, seems to be that the increase of pressure is to be estimated by Avogadro's law from the number of molecules in the solution which contain any part of the solutum, without reference to the quantity in each.

J. WILLARD GIBBS.

New Haven, Connecticut, February 18.

Changes in Faunæ due to Man's Agency.

PROF. HADDON'S interesting article in NATURE of January 28 certainly deserves serious attention. Probably few naturalists realise the rapid changes which are being brought aoout through the agency of man. The way in which the Coccidæ (scale-insects) are carried from country to country is amazing; and with them go their hymenopterous parasites in many instances. Thus, in 1894, Mr. L. O. Howard described the chalcidid *Homalopoda cristata* from St. Vincent, W.I.; in 1896 I described *Aspidiotus secretus*—a coccid—from Japan. Later, in 1896, Mr. Howard was able to report that Mr. Green had bred his St. Vincent chalcidid from my Japanese coccid—in Ceylon! Mr. Howard, in 1896, described another chalcidid, parasitic on scale-insects, from Ceylon; and the day he received the separate copies of his paper, he received the chalcidid from the Southern U.S. Aurivillius, in 1888, described a remarkable parasite of Coccidæ bred by him in Sweden; already it is known also from two localities in the United States, and from Ceylon. As early as 1863, Prof. A. Costa described from Italy a remarkable genus of Chalcididæ, after taking great pains to learn that it was unknown in Europe; but, as Mr. Howard has lately shown, it had been described (the very same species) in 1859 by Motschulsky from Ceylon, whence it had undoubtedly been accidentally introduced into Europe. *Diaspis amygdali*, a very destructive coccid, was described by Tryon in 1889 from Australia; already we knew it also from various localities in the Oriental, Palæarctic, Ethiopian, Nearctic and Neotropical regions! Very many other such cases might be cited, showing that there is great need for speedy investigation, before the data regarding the true habitats of these and other organisms become impossible of discovery, owing to the extermination of some species, and the dissemination of others.

T. D. A. COCKERELL.

Mesilla, New Mexico, U.S.A., February 12.

Formation of Coral Reefs.

I HAVE read with much interest the description in NATURE of the attempt of Prof. Sollas to bore through the rim of the Funafuti Atoll.

I should like to know what ground he has for believing that the soundings obtained by the officers of the ship which conveyed him to the island, support Darwin's theory of the formation of coral atolls; for there does not appear to be any new feature in the section printed with his letter. It is similar to many other sections of atolls in the China Sea and elsewhere, which have been published from time to time by the Hydrographic Department.

As this attempt has failed, it might be well to turn attention to a more accessible part of the Western Pacific.

The Fiji islands are a complete museum of corals, and contain reefs of every sort of formation. Many of these appear to support Darwin's theory. The Lau, or eastern group, has been elevated, and contains some ancient coral reefs many hundred feet above the sea. The island of Naiau is 580 feet high, and has a rim summit of coral enclosing a depression which, if my recollection serves me, is about 200 feet below the top. If Darwin's theory is correct, this ancient atoll must have been first formed by subsidence, and subsequently elevated to its present position. Borings would probably reveal the lost peak not far below the floor of the central depression.

The island of Kambara, 470 feet in height, is of similar formation.

A close geological examination of Naiau or Kambara would, in all probability, end the controversy, for the borings into the base of the island, commencing some hundreds of feet above the sea, but below what I suppose to be an ancient atoll, could be easily undertaken, and ought to prove at once the nature of the foundation upon which the reef rests.

With regard to the concluding paragraph of Prof. Sollas' letter, he has apparently overlooked the fact that a live specimen of reef-building coral (Astræa) has been dredged up from a depth of forty-five fathoms *in the lagoon* of the Tizard bank by Dr. Bassett-Smith, of H.M.S. *Rambler*. This specimen is in the Natural History Museum.

W. USBORNE MOORE.

8 Western Parade, Southsea, February 25.

Chinese Yeast.

A FRIEND has sent me a few ounces of what he calls Chinese yeast, a white substance which, so I understand, possesses the power of converting rice grains into a soluble substance, which is then allowed to ferment until it is converted into alcohol. Perhaps some of your readers could refer me to a more detailed account of the properties of this yeast. I shall be pleased to send samples for cultivation to anybody who would care to undertake it.

C. E. STROMEYER.

6 Jedburgh Gardens, Glasgow, March 6.

DINOSAURS.[1]

IT is only sixty years ago since George Catlin wrote his "North American Indians," and graphically described the vast herds of bison, numbering millions of individuals, travelling for days together across the rolling prairies; yet we have seen these disappear, like the aborigines, and their places usurped by the "cow-boy," and by countless herds of domestic cattle.

If we could only wind the clock of Time still further backwards, and make him disclose, with moving-photographic-vividness, some of those earlier Mesozoic scenes on the American continent, or even in our own little island, for that matter, we should find, not herds of bison, but far other cattle, though some wore horns, and were big and ugly enough in all conscience; yet they were mostly harmless, and herbivorous in diet, but belonging to patterns now entirely obsolete, like the old "brown-bess" of our grandfathers' days, only more so.

And, doubtless, it is due to the extreme rarity of preservation of old land-surfaces, as compared with the far more numerous and abundant records of marine areas which have come down to us, that renders their discovery of such paramount interest to the biologist and geologist. The vast physical changes also which they indicate are, undoubtedly, owing to the immense and unmeasured periods which have intervened, filled only by the slow-music of the sea.

Thus, after parting company with Eocene Mammals, such as *Tinoceras*, we take a plunge in the sea of time, and come again on shore to find that all but the tiniest of Mammals are absent, and the land is peopled by huge herbivorous and somewhat lesser carnivorous Dinosaurs in their stead.

Although this strange reptilian order was discovered so early in this century, it is only within the last thirty years that, thanks to Prof. Huxley, we have been led to understand them; and not till 1881, had we a correct notion even of the skeleton of our own famous *Iguanodon*, though Mantell had commenced to record the discovery of its bones in Sussex in 1825.

One of the most curious points about these mediæval animals is, that they make their earliest appearance in the Triassic period, and were first known in North America some sixty years ago, not by their bones or teeth, but by their footprints. These tracks, discovered so abundantly on the fine-grained, often fissile, sandstones of the Connecticut valley area, were at first attributed to birds, although any birds earlier than the Tertiary period were then unknown.

Yet the genius of Huxley had demonstrated (in 1868) that in the Dinosauria we are dealing with a group of reptiles which most nearly approached the flightless birds, not merely in the weakness and smallness of their fore-limbs, but in the structure of the pelvis, the ilium prolonged forward in front of the acetabulum as well as behind it, and the long rod-like ischium and pubis being all strongly ornithic characters; the head of the femur being set-on at right angles to the shaft of the bone, so that the axis must have been parallel with the median vertical plane of the body, as in birds. The metatarsals were free as in young birds, not anchylosed together as in adult ones; moreover, in *Iguanodon* and some other forms met with, the number of functional digits was three, as seen in the foot of *Dinornis*, and in the great majority of living birds, and the number of the phalanges agrees with that in the II, III and IV toes of the Emeu and Rhea, or any other typical bird's foot. So that there is good reason to conclude that the Connecticut footprints, instead of being those of birds, were certainly the tracks left behind by the *bird*-like Dinosaurs of that period.

From the great difference in size between the fore and hind limbs, Mantell and Leidy concluded that the *Iguanodon*, and some others of its kind, may have supported themselves for a longer or shorter period upon their hind-legs. This conclusion was further confirmed by the discovery made by Mr. S. H. Beckles, F.R.S., of huge three-toed footprints occurring in pairs upon ripple-marked surfaces of Wealden sandstone near Hastings, of such a size, and at such a distance apart, as to lead to the conclusion that they were undoubtedly made by *Iguanodon*. Mr. Beckles' discovery has since been confirmed by the observations of Louis Dollo upon the

[1] "The Dinosaurs of North America." By Othniel Charles Marsh. Extract from the Sixteenth Annual Report of the United States Geological Survey, 1894–95. C. D. Walcott, Director. Imperial 8vo. Pp. 133 + 414. Pl. ii + lxxxv. (Washington, 1896.)

Bernissart *Iguanodon* in the Brussels Museum, a cast of which may now be seen set up in the British Museum of Natural History, Cromwell Road.

A few detached reptilian remains from the Trias of America had been made known by Dr. Leidy and Prof. Hitchcock as early as 1854 and 1856; but in 1884, Prof. O. C. Marsh obtained for the Yale University Museum a large part of a dinosaur about 8 feet in length, and, later on, a smaller but most complete example, named by him

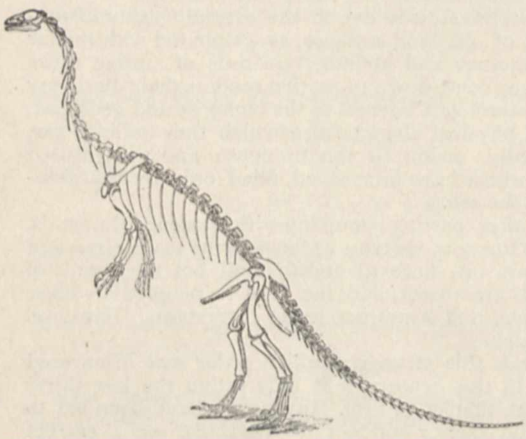


FIG. 1.—Restoration of *Anchisaurus colurus*, Marsh ($\frac{1}{24}$ nat. size). Triassic, Connecticut. The reptile which is believed to have made the bird-like bipedal footprints upon the Connecticut sandstones.

Anchisaurus colurus, of which five individuals were discovered, all being of carnivorous type, and the oldest known of the division Theropoda. Marsh feels confident that these and other (perhaps herbivorous) forms were the makers of the bipedal tracks met with in such numbers in the Trias of America, for of the presence of birds at this period we have no evidence whatever.

Passing from the Triassic sandstones to the Jurassic period, we have in the various deposits from the Lias of

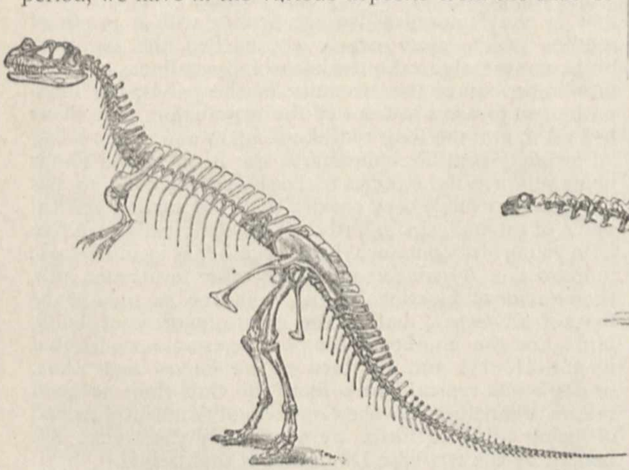


FIG. 2.—Restoration of a carnivorous Dinosaur, *Ceratosaurus nasicornis*, Marsh ($\frac{1}{30}$ nat. size). Jurassic, Colorado.

Charmouth, with its herbivorous dinosaur, *Scelidosaurus Harrisoni*, to the Inferior and Great Oolite, with its *Megalosaurus*, its *Omosaurus* and *Cetiosaurus* in this country, represented by *Atlantosaurus*, *Ceratosaurus*, *Stegosaurus*, *Brontosaurus*, *Camptosaurus*, *Laosaurus*, and many other well-known forms, discovered and described by Marsh, from the Jurassic beds of Colorado and Wyoming Territory, U.S.A.

We have, in fact, in the Jurassic period, entered upon "the age of Dinosaurs"; and if, as seems now to be the general conclusion arrived at concerning the age of our own Wealden formation—by Seward, from an examination of the plants; by A. Smith Woodward, from the mammals and fishes; by Marsh, from the reptiles—this deposit is also of Oolitic age, and thus another old-land-area must be relegated to the Jurassic, rather than to the Cretaceous epoch, and we may look upon *Iguanodon* as an Oolitic type.

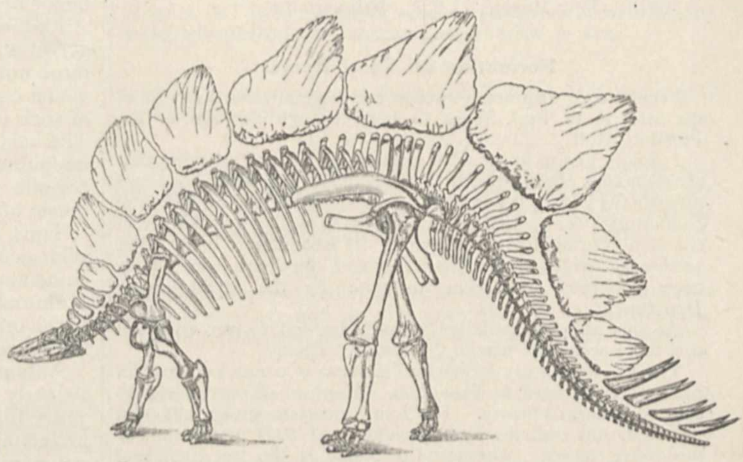


FIG. 3.—Restoration of *Stegosaurus ungulatus*, Marsh ($\frac{1}{28}$ nat. size), a hoofed and armoured herbivorous Dinosaur from the Jurassic of Wyoming. (The size of the brain of *Stegosaurus* was only $\frac{1}{100}$ that of a young alligator's, if the weight of the entire animal is considered).

Indeed, if the Iguanodon had not been contemporary with the Megalosaur in the Jurassic period, we should have had repeated over again the mournful story of the poor lion, in the Roman amphitheatre, who hadn't any Christian to eat; for the carnivorous Megalosaur of the Oolites would, in that case, have often gone supperless to bed for want of his Iguanodon.

Admitting the strong palæontological evidence which has been brought forward (*Geol. Mag.* 1896, pp. 8 and 69) in favour of the Jurassic age of the Wealden beds; nevertheless the age of Dinosaurs did not terminate until the close of the Cretaceous epoch, for Huxley

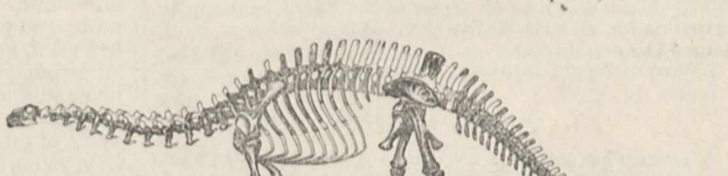


FIG. 4.—Restoration of *Brontosaurus excelsus*, Marsh ($\frac{1}{180}$ nat. size, length 60 feet), a huge unarmed herbivorous Dinosaur from the Jurassic of Wyoming. (Estimated when living to have weighed 20 tons! A stupid slow-moving reptile, probably existing upon aquatic or other succulent vegetation.)

described (*Geol. Mag.* 1867, p. 65) a small armed dinosaur (*Acanthopholis horridus*) from the Chalk-marl of Folkestone, and Seeley has determined another (*Orthomerus Dolloi*) from the Maestricht Chalk (*Q.J.G.S.* 1883, p. 248); whilst Marsh has obtained from the Cretaceous beds of the Laramie, in Wyoming, most complete evidence of the entire skeleton of *Claosaurus annectens*, one of a family of herbivorous dinosaurs, in which the cheek-teeth are very numerous and arranged in vertical series, not fewer than 150 being present, whilst the anterior portion of the jaws are narrower and edentulous, but produced in front in a rather wider predentary bone, which was, in all probability, covered with a horny mandible fitted to meet the strong beak above. Save in the more slender head, and the small and feeble fore-limbs, *Claosaurus* greatly reminds one of *Iguanodon*.

In support of the erect position in which so many of Marsh's animals are represented, it may be well to mention that *Claosaurus* has "in the median dorsal region, between the ribs and the neural spines, numerous rodlike ossified tendons, which increase in number in the sacral region and along the base of the tail, and then gradually diminish in number and size, ending at about the thirty-fifth caudal. These ossified tendons are well shown in the restoration (Fig. 6), and are of much interest." Similar ossified tendons are seen in *Iguanodon*, and they doubtless served to give attachment to the great dorsal muscles which supported the vertebral column when the animal assumed an upright attitude, or when it used its immense and powerful tail as an oar in swimming across a stream.

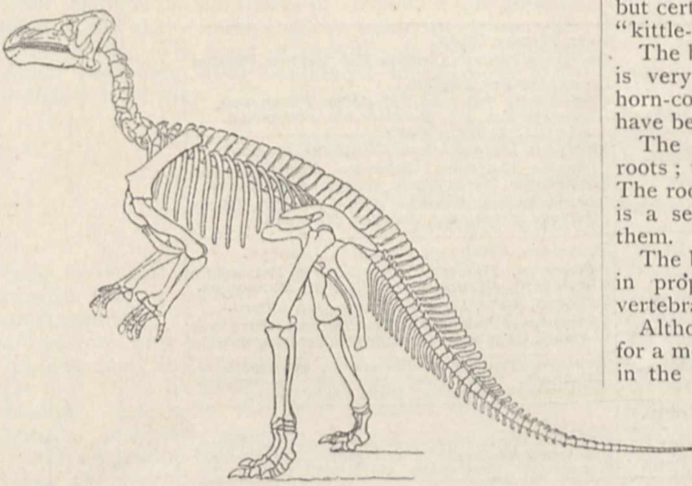


FIG. 5.—Restoration of *Iguanodon Bernissartensis*, Boul. ($\frac{1}{36}$ nat. size). An herbivorous dinosaur from the Wealden (Upper Jurassic ?) Bernissart, Belgium.

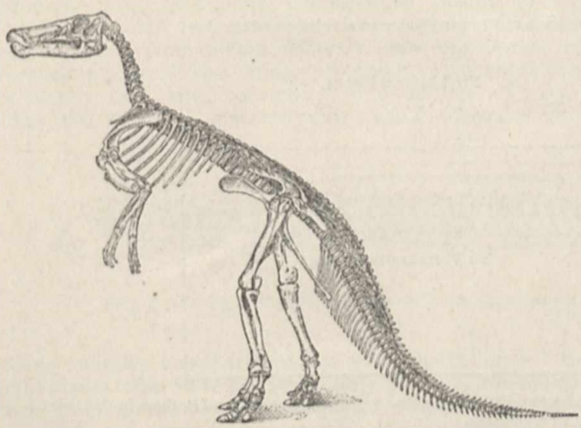


FIG. 6.—Restoration of *Claosaurus annectens*, Marsh, an herbivorous Dinosaur ($\frac{1}{30}$ nat. size). Cretaceous, Wyoming.

Another, and possibly the most singular, as well as one of the latest of Prof. Marsh's pets, is the huge *Triceratops prorsus*, one of the quadrupedal dinosaurs, with a skull armed with three horns, two of which were nearly a yard long, and having a bony frill, like an immense Elizabethan ruff, four feet broad, attached to the back of its occiput, the cranium and frill being 6 feet in length from the nose to the hinder border of the bony ruffle.

But skulls of *Triceratops horridus* have been obtained by Marsh, measuring from 7 to 8 feet in length.

Its horns, when found broken off from the skull, were so like the bony horn-cores of some bovine ruminant, as to have been suspected to belong to some very ancient ox; but certainly such three-horned beasts would have been "kittle-cattle" to yoke, or to plough with!

The beak-like edentulous character of the mandibles is very striking, and from the vascular surface of the horn-cores and bony frill, these too, when living, must have been sheathed in a strong horny external covering.

The teeth are very remarkable, having two distinct roots; this is true both of the upper and the lower series. The roots are placed transversely in the jaw, and there is a separate cavity more or less distinct for each of them. They form a single series only in each jaw.

The brain of *Triceratops* appears to have been smaller in proportion to the entire skull than in any known vertebrate.

Although we have nothing in this country which can for a moment compare, in magnitude, with the vast areas in the Western Territories of the United States, often covered to an enormous thickness by great lacustrine deposits of Tertiary, Cretaceous, Jurassic, and Triassic age, full of evidences of old land conditions, yet in our limited island we can show evidence probably of ten successive land-stages from the Wealden to the Trias, marked by Mammals or Dinosaurs, by Pterodactyles, and by insects, by plants and carbonaceous shales or coal-seams; so that throughout the lower Secondary series, at least, we can lay down buoys to mark the spots where the old land was situated, though of its actual extent we know but little.

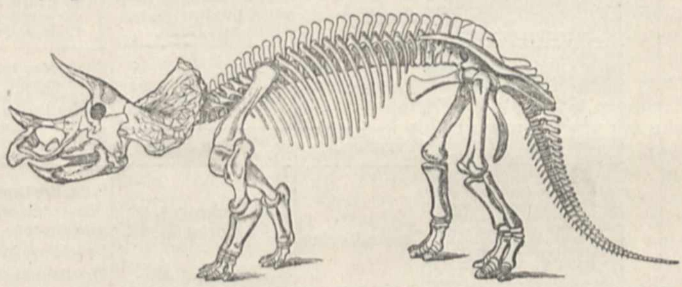


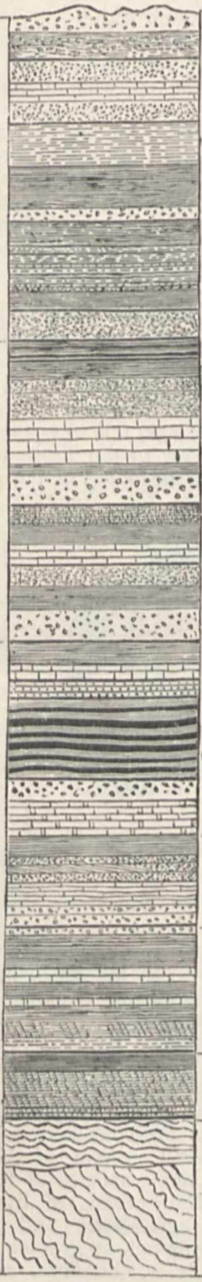
FIG. 7.—Restoration of *Triceratops prorsus*, Marsh ($\frac{1}{80}$ nat. size). Cretaceous, Wyoming. (Length in life about 25 feet, height 10 feet.)

What, we may well ask, were the peculiar conditions of life in the Mesozoic period, which brought about the evolution and continuance through this long æon of such a remarkable land fauna? The associated Jurassic flora may help to solve this query. It consisted largely of Araucarias, *Thujites*, and other Coniferæ, of Cycadeæ, and Palms, of Tree-ferns and many species of Filicinæ, of lesser growth, of giant Equisetums, of liverworts and club-mosses, and some herbaceous and aquatic plants; but, so far as our records tell, no grasses had as yet made their appearance. It is, therefore, certainly reasonable to conclude that most of the herbivorous dinosaurs must have subsisted, almost wholly, by browsing upon the leaves, shoots, and young branches of arboreal vegetation (as did the giant ground-sloths of later Tertiary times in South America), although some may perhaps have fed upon aquatic plants.

This habit doubtless tended to develop their frequent bipedal mode of progression amidst the tall and luxuriant vegetation along the river-banks where they pastured. It also enabled them the better to espy the approach of their enemies, the light-leaping *Hallopus* and *Compso-*

gnathus, and the fierce *Allosaurus* and *Megalosaurus*. These beasts of prey assumed the erect position, not only to observe, but also to rapidly overtake and leap upon their quarry; and it may be, too, that they were able to deceive them by their superficial resemblance to the vegetarians, who were literally taken in by them.

We cannot, in so brief a notice, do justice to the statement that Marsh had discovered an animal with its brain in its tail! "This reminds me"—I was asking the late Captain Speke on his return, in 1864, from Somaliland, what he thought of the Somalis, to which he replied, "They are a splendid race of men, only, unfortunately, their brain is developed at the wrong end of their backbone."



CENOZOIC.	Recent. Quaternary.			Tapir, Peccary, Bison. *Bos, Equus, Tapirus, Dicotyles, Megatherium, Mylodon.*
	Tertiary.	Pliocene.	Equus Beds. Pliohippus Beds.	*Equus, Tapirus, Elephas.* { *Pliohippus, Tapiravus, Mastodon, Procamelus, Aceratherium, Bos, Morotherium, Platygonus.*
		Miocene.	Miohippus Beds. Oreodon Beds. Brontotherium Beds.	*Miohippus, Diceratherium, Thinohyus, Protoceras.* { *Oreodon, Eporeodon, Hyænodon, Moropus, Ictops, Hyracodon, Agriochœrus, Colodon, Leptochœrus.* { *Brontotherium, Brontops, Allops, Titanops, Titanotherium, Mesohippus, Ancodus, Entelodon.*
		Eocene.	Diplacodon Beds. Dinoceras Beds. Heliobatis Beds. Coryphodon Beds.	*Diplacodon, Epihippus, Amynodon, Eomeryx.* { *Dinoceras, Tinoceras, Uintatherium, Palæosyops, Orohippus, Hyrachyus, Colonoceras, Homacodon.* *Heliobatis, Amia, Lepidosteus, Asineops, Clupea.* { *Coryphodon, Eohippus, Eohyus, Hyracops, Parahyus* Lemurs, Ungulates, Tillodonts, Rodents, Serpents.
MESOZOIC.	Cretaceous.		Laramie Series, or Ceratops Beds.	*Ceratops, Triceratops, Claosaurus, Ornithomimus.* Mammals, *Cimolomys, Dipriodon, Selenacodon, Nanomyops, Stagodon.* Birds, *Cimolopteryx.*
			Fox Hills Group.	
			Colorado Series, or Pteranodon Beds.	Birds with Teeth, *Hesperornis, Ichthyornis, Apatornis.* Mosasaurs, *Edestosaurus, Lestosaurus, Tylosaurus.* Pterodactyls, *Pteranodon.* Plesiosaurs, Turtles.
			Dakota Group.	
	Jurassic.		Atlantosaurus Beds. Baptanodon Beds. Hallopus Beds.	{ Dinosaurs, *Brontosaurus, Morosaurus, Diplodocus. Stegosaurus, Camptosaurus, Ceratosaurus.* Mammals, *Dryolestes, Stylacodon, Tinodon, Ctenacodon.*
	Triassic.		Otozoum, or Conn. River, Beds.	First Mammals, *Dromatherium.* First Dinosaurs. *Anchisaurus. Ammosaurus, Bathygnathus, Clepsysaurus.* Many footprints. Crocodiles, *Belodon.* Fishes, *Catopterus, Ischypterus, Ptycholepis.*
PALEOZOIC.	Permian.		Nothodon Beds.	Reptiles, *Nothodon, Eryops, Sphenacodon.*
	Carboniferous.		Coal Measures, or Eosaurus Beds.	First Reptiles (?) *Eosaurus.* Amphibians, *Baphetes, Dendrerpeton, Hylonomus, Pelion.* Footprints, *Anthracopus, Allopus, Baropus, Dromopus, Hylopus, Limnopus, Nasopus.*
			Subcarboniferous, or Sauropus Beds.	First known Amphibians (Labyrinthodonts). Footprints, *Sauropus, Thenaropus.*
	Devonian.		Dinichthys Beds. Lower Devonian.	*Dinichthys, Acanthodes, Bothriolepis, Chirolepis, Cladodus, Dipterus, Titanichthys.*
	Silurian.		Upper Silurian. Lower Silurian.	First known Fishes.
	Cambrian.		Primordial.	
	Archæan.		Huronian. Laurentian.	No Vertebrates known.

Known Range of Dinosaurs in Time. (Cretaceous to Triassic)

FIG. 8.—Table of British strata, with their North American equivalents, and a list of the vertebrate fossils which are found in them in the United States; drawn up by O. C. Marsh.

labours of Prof. Marsh in this interesting field of inquiry; but those who care to take up this latest volume on Dinosaurs, will find it well repay the perusal. His studies of the brains of these ancient reptiles is alone deserving most careful consideration. The comparison of the brain of *Stegosaurus ungulatus*, with the enormously larger neural cavity in the sacrum, has led to the

The present work by Prof. Marsh is, after all, but a summary of more than fifteen years' labour in the field and in the museum, and may, it is hoped, be followed by even a larger monograph. Nevertheless this volume is a storehouse of facts and figures (there are eighty-four plates!), and will prove of the greatest value to the palæontologist and the biologist.

THE DISCOVERY OF THE LARVA OF THE COMMON EEL.

THE first *Leptocephalus* was discovered in 1763, when a specimen was taken near Holyhead, by Mr. William Morris, and sent to Pennant. Since that time numerous specimens, having similar characters, have been obtained on the shores of Britain, in the Mediterranean, and at the surface of the ocean in various parts of the world. The chief peculiarities of these creatures, which have long been considered much more extraordinary than they really are, are the following. The body is several inches in length, thin and of uniform breadth like a piece of ribbon, very transparent, and unpigmented. The head is small in proportion; there are pectoral fins, but no pelvic, and there is a narrow fin running along the edge of the body, above and below, to the tail. The blood is not red, and there is no air-bladder. Internally the body consists largely of a peculiar gelatinous tissue.

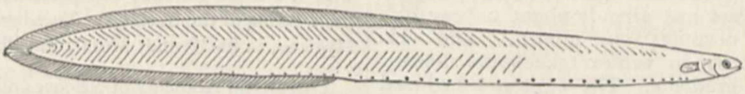


FIG. 1.—*Leptocephalus Morrisii*, the larva of the Conger. (After Couch.)

The suggestion that the *Leptocephali* were the normal larvæ of fishes of the eel family, was first made by the American ichthyologist, Gill, in 1864. In 1886 Yves Delage proved experimentally that *L. Morrisii* changed into a young conger.

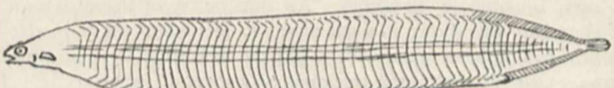


FIG. 2.—*Leptocephalus brevirostris*, the larva of the Eel. (After the original figure in Kaup's Catalogue of Apodal Fish, 1856.)

In 1892 Grassi and Calandruccio published their first paper on these forms, giving a brief and summary account of the results of observations at Catania. They had obtained a large number of living specimens from the harbour of Catania, and had succeeded in keeping them alive for varying periods in aquaria. The specimens belonged to several of the "species" which had previously been distinguished and named, and their metamorphosis into specimens of various species of Murænidæ was traced with complete, or nearly complete, continuity in a number of cases. Thus the complete metamorphosis of *L. Morrisii* into young congers was traced in 150 individuals, larvæ 5 in. long being reduced to conger of only 3 in. *L. diaphanus* became *Congromuræna balearica*, *L. Köllikeri*, *Yarrellii*, *Haeckeli*, and other forms proved to be all stages in the normal development of *Congromuræna mystax*, and *L. Kefersteini* changed into *Ophichthys serpens*.

Leptocephali are most frequently taken in the Straits of Messina, and amongst the forms there obtained is one named *L. brevirostris*, which is remarkable for its small size, and the entire absence of specks of pigment. In 1893 Grassi and Calandruccio announced that they had proved that this particular form was the larva of the common eel. They had not been able to follow the entire metamorphosis in one and the same specimen; but they had verified the most important changes in specimens kept in confinement, and compared all the organs in various stages with those in the perfect form. The greatest length of the larva is 8 cm., or 3¼ in., and the reduction after transformation is never more than 3 cm., so that the smallest elver, or young fully-developed eel, is 2 in. long.

A fuller account of this most interesting investigation was communicated by Prof. Grassi to the Royal Society last year, and is published in the *Proceedings* of December 1896, and also in the *Quarterly Journ. Mic. Sci.* of November 1896. It is well known that in the Straits of Messina strong currents and whirlpools occur. To the existence of these disturbances of the water, the occasional occurrence of various stages in the development of Murænoids in the surface water is to be attributed. As the Leptocephali are captured in company with fish of various species known to belong to the deep-sea fauna, it is inferred that the spawning of the eel and other Murænidæ, and the development of the eggs and larvæ, take place normally at great depths—at least 500 metres (250 fathoms)—and that the larvæ are carried to the surface with deep-sea fishes by the movements of the water just mentioned. Specimens of *Muræna helena* with ripe eggs, and of adult eels, both male and female, have also been captured under the same circumstances. In these adult eels the generative organs are sometimes more developed than in specimens otherwise obtained, and in some of the males ripe spermatozoa have been observed for the first time. A ripe male conger was described in 1881 by Otto Hermes, and several were kept alive by the present writer in the Plymouth Aquarium, but ripe male eels had never before been obtained.

These mature, or nearly mature, eels are remarkable for the large size of their eyes; and similar specimens, previously obtained from deep water, were described as distinct species by Kaup. The mature male conger is also distinguished by the greater size of its eyes. In the mature eels, also, the skin of the belly is silvery, not yellow, as in river eels.

Raffaele, in his valuable paper on the pelagic eggs and larvæ of fishes in the Gulf of Naples, published in the *Mittheilungen* of the Naples Station in 1888, described five different kinds of pelagic eggs which had certain common characters, and which, in his opinion, possibly belonged to various species of the Murænidæ. Raffaele described the larva hatched from one of these eggs, and it has the essential characters of a *Leptocephalus.* Grassi considers that one kind of these eggs, which has no oil-globules, is that of the common eel. But he believes that the eggs, like the larvæ, are only occasionally brought to the surface, and that they normally remain at great depths.

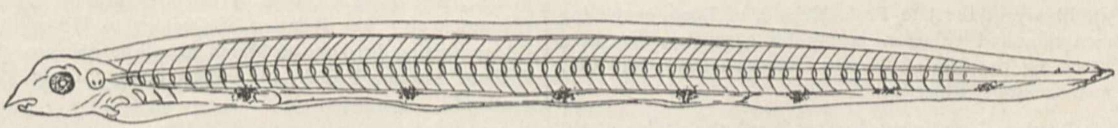


FIG. 3.—Young *Leptocephalus*, hatched in the aquarium, as it appears after the absorption of the yolk. Actual length, 9·1 mm. (After Raffaele.)

It is a curious fact that the larvæ, now identified as those of the eel, are found in greatest abundance in the stomach of the sun-fish (*Orthagoriscus mola*), which Grassi believes to be a deep-sea species. In the Straits of Messina this fish rarely appears, except in the months from February to September, and the occurrence of *L. brevirostris* is limited to that period. The eggs, which evidently belong to Muraenidae, are found in the sea from August to January; the adult eels in an advanced stage of sexual development have been obtained from November to July; while, lastly, the migration of eels from fresh waters to the sea takes place from October to January. Thus Grassi traces backwards the succession of events in the origin and development of young eels, and reaches the conclusion that the elvers or eel-fare which ascend rivers are already about a year old. The metamorphosis occupies one month. The eels which descend to the sea in winter take some months to ripen their sexual products. The eggs are fertilised in August and following months, and the larvæ are found in the following spring and summer. This agrees with the facts that have been established concerning the conger, the female of which takes about six months to develop her ovaries, and during this period takes no food. The eels which migrate to the sea in autumn have the generative organs in a quite immature condition, and, therefore, could not well be the parents of the elvers, which begin to ascend rivers in the following February. It would appear, however, from Grassi's paper, that he considers the metamorphosis to take place in winter, and that by one year old, he means derived from the larvæ of the previous summer; so that two years would elapse between the descent of the adult eels and the ascent of their progeny.

J. T. CUNNINGHAM.

NOTES

THE death of Prof. J. J. Sylvester, on Monday, deprives mathematical science of a most brilliant mind, and the scientific world in general of one of its foremost workers. The greatness of his genius has long been recognised wherever pure mathematics is studied; for his works command admiration by their originality and breadth of treatment. Eight years ago, Prof. Sylvester was added to the NATURE Series of "Scientific Worthies," and an account was then given of his career and of his more important contributions to mathematical science. We merely call attention to this article now, deferring until our next issue a fuller notice of the life and work of the esteemed investigator just lost to science.

M. G. BONNIER has been elected a member of the Section of Botany of the Paris Academy of Sciences, in succession to the late M. Trécul.

THE library of the late Prof. Kekulé, of Bonn, containing eighteen thousand volumes, mostly on chemistry, has been purchased by the firm of Messrs. Friedrich Bayer and Co., dye manufacturers, Elberfeld.

THE Russian Government has conferred the Order of St. Stanislas upon M. Moureaux, the director of the magnetic work at the Parc St. Maur Observatory. M. Moureaux has also been awarded a gold medal by the Geographical Society at St. Petersburg.

A "DISCUSSION" meeting of the Royal Society will be held on Thursday next, March 25. The subject for discussion is the chemical constitution of the stars, and it will be introduced by Mr. J. Norman Lockyer, C.B., F.R.S., with a communication "On the Chemistry of the Hottest Stars."

THE annual meeting of the Iron and Steel Institute will be held on Tuesday and Wednesday, May 11 and 12. At this meeting the Bessemer gold medal for 1897 will be presented to Sir Frederick A. Abel, Bart., K.C.B., F.R.S. The autumn meeting of the Institute will be held at Cardiff, August 10 to 13.

A REUTER telegram from Christiania states that the Financial Committee of the Norwegian Storthing has unanimously adopted a proposal in favour of granting 4000 kroner to each of Dr. Nansen's twelve companions, and 3000 kroner yearly during a period of five years to Captain Sverdrup, who will be at the head of the next expedition in the *Fram* planned by Dr. Nansen for 1898.

THE Howard Medal of the Royal Statistical Society, together with a cheque for 20*l.*, was presented to Dr. James Kerr, at the meeting of the Society on Tuesday, for his essay on "School Hygiene, in its Mental, Moral, and Physical Aspects."

THE Berlin Academy of Sciences offers a prize of 2000 m. for the best treatise on the origin and characters (*Entstehung u. Verhalten*) of the varieties of cereals during the past twenty years. The essays, which may be written in German, French, English, Italian, or Latin, must be sent in by December 31, 1898.

THE American Commission for the selection of a site for a Tropical Botanical Laboratory has now been constituted as follows:—Prof. D. H. Campbell (Leland Stanford University), Prof. J. M. Coulter (University of Chicago), Prof. W. G. Farlow (Harvard University), Prof. D. T. MacDougal (University of Minnesota).

CONSIDERABLE damage to gas and water pipes by electrolysis, due to the escape of the electric current used to propel trolley cars, is noted in Brooklyn. An illustration of the action of electricity was shown in a gas pipe two feet below the rail; the pipe having been found with a gap an inch wide in it, and the edges eaten down to the thickness of a sheet of paper.

PRESIDENT CLEVELAND celebrated the one hundred and sixty-fifth anniversary of the birth of George Washington on Monday, February 22, by setting apart thirteen forest reservations on the recommendation of Secretary Francis and a forestry commission of the National Academy of Sciences appointed by Prof. Wolcott Gibbs, President of the Academy. The reservations have an aggregate area of 21,379,840 acres.

THE Bertillon system of anthropometrical measurements is now applied to criminals in New York City.

THE veteran Italian botanist, Prof. T. Caruel, has retired from the professorship of Botany at the University of Florence.

ON Thursday next, March 25, Prof. W. Boyd Dawkins, F.R.S., will begin a course of three lectures at the Royal Institution on "The Relation of Geology to History." The Friday evening discourse on March 26 will be delivered by Sir William Turner, F.R.S., his subject being "Early Man in Scotland."

WE regret to have to record the death of Prof. Henry Drummond, the author of "Natural Law in the Spiritual World," "The Ascent of Man," and other works aiming at the reconciliation of theological revelation with science and evolution. He travelled in many parts of the world, and his "Tropical Africa" contains a very readable account of his journeys in the interior of that continent. With Sir Archibald Geikie he went on a geological expedition to the Rocky Mountains, and he more recently visited Australia, Java, Japan, and China. He was only forty-six years of age at the time of his death.

THE Report of the Meteorological Council for the year 1895–96 has just been presented to Parliament, and is, as usual, divided into four sections. (1) Ocean meteorology.—The practice followed by the Office in the collection of information is to supply observers on ships with a complete set of instruments on condition of their return, with a log-book, on the completion of the voyage. The large steamship companies also allow access to their logs, and in some special cases the documents are deposited at the Office. The principal discussions in preparation for publication during the year in question were current charts of the Arctic regions, embracing the area lying north of 60° north latitude, and the meteorology of the South Sea, embracing the area from the Cape of Good Hope to New Zealand. The latter charts, which are the first published for that part of the ocean, will be found very useful by the navigator, especially in connection with the question of the westward homeward route from Australia. Under this head is also included the supply of instruments to distant stations; everal sets have been supplied, at the cost of the Foreign Office, for use in Uganda. (2) Weather telegraphy and forecasts.—The work in this branch is constantly increasing from inquiries by the public as to current and past weather, which necessitate a considerable amount of investigation. The number of stations to which storm-warning telegrams are sent has been materially increased during the year by the addition of a number of lighthouses, in accordance with a suggestion made by the Royal Commission on Electrical Communication with Lighthouses. The Council renewed the offer, made in previous years, of sending daily forecasts to agriculturists during hay-making; the results show that the total percentage of useful forecasts amounted to 89 per cent., the same as in the preceding year. (3) Climatology.—This branch includes the discussion and publication of all observations relating to the climate of the British Isles. The publication of the monthly and yearly results for a number of stations for the fifteen years (1876-90) appeared during the year, and forms a valuable contribution to climatological knowledge. (4) Miscellaneous experiments and researches.—The comparison of various forms of anemometers has been made, with the object of determining the factor for converting the records of various instruments to the true velocity of the wind. Experiments have also been made for the measurement of earth temperatures at considerable depths. Rainfall means for a large number of stations are in an advanced state of preparation, and when completed will form a standard of reference in this important subject.

Since Jühler and Jörgensen, now nearly two years ago, revived the idea of moulds being the parent of yeast cells, a considerable amount of attention has been directed to the careful reinvestigation of this question. Amongst those who have submitted Jühler and Jörgensen's results to the several tests of experimental inquiry, must be reckoned Messrs. Klöcker and Schiönning, and in the last number of the *Compte-rendu des travaux du Laboratoire de Carlsberg* these gentlemen publish an extremely interesting memoir entitled "Que savons nous de l'origine des Saccharomyces?" An historical survey of the subject prefaces their own extensive investigations, and we are carried back to the days when Pasteur himself was under the impression that the mould Dematium, so abundantly present on vines, might furnish forth yeast cells, an idea which his later experiments led him, however, to discard. If this Dematium, as Jörgensen claims, is a parent of yeast cells found on grapes, then, provided this mould is present, yeast cells are bound to appear on the surface of the fruit. Klöcker and Schiönning, following in the earlier footsteps of Chamberland and Pasteur, protected grapes from aërial contamination by enclosing them in glass vessels plugged with cotton wool whilst still attached to the vine. The time selected for their imprisonment was the green stage of the fruit when, whereas Dematium is present in abundance, no yeast cells are to be found. Comparative examinations made later of protected and unprotected grapes respectively, revealed the fact that, whilst the former exhibited plenty of Dematium and not a single yeast cell, the latter, along with the mould, had an abundant crop of yeast cells. The conditions of the two sets of grapes were identical, barring the air being deprived of germs in the one case before reaching the fruit, and not in the other. The experiment was varied in divers interesting ways, but in no single instance was any evidence forthcoming that the yeast cells obtained access to the fruit otherwise than from the surrounding air, the mould Dematium being proved absolutely innocent of any participation in their presence.

Mr. P. Lee Phillips speaks truly where he says, in a paper entitled "Virginia Cartography," just issued as No. 1039 of the Smithsonian Miscellaneous Collections, that no records of the past have suffered more from the wear and tear of time than maps. On this account the preparation of a bibliographical description of maps of Virginia—a portion of North America which in early days embraced much of that which is now known as the United States—must have been a very laborious task, and Mr. Lee Phillips is to be congratulated upon having brought his work to a successful conclusion. The maps comprised in his monograph range in date from 1585 to 1893.

We have on our table several very valuable excerpts from the Report of the U.S. National Museum for 1894, but the limitations of space prevent us from doing more at the present time than call attention to their publication by the Smithsonian Institution. In one of these excerpts Mr. Thomas Wilson describes, and lavishly illustrates, "The Swastika" and its migrations; and makes some observations on the migrations of certain industries in prehistoric times. The Swastika is the earliest known symbol, and consists of a monogrammatic sign of four branches, of which the ends are bent at right-angles, thus 卐. Prof. Max Müller has found evidence for believing that among the Aryan nations the Swastika may have been an old emblem of the sun; but he has also shown that in other parts of the world the same, or a similar emblem, was used to indicate the earth. Mr. Wilson does not attempt to discuss the primitive meaning of the sign, or the place of origin, because they are considered to be lost in antiquity. The principal object of his paper is to present in a compact form all the information obtainable concerning the Swastika, and to trace its possible migrations in prehistoric times. Another of the papers from the U.S. National Museum is on "Primitive Travel and Transportation," by Dr. O. T. Mason. As is the case with all the publications of the Museum, this is illustrated with numerous plates and figures in the text. We must content ourselves now with noting the statement that the mechanical powers, as they are called, seem to have come into vogue in the following order: (1) The weight, for hammers, traps, and pressure; (2) the elastic spring, in bows, traps, machines; (3) inclined and declined plane, in locomotion and transportation; (4) the lever; (5) the wedge, in riving and tightening; (6) the sled, on snow or prepared tracks; (7) the roller, for loads and in machine bearings; (8) the wheel, in travel and carriage; (9) wheel and axle in many forms; (10) pulleys, with or without sheaves; (11) twisting, shrinking, and clamping devices; (12) the screw. The subjects and authors of three other publications just received from the U.S. National Museum are: "A Study of the Primitive Methods of Drilling," by Mr. J. D. McGuire; "Mancala, the National Game of Africa," by Mr. Stewart Culin; and "The Golden Patera of Rennes," by Mr. Thomas Wilson.

The very important question of the physical and chemical nature of the pigment substances found within the scales of

Lepidoptera, form the subject of a paper, by Mr. A. G. Mayer, in the March number of the *Entomologist*. Experiments have shown that reds, yellows, browns and blacks are always due to pigments. In some cases, greens, blues, violets, purples and whites are also due to pigments, and not, as is usually the case, to structural conditions, such as striæ upon the scales, &c. Concerning the chemical nature of the pigment substances within the scales, little has as yet been made known. The white pigments in the Pieridæ appear to be due to uric acid, and the red and yellow pigments to two closely related derivatives of uric acid. The green pigment found in several species of butterflies and moths has also been shown to consist of a derivative of uric acid. The results of a careful investigation leads Mr. Mayer to believe that the colours of many of the Lepidopteral imagos are derived from the hæmolymph or blood of the chrysalis. It is well known that the most universal colours of the more lowly organised moths are the drab-grey and yellow-drab tints, and these are the colou s which Mr. Mayer found were assumed by the hæmolymph after exposure to the air. The brilliant yellows, reds, &c., are the result of more complex chemical processes; but the colours can be manufactured to some extent by treating the hæmolymph with certain reagents. In connection with the phenomena of pigmentation it is noted that uric acid is never present in the hæmolymph of the imago of Saturnidæ, nor could Mr. Mayer detect it in the drab-coloured pigment of the outer edges of the wings.

Attention may here profitably be directed to a paper which, though at first sight may appear of purely medical interest, has an important bearing upon the results described in the preceding paragraph. We refer to a brochure by Mr. J. Barker Smith, reprinted from the *Medical Press and Circular*, 1896-97 (Baillière, Tindall, and Cox). Mr. Smith's experiments suggest that urates may be excreted by the hair, and that uric acid plays a *rôle* in respiration and in the formation of the red corpuscles from nuclear elements. The discovery of urates in the hair is significant, for it naturally brings into consideration wool, feathers, fur, &c., as to colouration and use, and also adornment and odour with reference to excretion and sex. Should Mr. Smith's results be verified, they indicate that one chemical of necessity determines many common characteristics in a large section of our fauna. Another noteworthy point in the paper is the description of a new and rapid method of estimating urates.

Baron H. Eggers contributes a paper on the Gulf of Maracaybo to the *Deutsche Geographische Blätter*, referring specially to the asphalt springs of El Menito. The whole region is of great geographical interest, but is little known on account of its extremely unhealthy climate. El Menito itself is a rounded knoll about 1 km. in diameter, and dotted about on its surface is a number of small cones, from which streams a mixture of mud, water and asphalt. The asphalt is in general colder than the surrounding air, and hardens in a few days, usually in a much cleaner and purer condition than the familiar asphalt of Trinidad. The greatest output of asphalt from this region took place in 1885, when it amounted to 161,000 kilogs., but since then the quantity has steadily diminished, chiefly from political causes.

Many and various are the lakes in the United States, but there is only one which occupies the crater of an extinct volcano; it is the Crater lake of Southern Oregon, lying in the very heart of the Cascade range, and belonging to the great volcanic field of the north-west. A very instructive illustrated account of the features of this lake is contributed to the *National Geographic Magazine* by Mr. J. S. Diller, of the U.S. Geological Survey. The lake contains no fish, but a small crustacean flourishes in its waters, and salamanders occur in abundance locally along the shore. According to observations made by Mr. B. W. Evermann last summer, the temperature of the water decreases from a depth of 555 feet to the bottom (1623 feet). The results suggest that the bottom may still be warm from volcanic heat, but more observations are needed to fully establish such an abnormal condition. Mr. Diller shows that Crater lake not only presents very attractive scenic features, but also affords a most instructive and interesting field for the study of volcanic geology.

Mr. Scourfield's plea for a fresh-water biological station in England is supported by Prof. Dr. Anton Fritsch, who, in a short article in *Natural Science* (March), shows that valuable work is being done on the fauna and flora of fresh water in Bohemia and Germany. Prof. Fritsch hopes that England will soon likewise do her duty to fresh-water biology, by establishing a station where investigations can be carried on. Such an institution would give results of a practical, as well as scientific value. In connection with this subject, and in evidence of the valuable work accomplished at the Biological Station of the University of Illinois, situated at Havana, on the Illinois River attention may be directed to a bulletin just received. By this publication Mr. Richard W. Sharpe makes a noteworthy "Contribution to a Knowledge of the North-American Fresh-water Ostracoda included in the families Cytheridæ and Cyprinidæ."

No better evidence could be adduced of the valuable services rendered to science by the establishment of a national physical laboratory, than the following list of investigations published within the last few months in *Wiedemann's Annalen*, all emanating from Charlottenburg:—Herr K. Kohle describes Helmholtz's absolute electrodynamometer as constructed during the lifetime of Helmholtz at the Reichsanstalt, and which he has employed to determine the electromotive force of Clark's cell; Herr Willy Wien contributes a mathematical investigation of the formulæ required to determine the constants of the instrument; Herrn W. Jäger and R. Wachsmuth describe a series of experiments on the cadmium cell, including a comparison of its electromotive force with that of Clark's cell, and a determination of the variations of this element with the temperature; Dr. L. Holborn and Herr W. Wien describe some important researches on measurement of low temperatures, including a comparison of the air and hydrogen thermometers; and Herrn M. Thiesen, K. Scheel and H. Diesselhorst give an account of a series of determinations of the coefficient of expansion of water.

As the result of work carried on in the same laboratory, Prof. Friedrich Kohlrausch, of Berlin, contributes to the *Annalen* papers on the following subjects:—On platinum electrodes and determinations of resistance; on the plugs of rheostats; on very rapid fluctuations of terrestrial magnetism; and on a thermometer for low temperatures, and a determination of the coefficient of expansion of petroleum-æther. The latter name is applied to a certain mixture of hydrocarbons whose boiling point is 33°, and specific gravity 0·6515 at 17°. This substance remains fluid down to the temperature of liquid air, when it becomes highly viscous.

In the *Zeitschrift des Vereines deutscher Ingenieure*, Dr. L. Holborn gives an account of Le Chatelier's thermo-electric element, and shows how it may be applied to the continuous measurement of the temperature of a furnace, thus possessing considerable advantages over the pyrometers in common use. Writing in the *Berliner Sitzungsberichte*, the same physicist describes a number of observations on the coefficient of magnetisation of different kinds of iron and steel, showing that in a feeble field of force the coefficient in question is a linear function of the temperature. The experiments connected with both of Dr. Holborn's present papers, like those of the two preceding articles, were carried out at Charlottenburg.

THE hostility often shown by farmers to the work of the Technical Instruction Committees of the County Councils may, perhaps, be tempered a little by an examination of a report on manurial trials, conducted by Prof. W. Somerville, during the season 1896, under the auspices of the County Councils of Cumberland, Durham, and Northumberland, and the Durham College of Science. The experimental work furnishes agriculturists in the North of England with very valuable information upon the effect of different manures and mixtures of manures upon crops. It has been proved that though increasing quantities of farmyard, or of artificial, manure will produce increasing yields up to a certain point, the profits per cwt. are greater for a moderate than for a large dressing. The addition of artificial manures to a fair dressing of farmyard manure appears to have exceedingly little, if any, effect upon the crop. This and other results show that there is need for manurial reform in the matter of the combined use of natural and artificial manure. Prof. Somerville has again demonstrated by experiment the extremely infectious character of the "finger and toe" disease; and, as already noted, his experiments with "nitragin" have failed to give positive results; so it is doubted whether the new substance, in its present state, will prove of any service to agriculture.

A QUANTITATIVE study of correlated variation and of the comparative variability of the sexes has been made by C. B. Davenport and C. Bullard, by counting the Müllerian glands in the fore-legs of four thousand swine. The total number of glands on a single leg varies from 0 to 10; and the counting has shown that they are slightly less abundant in the female than in the male. The average numbers of the glands on the right leg and on the left leg, taken without regard to sex, are about equal. As to their variability, it appears that the variants are distributed in accordance with the probability curve, or very nearly so. The degree of variability in the right and left legs is, especially in the case of the male, strikingly similar, being 1·41089 and 1·41083 in the two cases respectively, the difference being within the errors of the method. The males are about 2·5 per cent. more variable than the females. The degree of correlation in the variability of the right and left legs is about ·777. The observations are described in the *Proceedings* of the American Academy of Arts and Sciences (vol. xxxii. No. 4, December 1896).

THE April number of *Science Progress* will contain articles on the "Physiology of Reproduction," by Prof. H. Marshall Ward, F.R.S.; on "Condensation and Critical Phenomena," by Prof. J. P. Kuenen; on "Diseases of the Sugar-cane," by Mr. C. A. Barber, late Superintendent of Agriculture in the Leeward Islands; and on "Coagulation of the Blood," by Dr. Halliburton, F.R.S.

THE volume containing the "Results of Rain, River, and Evaporation Observations made in New South Wales" during 1895, under the direction of Mr. H. C. Russell, C.M.G., F.R.S., has just been published. In addition to the usual statistics, the volume contains Mr. Russell's paper on the "Periodicity of Good and Bad Seasons," already abridged in NATURE (vol. liv. p. 379), and also some instructive diagrams showing the relative values of the rainfall of the Colony for the past six years.

A NEW "Encyclopædic Dictionary of the English and German Languages," edited by Prof. Ed. Muret and Prof. Daniel Sanders, is in course of publication, in parts, by the Langenscheidtsche Verlagsbuchhandlung, Berlin. The work is being issued in two sections—English-German and German-English—and will be completed in about forty-eight parts. The last part of the former section will appear in a few months; the first part of the German-English section has, however, only just been issued. Judging from this part, the Muret-Sanders "Wörterbuch" will, when completed, possess advantages over all existing German dictionaries. The London agents are Messrs. H. Grevel and Co.

MESSRS. WILLIAM WESLEY AND SON have, since 1871, issued a number of excellent catalogues of scientific works, but they have not compiled a better catalogue than the one just published as Nos. 127 and 128 of their "Natural History and Scientific Book Circular." In the ninety-two pages of this list are the titles of more than three thousand works on every subject connected with botanical science, both in its theoretical and applied branches. The works are classified into about fifty groups, and are arranged alphabetically, according to authors, in each group. Great attention appears to have been paid to careful description and correct classification, and we have no doubt that the catalogue will be of real use both to botanists and gardeners.

NEW editions of two standard German scientific works have been received. One is Naumann's "Elemente der Mineralogie" (Leipzig: Wilhelm Engelmann), the thirteenth edition of which has been revised and enlarged by Prof. Dr. Ferdinand Zirkel. Only the first half of this new edition has as yet been published; the second half will appear towards the end of this year.—Kirchhoff's "Vorlesungen über mathematische Physik" (Leipzig: B. G. Teubner) has reached a fourth edition. The first volume, on mechanics, has appeared under the editorship of Prof. Dr. W. Wien. The original work was published twenty years ago, and the two following editions of it—the third in 1883—were seen through the press by the author himself. The present edition of Kirchhoff's "Mechanik" is thus the first which has been issued under the guidance of another.

HERR A. SONNEWALD, veterinary surgeon, contributes a paper of considerable interest to the current issue of *Deutsche Geographische Blätter*, summarising present knowledge of animal epidemics in South Africa, and describing in particular the geographical distribution of the rinderpest. The paper refers specially to the work of Edington and Thompson.

A POINT which strikes one on glancing through the annual report of Mr. Frederick J. V. Skiff, the Director of the Field Columbian Museum, is that a large number of expeditions are sent out by the Museum to collect specimens and make observations. The most important expedition of the year was one which went to Africa, under the direction of Mr. D. G. Elliot, Curator of the Department of Zoology, except ornithology. This party arrived at Aden last September with a splendid collection. Mr. C. F. Millspaugh, Curator of the Department of Botany, began his work last year on the forestry of the Mississippi Valley. The Curator of Geology went on expedition to the Republic of Mexico. He made a complete ascent of Popocatepetl and explored the crater, and ascended Ixtaccihuatl far enough to permit a study of its glacier. A great many mineral specimens and ores were obtained. Mr. G. K. Cherrie, Assistant Curator of Ornithology, spent three months collecting bird skins along the Gulf coast between New Orleans and Corpus Christi, Texas. Nearly one thousand skins were thus added to the North American division of this department. Mr. Miner W. Bruce arrived from Alaska after nearly two years absence, with a collection of 1200 or more specimens illustrating the arts and industries of the Eskimo of Alaska. He has returned again to the North with a commission to add further material, and to extend his work into Siberia. Mr. E. H. Thompson made a report on the recently examined ruins of Xkichmook, accompanied by specimens and photographs. Vice-President Ryerson and Mr. C. L. Hutchinson, on their trip around the world, procured and presented to the Museum a large and unique amount of material, including Etruscan and Stone Age remains from Italy, Roman terra-cottas, metal and stone work from the Indies, and butterflies from the Himalayas. Mr. Owen F. Aldis invited Mr. O. P. Hay, Assistant Curator of Ichthyology, to accompany him on an excursion to the waters of Southern Florida. Nearly one hundred fine specimens were thus obtained. By sending collectors to all parts of the world in this way, the Field Columbian Museum gives evidence of very great activity. The specimens obtained by its officers will not only serve to enrich the Museum directly, but a large number of them can do so indirectly by exchange.

THE additions to the Zoological Society's Gardens during the past week include two Secretary Vultures (*Serpentarius reptivorus*) from South Africa, presented by Mr. P. Myburgh; two Sacred Ibises (*Ibis æthiopicus*) from South Africa, presented by Mr. Almeda; a Herring Gull (*Larus argentatus*), a Lesser Black-backed Gull (*Larus fuscus*) from Nova Zemlya, presented by Mr. C. L. Rothera; a Rose-crested Cockatoo (*Cacatua moluccensis*) from Moluccas, presented by Mrs. Anderson; two Crested Porcupines (*Hystorix cristata*), a Griffon Vulture (*Gyps fulvus*) from North Africa, presented by Mr. R. S. Hunter; four Common Rat-Kangaroos (*Potorous tridactylus*, 2 ♂, 2 ♀), seventeen Lesueur's Water Lizards (*Physignathus lesueuri*) from Australia, deposited; two —— Parrakeets (*Psephotus chrysopterygius*) from Australia, four Brent Geese (*Bernicla brenta*, 2 ♂, 2 ♀), European; a Bengalese Cat (*Felis bengalensis*) from the East Indies; four Red-crested Pochards (*Fuligula rufina*, 2 ♂, 2 ♀) from India, three Mandarin Ducks (*Æx galericulata*, ♀) from China; three Summer Ducks (*Æx sponsas*, ♀) from North America; two Rosy-billed Ducks (*Metopiana peposaca*, ♂) from South America; a Japanese Teal (*Querquedula formosa*, ♀) from North-east Asia; five Chiloe Widgeon (*Mareca sibilatrix*, 3 ♂, 2 ♀) from Chili, a Spur-winged Goose (*Plectropterus gambensis*, ♂) from West Africa, purchased.

OUR ASTRONOMICAL COLUMN.

COUDÉ MOUNTINGS FOR REFLECTING TELESCOPES.—For spectroscopic work the reflector is, without doubt, the most ideal form of telescope. Not only does the visual light-grasping power increase very rapidly the larger the aperture, but for the purposes of photography the same is also true. The refractor has, however, as yet the most convenient and comfortable arrangement for observation from the observer's point of view, while with the reflector the observer is not so conveniently situated. That some kind of coudé arrangement can be adopted is, therefore, an important step in bringing these instruments more into use; for not only are reflectors cheap when compared with objectives, but their mountings and the accompanying housing are much less expensive. Prof. Wadsworth, in the February number of the *Astrophysical Journal* (vol. v. No. 2), describes several ways in which the reflector may be coudé mounted, one of which was suggested by the late Mr. Cowper Ranyard, but was not completely worked out owing to his sudden death. Perhaps the two most promising arrangements are (1) when the reflector is of the Newtonian type, and the primary flat is placed at right angles to the axis of the tube reflecting the cone of rays back again on to two small mirrors, one placed just in front of the mirror, and the other in the polar axis; and (2) when the reflector is of the Cassegrain type, and a single small additional mirror is necessary to reflect the rays directly down the polar axis. The latter appears, however, the more simple of the two, but the method of mounting seems somewhat too weak for mirrors of large size. Prof. Hale, in the same number of that journal, discusses the comparative value of refracting and reflecting telescopes for astrophysical investigations, pointing out the superiority of the latter from many points of view, while Mr. Ritchey describes a new method of a support system for large specula.

ON APPARENT AND REAL DISELECTRIFICATION OF SOLID DIELECTRICS PRODUCED BY RÖNTGEN RAYS AND BY FLAME.[1]

THE fact that air is made conductive by flame, by ultra-violet light, by Röntgen rays, and by the presence of bodies at a white heat has been shown experimentally by many experiments. We propose in this communication to give some results bearing on this conductivity of air, based chiefly on experiments of our own.

We have examined more particularly the behaviour of paraffin and of glass.

In our first experiments with paraffin we used a brass ball of about an inch diameter, connected to the insulated terminal of an electrometer by a thin copper wire soldered to the ball. The ball and the wire were both coated to the depth of about one-eighth of an inch with paraffin. The ball was then laid on a block of paraffin in a lead box with an aluminium window, both of which were in metallic connection with the case of the electrometer. By this means we avoided all inductive effects.

The electrometer was so arranged as to read 140 scale divisions per volt.

After testing the insulation the paraffined ball was charged positively and the rays played on it. After two minutes the electrometer reading was steady at 0·5 of the initial reading. The electrometer was then discharged by metallic connection, and again charged positively. Its reading remained steady after three minntes at 0·63 of the initial charge. In the third and fourth experiments the readings after three minutes were ·81 and ·90 of the initial charges respectively.

The ball was next charged negatively. When the rays were played on it a steady reading was obtained after four minutes at ·18 of the initial charge. In the second, third, and fourth experiments the steady readings after four minutes were ·45, ·70, and ·78 of the initial charges respectively.

The paraffin was then removed and the brass ball polished with emery paper; whether the charge was positive or negative, it fell in about five seconds to one definite position, 50 scale divisions on the positive side of the metallic zero, when the Röntgen rays were played on the charged ball.

These experimental results demonstrate that the Röntgen rays *did not produce sensible conductance* between the brass ball, when it was coated with paraffin, and the surrounding metal sheath: and that *they did produce it* when there was only air and no paraffin between them. From experiments by J. J. Thomson, Righi, Minchin, Benoist and Hurmuzescu, Borgmann and Gerchun, and Röntgen,[2] we know that air is rendered temporarily conductive by Röntgen rays, and Röntgen's comparison of the effect of the rays with that of a flame shows that our experimental results are explained by the augmentation of the electrostatic capacity (quasi-condenser) of the brass ball by the outside surface of its coat of paraffin being put into conductive communication with the surrounding lead sheath and the connected metals.

In our second experiments we have endeavoured to eliminate the influence of the varying capacity of this quasi-condenser. For this purpose, we placed a strip of metal connected to the insulated terminal of the electrometer inside an aluminium cylinder; the space between the metal and the cylinder was first filled with air, afterwards with paraffin. The aluminium was connected to the case of the electrometer, and inductive disturbances were avoided by surrounding the copper wire connecting the metal to the isulated terminal with a lead sheath in metallic connection with the electrometer sheath (see diagram).

In our first experiments with this apparatus we had air, instead of the main mass of paraffin, separating the insulated metal from the surrounding aluminium tube, as shown in the diagram, and we had only small discs of paraffin serving as insulating supports for the ends of the metal, and not played on by the Röntgen rays. When the metal thus supported was charged, whether positively or negatively, the Röntgen rays

[1] By Lord Kelvin, Dr. M. Smoluchowski de Smolan, and Dr. J. Carruthers Beattie. Read before the Royal Society of Edinburgh, February 15, 1897.

[2] J. J. Thomson, *Proceedings* R.S.L., February 13, 1896; Righi, *Comptes Rendus*, February 17, 1896; Benoist and Hurmuzescu, *Comptes Rendus*, February 3, March 17, April 27, 1896; Borgmann and Gerchun, *Electrician*, February 14, 1896; Röntgen, Würzburger. Phys. Med. Gesellschaft, March 9, 1896; Minchin, *The Electrician*, March 27, 1896.

diselectrified it in about five seconds; not, however, to the metallic zero of the electrometer, but to a "rays-zero" depending on the nature of the insulated metal and of the metal surrounding it.

With paraffin between the aluminium cylinder and the insulated metal within, as shown in the diagram, the following results were obtained:—

December 30, 1896. 5.30 p.m.—Interior metal charged negatively. Total charge 356.

Röntgen lamp in action and no screen	39 scale divisions discharged in 5 mins.
R. L. not acting	25 ,, ,, 5 ,,
R. L. again acting and no screen	17 ,, ,, 5 ,,

5.45.—Interior metal charged positively. Total charge 244.

R. L. in action and lead screen	1 scale division discharged in 3 mins.
R. L. in action and no screen	6 ,, ,, 3 ,,
R. L. not acting	0 ,, ,, 3 ,,

Dec. 31, 1896. 10.54 a.m.—Interior metal charged positively. Total charge 163.

R. L. not acting... ...	2 scale divisions discharged in 3 mins.
R. L. acting & no screen	1 ,, ,, 3 ,,
11.0—R. L. stopped ...	1·5 ,, ,, 2 ,,
R. L. again acting, no screen	3 ,, ,, 2 ,,
R. L. stopped	2·5 ,, ,, 3 ,,

11.12.—Interior metal charged negatively. Total charge 342.

R. L. not acting... ...	10 scale divisions discharged in 3 mins.
R. L. acting, no screen	21 ,, ,, 3 ,,
11.18—R. L. stopped	11·5 ,, ,, 3 ,,
R. L. acting, no screen	16·5 ,, ,, 3 ,,

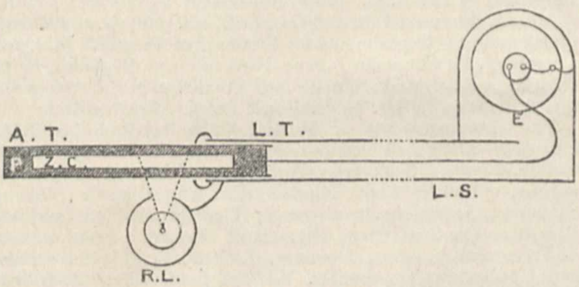


FIG. 1.—A. T., Aluminium tube; L. T., Lead tube; R. L., Röntgen lamp; L. S., Lead sheaths; E., Electrometer; P., Paraffin; Z. C., Zinc cylinder.

These results are quite in accordance with those found in similar experiments by Röntgen; and they show that if paraffin is made conductive, it is only to so small an extent that it is scarcely perceptible by the method we have used.

To make a similar series of experiments with glass, we used a piece of glass tubing 9·5 mm. thick, length 70 cm., and 1 cm. external diameter. The inside of this tube was coated with a deposit of silver, which was placed in metallic connection with the insulated terminal of the electrometer. The outside of the glass was covered with wet blotting-paper connected to sheaths.

With this arrangement we obtained the following results:—

Feb. 8, 1897.

Insulated terminal of electrometer charged to − 333 scale divisions from the metallic zero.

4.23.—Röntgen lamp,	acting ...	0·5 sc. div. lost in 3 mins.
,, ,,	not acting ...	1·0 ,, ,, 5 ,,

Charged to + 164 scale divisions from the metallic zero.

4.36.—Röntgen lamp,	not acting ...	13 sc. divs. lost in 7 mins.
,, ,,	acting ...	8·5 ,, ,, 5 ,,
,, ,,	not acting ...	6·0 ,, ,, 6 ,,
,, ,,	acting ...	3·5 ,, ,, 5 ,,
,, ,,	not acting ...	3·5 ,, ,, 5 ,,

[Sensibility of electrometer, 140 scale divisions per volt.]

We next removed a part of the wet blotting-paper from the outside of the glass, and, after having charged the insulated interior metal deposited on the inside of the glass, we heated the exposed part with a spirit flame, in this way making the glass a conductor. Thus with a charge of + 280 scale divisions from the metallic zero, the loss in 30 seconds, during which time the glass was heated in the spirit flame, was 90 scale divisions; in the next minute, with no further heating, the loss was 20 scale divisions. Re-application of heat gave complete discharge in 2½ minutes. Thus we see that our method is amply sensitive to the conductance produced in glass by heating.

We conclude that the Röntgen rays do not produce any conductance perceptible in the mode of experimenting which we have hitherto followed.

A similarity in effects produced by flame and by Röntgen rays is brought out by the following experiments.

Two similar sticks of paraffin, which we shall call A and B respectively, each of about four sq. cm. cross section, were coated throughout half their lengths with tinfoil. These tinfoils ought to be each metallically connected to sheaths.

To obtain a sufficiently delicate test for their electric state, a metal disc of three cm. diameter was fixed horizontally to the insulated terminal of the electrometer.

The two pieces of paraffin were first diselectrified by being held separately in the flame of a spirit-lamp. Their non-tinfoiled ends were then pressed together, and their electric state again tested after separation. It was found that they were still free from electric charge. After this B was charged by being held over the pointed electrode of an inductive electric machine. The quantity of electricity given to it in this way was roughly measured by noting the electrometer reading when the paraffin was held at a distance of 4 cm. above the metal disc connected to the insulated terminal of the electrometer.

The free ends of A and B were again held together, and, after separation, both pieces were tested separately. The charged one, B, had suffered no appreciable loss, and the other, A, induced an electrometer reading of a few scale divisions in the same direction, when held as near as possible to the metal disc without touching it. This showed that an exceedingly minute quantity of electricity had passed from B to A when they were in contact.

A was then diselectrified by being held alone in the flame. The ends of A and B were again put together, and in this position were passed through the flame. They were tested with their ends still pressed together, and it was found that when held as near as possible to the metal disc without touching it, no reading was produced on the electrometer. After this they were separated and tested separately; and it was found that B, when held over the disc, gave a large reading in the same direction as before it had been passed through the flame, and A (which was previously non-electrified) gave a reading of about the same amount in the opposite direction.

The same results were obtained when Röntgen rays were substituted for the flame.

The explanation clearly is this: the flame or the Röntgen rays put the outer paraffin surfaces of A and B temporarily in conductive communication with the tinfoils; but left the end of B, pressed as it was against the end of A, with its charge undisturbed. This charge induced an equal quantity of the opposite electricity on the outer surfaces of the paraffin of A and B between the tinfoils; half on A, half on B.

When the application of flame or rays was stopped, this electrification of the outer paraffin surfaces became fixed. B, presented to the electrometer, showed the effect of the charge initially given to its end, and an induced opposite charge of half its amount on the sides between the end and the tinfoil. A showed on the electrometer only the effect of its half of the whole opposite charge induced on the sides by the charge on B's end.

We have here another proof that paraffin is not rendered largely conductive by the Röntgen rays. Had it been made so, then the charge given to the end would have leaked through the body of the paraffin to the outside, and have been carried away either by the tinfoil or by the conductive air surrounding the non-tinfoiled parts.

To show that the induced charges were fixed on the sides, the two sticks, A and B, were next coated with tinfoil throughout their whole length, only one end of each being uncovered. The uncoated end of B was then charged and pressed against that of A, and the two were held either in the flame of a spirit-lamp or in the Röntgen rays. When taken out of the flame or the Röntgen rays, and then separated and tested separately, it was found that B had retained its charge practically undiminished, and that A had acquired a very slight charge of the opposite kind.

Instead of placing the two ends of the paraffin in immediate contact, four pieces of metal of 1/10 of a mm. thickness were placed one at each corner of one of the ends, so that when the sticks of paraffin were placed end to end there was now an air space of 1/10 of a mm. between the paraffin ends. When B was charged and A not charged, and the two put end to end, and then exposed to flame or to Röntgen rays, it was found that B's end still retained its charge, and A's end acquired a very slight opposite charge.

With an air space of 1/5 of a mm. the same results were obtained.

With the air space increased to 1 mm. the charge on B was less after the two had been passed through the flame or the rays.

Similar experiments were made with rods of glass and of ebonite, with similar results.

FORTHCOMING BOOKS OF SCIENCE.

MR. EDWARD ARNOLD has in preparation:—Practical Science Manuals; Agricultural Chemistry, by T. S. Dymond; Steam Boilers, by George Halliday, illustrated; The Chemistry of the Raw Materials of the Coal-Tar Colours, by R. J. Friswell; A Manual of Physiology, by W. Snodgrass, arranged to meet the requirements of the syllabus of the Science and Art Department; The Calculus for Engineers, by Prof. John Perry; A New Elementary Geography, based on Frye's Complete Geography, and revised and largely re-written from the British standpoint, by Andrew J. Herbertson, illustrated.

Mr. Batsford announces:—A Text-Book on Sanitary Engineering, by C. E. Moore.

In Messrs. A. and C. Black's list are to be found:—Ferrets: their Management in Health and Disease, by Nicholas Everitt, illustrated; On the Threshold of Three Closed Lands, viz. Tibet, Nepal and Bhutan, by J. A. Graham.

Messrs. W. Blackwood and Sons give notice of:—Brown's Forester: a Practical Treatise on the Planting and Tending of Forest Trees and the General Management of Woodland Estates, edited by John Nisbet; Wild Traits in Tame Animals, being some Familiar Studies in Evolution, by Dr. Louis Robinson, illustrated; Man's Place in the Cosmos, and other Essays, by Prof. Andrew Seth; Prehistoric Problems, by Dr. R. Munro; Introductory Text-Book of Zoology, by Prof. H. Alleyne Nicholson, new edition, illustrated; Page's Introductory Text-Book of Geology, new edition, revised and enlarged by Prof. Lapworth.

Messrs. Cassell and Co., Ltd., will publish:—Cheap editions of The Story of the Sun, by Sir Robert S. Ball, illustrated; and Cassell's Concise Cyclopædia, illustrated; the completion of Cassell's Natural History, edited by P. Martin Duncan, three volumes, illustrated; a New Cyclopædia of Technical Education, six volumes, illustrated; new issues in serial form of The Story of our Planet, by Prof. T. G. Bonney, illustrated; and Familiar Wild Flowers, by F. E. Hulme.

In Messrs. J. and A. Churchill's list we find:—Commercial Organic Analysis, by Alfred H. Allen, vol. iii., part iv.; Practical Chemistry, by Prof. T. Campbell Brown; fourth edition; A System of Dental Surgery, by C. S. Tomes, third edition; A Short Practice of Midwifery, by Dr. Yellett; Bazaar Medicines, by Dr. Waring, fifth edition, revised by Dr. Aitchison; Fingers and Toes, by W. Anderson; Antiseptics for Nurses, by C. E. Richmond; Mechanical Dentistry, by T. Richardson, seventh edition.

The Clarendon Press has in preparation:—The Opus Majus of Roger Bacon, edited by J. H. Bridges, 2 vols.; The Flora of Berkshire, by G. C. Druce.

Mr. W. B. Clive promises:—A Manual of Psychology, by G. F. Stout; Questions on Welton's Logic, with illustrative examples, by H. Holman; Key to Holman's Questions on Welton's Logic; A Primer of Logic, by J. Welton; Advanced Algebra, by William Briggs and Prof. G. H. Bryan, based on the "Algebra" of Radhakrishnan; Euclid, Books I.–IV., by Rupert Deakin; Deductions in Euclid, by T. W. Edmondson and J. Briggs; Geometrical Conic Sections, by Prof. G. H. Bryan; Co-ordinate Geometry, by Prof. G. H. Bryan, part ii.; Mechanics of Fluids, First Stage, by F. Rosenberg; The Tutorial Dynamics, by William Briggs and Prof. G. H. Bryan; A Higher Text-Book of Dynamics, by Prof. G. H. Bryan; A Higher Text-Book of Hydrostatics, by Prof. G. H. Bryan; The Intermediate Trigonometry, by W. Briggs and Prof. G. H. Bryan; The Preceptors' Trigonometry, by W. Briggs and Prof. G. H. Bryan; The Properties of Matter, an Introduction to the Tutorial Physics, by E. Catchpool; Inorganic Chemistry, First Stage, by Dr. G. H. Bailey; Advanced Science and Art Chemistry, by the same author; A Synopsis of Non-Metallic (Inorganic) Chemistry, by William Briggs, fourth edition, revised by W. Hurtley; A Synopsis of Metallic Chemistry, by W. Hurtley; The Tutorial Chemistry, by Dr. G. H. Bailey, edited by William Briggs, part ii., Metals; Magnetism and Electricity, First Stage, by Dr. R. H. Jude; Advanced Science and Art Magnetism and Electricity, by Dr. R. W. Stewart; Sound, Light, and Heat, First Stage, by John Don; Advanced Science and Art Heat, by Dr. R. W. Stewart; Science and Art Physiography, by A. M. Davies.

Messrs. J. M. Dent and Co.'s list contains:—The First Crossing of Spitzbergen, by Sir Martin Conway, illustrated; Picturesque Burma, by Mrs. Ernest Hart, illustrated.

Mr. Heinemann will issue:—The New Africa: a Journey up the Chobé and down the Okovango Rivers, by Dr. A. Schulz and A. Hammar; Rhodesia, by Dr. F. Du Toit, illustrated.

Messrs. Hutchinson and Co. give notice of:—Concise Knowledge Library, illustrated: Vol. i. Natural History, by R. Lydekker, Dr. R. Bowdler Sharpe, W. F. Kirby, R. B. Woodward, F. A. Bather, W. Garstang, R. Kirkpatrick, and R. I. Pocock; vol. ii. Astronomy, by J. Ellard Gore, Agnes M. Clerke, and A. Fowler.

Messrs. Longmans' announcements include:—The Life and Times of Thomas Wakley, by S. Squire Sprigge; Papers and Notes on the Genesis and Matrix of the Diamond, by the late Prof. H. Carvill Lewis, edited from his unpublished MSS. by Prof. T. G. Bonney; Teaching and School Organisation, with especial reference to Secondary Instruction, edited by P. A. Barnett; Differential Equations, by D. A. Murray; A Guide to the Clinical Examination of the Blood for Diagnostic Purposes, by Dr. R. C. Cabot, illustrated.

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The announcements of Messrs. Macmillan and Co., Ltd., include:—Ancient Volcanoes of Britain, by Sir Archibald Geikie, 2 vols., illustrated; A System of Medicine, by many writers, edited by Dr. Thomas Clifford Allbutt: Vol. ii. containing Infections (continued); The Intoxications and the Parasites, also the General Diseases of Obscure Causation, such as Rheumatism, Gout, Diabetes, Rickets, Scurvy, &c.; Farm and Garden Insects, by Dr. William Somerville, illustrated; The Dahlia, by many writers; Infinitesimal Analysis, by Prof. William Benjamin Smith, Vol. i., Elementary; On Laboratory Arts, by Prof. Richard Threlfall; Mathematical Theory of Electricity and Magnetism, by A. G. Webster.

Messrs. Methuen and Co. promise:—British Central Africa, by Sir H. H. Johnston, illustrated; Scouting Sketches in Rhodesia, by Lieut.-Colonel Baden-Powell, illustrated; From Tonkin to India, by Prince Henri of Orleans, translated by Hamley Bent, illustrated; Three Years in Savage Africa, by Lionel Decle, illustrated; The Hill of the Graces: or, the Great Stone Temples of Tripoli, by H. S. Cowper, illustrated; The North-West Provinces of India, their Ethnology and Administration, by W. Crooke, illustrated; Neo-Malthusianism, by R. Ussher; Magnetism and Electricity, by R. Elliott Steel, illustrated.

In Mr. Murray's list we find:—Some Unrecognised Laws of Nature, an Inquiry into the Causes of Physical Phenomena, with special reference to Gravitation, by Ignatius Singer and Lewis H. Berens, illustrated; Zermatt and the Matterhorn, by Edward Whymper, illustrated; The Life of William Pengelly of Torquay, F.R.S., Geologist, with Selections from his Correspondence, by his daughter, Hester Pengelly, and a summary of his scientific works, by Prof. Bonney, illustrated; Waste and Repair in Modern Life, by Dr. Robson Roose; University Extension Manuals, edited by Prof. Knight; An Introduction to Physical Science, by Prof. John Cox; The History of Astronomy, by Arthur Berry; A History of Education, by Principal James Donaldson; An Introduction to Philosophy, by Prof. Knight.

Messrs. George Newnes, Ltd., have in preparation:—The Story of Animal Life, by B. Lindsay, illustrated; The Story of the Earth's Atmosphere, by Douglas Archibald, illustrated;

The Story of the Earth's Surface, by Prof. H. G. Seeley, illustrated; The Story of Religion, by E. D. Price, with map, &c.

Messrs. Kegan Paul, Trench, Trübner, and Co. Ltd., announce:—Studies in Psychical Research, by Frank Podmore; Creation with Development, by Captain J. D. K. Hewitt, with diagrams and an illustration; Fichte's Science of Ethics, translated by A. E. Kroeger, and edited by Prof. the Hon. W. T. Harris; new volume of "The International Scientific Series": What is Electricity? by Dr. John Trowbridge, illustrated; the "Agricultural Series": Chemistry, by R. H. Adie and T. B. Wood; Botany, by Dr Wm. Fream; Physiology and Feeding, by T. B. Wood and R. H. Adie; Agriculture, by Robert Menzies; Horticulture, by E. Pillow and W. K. Woodcock; The Conversion of Arable Land to Pasture, by Prof. W. J. Malden.

The Rebman Publishing Company, Ltd., will issue:—Yearbook of Medicine and Surgery, 1897, collected and arranged by eminent specialists and teachers, under the editorial charge of Dr. George M. Gould; The Diseases of Women: a handbook for students and practitioners of medicine, by J. Bland Sutton and Dr. Arthur E. Giles, illustrated; Injuries and Diseases of the Ear: being various papers on Otology, by Macleod Yearsley; Archives of Clinical Skiagraphy, by Sydney Rowland, part iv.

Messrs. L. Reeve and Co. have in the press:—Respiratory Proteids, by Dr. A. B. Griffiths.

Among the forthcoming books of the Scientific Press, Ltd., we notice:—The Romance and Mystery of Alchemy and Pharmacy, by C. J. S. Thompson, illustrated; Elementary Physiology for Nurses, by Dr. C. F. Marshall; "The Burdett Series" of popular Text-Books on Nursing: No. 1, Practical Hints on District Nursing, by Amy Hughes; No. 2, The Matron's Course: an introduction to hospital and private nursing, by S. E. Orme.

Messrs. Walter Scott, Ltd., will add to their "Contemporary Science Series":—Hallucinations and Illusions, by E. Parish; Psychology of the Emotions, by Ribot; The New Psychology, by Dr. E. W. Scripture; Man and Woman, by Havelock Ellis, second edition; Hypnotism, by Albert Moll, fourth edition.

The announcements of Messrs. Swan Sonnenschein and Co., Ltd., include:—Aristotle's Psychology, including the Parva Naturalia, translated and edited, with commentary and introduction, by Prof. William A. Hammond; Ethics, by Prof. W. Wundt, translated under the supervision of Prof. E. B. Titchener, 2 vols.; Physiological Psychology, by Prof. W. Wundt, translated by Prof. E. B. Titchener, 2 vols., illustrated; Introduction to the Study of Philosophy, by Prof. Oswald Külpe, translated by W. B. Pillsbury, under the supervision of Prof. E. B. Titchener; Text-Book of Palæontology for Zoological Students, by Theodore T. Groom, illustrated; Text-Book of Embryology: Invertebrates, by Drs. Korschelt and Heider, vol ii., Crustacea and Arachnoids, translated and edited (with additions) by Eric Pritchard; Practical Plant Physiology, by Prof. Wilhelm Detmer, translated by S. A. Moor; A Student's Text-Book of Zoology, by Adam Sedgwick, 2 vols., illustrated; Handbook to Practical Botany, for the botanical laboratory and private student, by Prof. E. Strasburger, edited by Prof. W. Hillhouse, new edition; The Young Beetle-Collector's Handbook, by Dr. E. Hofmann, translated and edited with an introduction by Dr. W. Egmont Kirby, illustrated; Organic Chemistry: Introduction to the Study of, by J. Wade; Among the Wild Flowers, by the Rev. H. Wood, vol. i. (Spring), vol. ii. (Summer); Fishes, by the Rev. H. A. Macpherson; Handbook of Grasses, by W. Hutchinson, illustrated; Mammalia, by the Rev. H. A. Macpherson; Birds' Eggs and Nests, by W. C. J. Ruskin Butterfield; The Dynamo: how made and how used, by S. R. Bottone, new edition, illustrated, and an appendix on the construction of a six-unit dynamo; Radiation, by H. H. F. Hyndman and Cecil H. Cribb, with an introduction by Prof. Silvanus P. Thompson; Williams' British Fossils, new edition; Specimens of Bushman Folk-lore, by Dr. W. H. J. Bleek and L. C. Lloyd, with a preface by Dr. George McCall Theal.

Mr. Fisher Unwin's list contains:—Glimpses into Plant Life, by Mrs. Brightwen, illustrated; Mother, Baby, and Nursery, a Manual for Mothers, by Mrs. Genevieve Tucker.

Messrs. Frederick Warne and Co. announce:—Wayside and Woodland Blossoms, by Edward Step, third edition; Favourite Flowers of Garden and Greenhouse, edited by E. Step, vols. ii. and iii.

Messrs. Whittaker and Co. announce:—Central Station Electricity Supply, by Gay and Yeaman; A Series of Electrica Engineering Designs, by Gisbert Kapp; Horseless Road Locomotion, by A. R. Sennett; A Railway Technical Vocabulary (French, English, and American), by Lucien Serraillier; A Technological Dictionary in Four Languages (English, French, Italian, and German); Loppé and Bouquet's Alternating Currents, a practical treatise, translated from the French by F. J. Moffett; The Alternating Current Circuit, by W. Perren Maycock; Railway Material Inspection, by G. R. Bodmer; Organic Chemical Manipulation, by J. T. Hewitt; Industrial Electro-Chemistry, by Dr. Hoepfner; Whittaker's Engineers' Pocket-Book; Practical Electrical Measurements, by E. H. Crapper; Vol. ii. of Electric Lighting and Power Distribution, by W. Perren Maycock; A School Geography, by C. Bird.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The degreee of D.C.L., *honoris causa*, will be conferred on Dr. Nansen to-day, March 18, in the Sheldonian Theatre at 3 p.m.

Dr. James Ritchie has been appointed Lecturer in Pathology for two years, from January 1, 1897.

The bust of Sir Henry Acland, Bart., K.C.B., formerly Regius Professor of Medicine, has been placed in the Court of the University Museum.

The Romanes Lecture will be delivered on Wednesday, June 2, 1897, by the Right Hon. John Morley, M.P., D.C.L. The subject will be Machiavelli.

The Junior Scientific Club held its last meeting on Friday, March 12, Mr. A. W. Brown (Ch. Ch.), President, in the chair. Mr. E. H. Hunt (Balliol) gave an account of some experiments made by himself on the "Excretion of Urea and Phosphates." Mr. W. B. Billinghurst (St. John's) read a paper on "Pentacarbon Rings," and Mr. J. N. Ramsden (New Coll.) on "Coal in Kent." The following were elected Members of Committee for next term:—Mr. R. A. Buddicom, Keble (President), Mr. J. E. H. Sawyer, Ch. Ch., Mr. A. Hartridge, Exeter (Secretaries), Mr. A. E. Boycott, Oriel (Treasurer), Mr. A. R. Wilson, Wadham (Editor), and Messrs. W. B. Billinghurst, St. John's, N. B. Odgers, Lincoln, and W. M. G. Glanville, Ch. Ch.

CAMBRIDGE.—THE following is the speech delivered by the Public Orator, Dr. Sandys, Fellow and Tutor of St. John's, in presenting Dr. Nansen for the honorary degree of Doctor in Science, on March 16:—

Scandinaviae filium intrepidum, oceani septentrionalis exploratorem indefessum, post tot pericula terra marique per tres annos fortiter tolerata, salvum et sospitem reducem salutamus. Quid referam viri indomiti iuventutem primam disciplina severa assidue exercitam, et rerum naturae studiis feliciter dedicatam? Quid itinera per priora animi et corporis patientiam et fortitudinem spectatam probatamque? Quid itinere in ultimo, adiutoris optimi auxilio, tot observationes sive magneticas sive meteorologicas e regione prius ignota reportatas? Quid dicam de bene ominati nominis nave illa, quae glaciei solidae in mediis molibus, velut Symplegadum novarum in amplexu, constricta et compressa, ductoris tamen providi vota non fefellit, sed, mobili in glacie immobilis inhaerens, ad ulteriora sensim delata est? Navam illam, navisque rectorem, ipsum Vergilium praedixesse crediderim:—

> "alter erit tum Tiphys et altera quae vehat Argo
> delectos heroas."

Quis autem pro rei dignitate laudare poterit par nobile illud comitum, qui, nave ipsa relicta, glaciei asperrimae per solitudines immensas audacter progressi, in regionem tandem pervenerunt orbis terrarum vertici septentrionali proximam, quo ex ipsa mundi origine nulla hominum vestigia prius umquam penetraverant? Etiam arctoi pelagi tum demum patefacti de navita primo Horati verba licet usurpare:

> "illi robur et aes triplex
> circa pectus erat qui fragilem truci
> commisit pelago ratem."

Talium virorum exemplo admoniti discimus nihil magnum, nihil memorabile, nisi labore longo curaque infinita posse perfici. Talium virorum in orbe terrarum explorando providentia et fortitudine verba poetae Romani futura vaticinantis denuo vera reddita sunt:—

"venient annis saecula seris
quibus oceanus vincula rerum
laxet et ingens pateat tellus,
Tethysque novos detegat orbes
nec sit terris ultima Thule."

The following is the speech delivered by the Public Orator, Dr. Sandys, on March 11, in presenting Prof. Felix Klein, of Göttingen, for the honorary degree of Doctor in Science:—

Universitatem Goettingensem nostis omnes a rege nostro Hanoveriensi, Georgio secundo, fuisse fundatam. Eo maiore gaudio scientiae mathematicae professorem Goettingensem, Newtoni Universitatis nomine, salutamus, virum vinculo non uno nobiscum coniunctum, non modo societatis regiae et societatis philosophicae Cantabrigiensis inter socios exteros numeratum, sed etiam a societate mathematica Londinensi exteros inter omnes numismate honorifico solum donatum. Nuper Newtoni nostri a linearum tertii ordinis enumeratione exorsus, et lineae curvatae et superficies rationibus Algebraicis expressae quam potissimum formam revera habere demonstratae sint, luculenter enarravit; idem Caleii nostri inventa insignia in maius auxit et rebus novis explicandis feliciter adhibuit. Neque Europae tantum terminis inclusus, etiam inter fratres nostros transmarinos, scientae suae provincia tota colloquio familiari breviter percursa, inter alia ostendit scientiae illius regionem puram (ut aiunt) a scientia eadem ad usum cotidianum adhibita non sine periculo posse divelli; ne numerorum quidem *θεωρίαν*, quam gloriatum esse quendam utilitatis macula nondum esse inquinatam, solam per se posse separari. Ergo scientiae mathematicae partes omnes societate quadem inter se coniunctas esse libenter accipimus; neque minus libenter confitemur hodie non modo omnes doctrinae sedes, sed etiam gentes omnes, ubi doctrina in honore est, necessitudinis vinculis artissimis inter sese esse consociatas.

Dr. Arthur Willey has been re-elected Balfour student for one year.

The Vice-Chancellor has appointed Prof. A. W. Rücker, secretary of the Royal Society, to the office of Sir Robert Reade's lecturer.

MR. J. T. CUNNINGHAM has been appointed lecturer on fisheries under the Cornwall County Council Technical Instruction Committee.

IT is reported that, in addition to the offer of 5000*l.* towards the foundation of a chair of public health in the University of Edinburgh, a further offer of 3000*l.* towards the same object had been received from the same donor.

FROM a reply made by the First Lord of the Treasury to a question asked by Sir H. Havelock-Allan, in the House of Commons on Tuesday, it seems that the Government have no great hope of being able to deal with secondary education in the course of the present Session. Secondary education is thus postponed *sine die*.

MR. JAMES R. PARSONS, JUN., Director of Examinations of the Board of Regents of the University of the State of New York, has made his annual report. He notes an extraordinary development in the condition of medical schools within the last four years, notwithstanding that the standards for admission and the courses of instruction have been greatly raised. In 1893 the total value of property was 2,108,855 dols., which has now increased to 4,562,836 dols. The receipts were 262,129 dols., and they have increased to 498,146 dols. In 1895 there were 22,887 medical students in the United States, of which number about 17 per cent. were in the State of New York.

THE excellent courses of study followed at the Central Technical College and the Finsbury Technical College are too well known to need commendation. At the former institution advanced instruction is provided in those kinds of knowledge which bear upon the different branches of productive industry; and at the latter a systematic scheme of technical education, suitable for students who will fill intermediate posts, may be followed in day classes, or special subjects may be taken up in evening classes. The programmes of both Colleges have just been issued by the City and Guilds Institute, and a reference to them will show what valuable work the Colleges are doing for the advancement of science and industry.

WE are glad that Prof. Warington's appeal for a further recognition of agricultural teaching at Oxford, referred to in last week's NATURE (p. 449), has been given support by the Clothworkers' Company. The Company has communicated to Prof. Warington the following resolution:—"That a sum of 200*l.* per annum be guaranteed by the court for five years, for the purpose of enabling the Sibthorpian Professor of Rural Economy at Oxford to supplement his lectures by those of specialists, embracing the most important parts of agriculture and forestry; it being understood and stipulated, however, that no part of the sum so guaranteed is to be drawn in the event of the University not consenting to make agriculture a subject in the Pass School." It is remarked that if this action of the Company promotes the desirable object of inducing the (Oxford) University to bring agriculture and the sciences ancillary thereto into the curriculum of the University and of impressing it with the sanction of a degree as at the Scotch Universities, the Company will be gratified to have contributed to some extent towards a consummation so devoutly to be wished for.

SCIENTIFIC SERIALS.

American Journal of Science, March.—Crater Lake, Oregon, by J. S. Diller. (See p. 470.) The little-known crater lake of Southern Oregon is remarkable not only for its geological history, but also on account of its position and depth, its beautiful blue transparent waters, and the grandeur of its completely encircling cliffs, which afford no outlet. The rim of the lake, which is nearly circular, with an average diameter of six miles, rises 1000 feet above the general level of the Cascade range. During the glacial period the site of the lake was occupied by a huge volcano. The rim is not made up of fragments, but of solid lava, alternating with conglomerate and tuff. The lake basin is therefore probably not due to eruption, but to subsidence.—Outline of a natural classification of the Trilobites, by C. E. Beecher (Part ii.). This important paper gives a classification of the Trilobites on the principles detailed in the first part. The sub-class Trilobita is divided into three orders, viz. Hypoparia, three families; Opisthoparia, seven families; Proparia, four families. Complete diagnoses are appended, the chief characteristics being: Hypoparia, free cheeks, forming a continuous marginal ventral plate of the cephalon, and in some forms also extending over the dorsal side at the genal angles. Opisthoparia: free cheeks, generally separate, always bearing the genal angles. Proparia: free cheeks not bearing the genal angles. These orders are in chronological succession, the Hypoparia being the smallest and oldest, and the Proparia only beginning in the Ordovician.—Excursions of a telephone diaphragm, by C. Barus. Experiments with a Michelson refractometer and a mirror attached to a telephone diaphragm prove that the excursions corresponding to sounds of faint but distinct audibility are small as compared with the wave-length of sodium light. They are probably below 10^{-6} cm. The force necessary to produce this flexure exceeds 10 dynes in a plate 2 cm. in radius and 0·016 cm. thick.—The Arctic Sea ice as a geological agent, by R. S. Tarr. The sea-made ice protects the coasts from sea-erosion until it breaks up and forms a kind of grinding tool and carrier of débris. In some regions of floe ice along the Labrador coast fully 50 per cent. of the floes are discoloured by detritus.—Iodometric estimation of molybdenum, by F. A. Gooch. In reducing molybdic acid by means of hydriodic acid, the development of the green colour is not a sufficient criterion of the exact reduction to the pentoxide and of the removal of the iodine, which should be theoretically set free. It is better to boil down the liquid by a certain amount in an apparatus so arranged that a current of pure CO_2 can be passed through retort and receiver during distillation. This avoids the action of the air upon the hot vaporous hydriodic acid in the retort.

Bollettino della Società Sismologica Italiana, vol. ii. N. 5, 6.—L. Palmieri, a brief notice of his life and work.—On the variation of the velocity of seismic waves with the distance, by G. Agamennone.—Horizontal pendulums for continuous mechanical registration, by G. Grablovitz.—Note on the Tōkiō earthquake of June 20, 1894, by F. Omori.—On the intensity and amplitude of the movement in the great Japanese earthquake of October 28, 1891, by F. Omori.—Notices of earthquakes registered in Italy (June to August 1896), the more important being a valuable series of records of the earthquake of June 15, which gave rise to the great sea-waves in Japan, and several records of the shocks which occurred in Iceland on August 27.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, March 4.—"Experiments on the Absence of Mechanical Connection between Ether and Matter." By Oliver Lodge, D.Sc., F.R.S., Professor of Physics, University College, Liverpool. Received January 19.

The author gives an abbreviated account of a long series of experiments conducted by himself and his assistant, Mr. Davies, in continuation of those related in *Phil. Trans.*, 1893 (Aberration Problems, &c.). The method consists in bifurcating a beam of light, and sending each half in opposite directions round a closed periphery very near a rapidly rotating mass of matter, and then observing by means of interference fringes whether the velocity of light is affected in the slightest degree by this neighbourhood of moving matter. The steel disks have been now whirled to higher speeds, chiefly at 3000 revolutions a minute; the steadiness of the machine and the definition of the bands have been improved, other minor improvements have been made, and a long series of micrometric readings have been taken, both at increasing and at decreasing speeds.

Further, the steel disks have been replaced by a much more massive lump of iron, weighing ¾ ton, with a narrower channel for the light to travel in; and the bands have been observed close up to the moving surface, and even when reflected in it. The rotation was also continued for some hours to see if by chance *time* had any influence.

Moreover, the iron mass was strongly magnetised by a steady current, so that the light travelled across a moving magnetic field; and lastly the steel disks were replaced, with an insulated third disk between them, and strongly electrified, so that the beam of light travelled across a moving electrostatic field. After a number of spurious disturbances had been gradually eliminated, the author finds that in none of these ways is the velocity of light at all appreciably affected, and accordingly concludes that there is no viscous connection between the ether and matter of observable magnitude; *i.e.* that whatever motion moving matter may confer upon the ether must be of an irrotational kind. It was demonstrated theoretically in the previous memoir that no optical experiments could be competent to detect motion of this latter character, and accordingly no attempt has been made to look for any kind of motion except such as would be caused by something akin to viscosity.

Incidentally the author points out that by rotating the whole optical apparatus and observer, instead of the disks, at a very moderate speed, a shift of the bands should be seen; and even that the earth's rotation would with a large enough frame produce an effect, which latter, however, it appears difficult or impossible to observe, not on account of its smallness, but on account of its constancy.

The effect to be expected on Fresnel-Fizeau principles from whirling *air*, was unfortunately just too small for the author to safely observe. The residual disturbing causes just masked it, but it is probably not beyond the reach of another attempt with a still more thoroughly steady machine, if any one feels inclined to persevere so far. At the same time if it be supposed that any microscopic trace of true ether effect still possibly exists (which the author wholly disbelieves), and if a further attempt be hereafter made to observe it, a number of slight residual disturbing causes would be got rid of (and probably other difficulties introduced), by rotating the machine in a vacuum.

Physical Society, March 12.—Mr. Shelford Bidwell, President, in the chair.—Mr. William Barlow read a paper on a mechanical cause of homogeneity of structure and symmetry, geometrically investigated, with special application to crystals and to chemical combination, illustrated by models. The author has previously established that every homogeneous structure displays one or other of the thirty-two kinds of crystalline symmetry. He now shows that homogeneous structures possessing most, if not all, of these kinds of symmetry may be produced mechanically, as the equilibrium arrangements of assemblages of mutually-repellent particles; and also that these mechanical systems of particles exhibit characteristics entirely analogous to certain crystalline and other properties of matter. The fundamental concept may be summarised thus: A number of different kinds of mutually-repellent particles dispersed through space; the amount of this repulsion being some inverse function of the distance between the particles concerned; the particles are destitute of polarity, and the difference in kind consists in a difference in the degree of mutual repulsion which two particles exercise, according to the kinds taken. It is further premised that the assemblage is agitated so as to render unstable all but the final equilibrium arrangement, and a means is provided for linking the particles symmetrically, and unlinking them, under certain circumstances, so as to modify the repulsion between the particles affected. The data thus summarised may be regarded as merely provisional, because the making of the equilibrium arrangement one in which "closest packing" prevails is the object primarily aimed at; and these concepts are mere devices for attaining this end. By the employment of particles of different kinds, a large amount of variety is provided for. The first step taken is to deduce the law of "closest packing," which runs thus: Every assemblage of mutually-repellent particles will continually approximate to, or strive after, that relative arrangement of the particles composing it, in which it has come, at every part, to occupy a minimum of space under a given general pressure, or average repulsion, between the particles. This law acts on all assemblages, of the nature defined, however numerous the kinds of particles composing them; but, for its effects to be traceable, a very limited number of kinds must be present. Passing from assemblages consisting of a single kind of particle, the author takes a very simple case of two kinds of particles confined to a plane, and shows what type of symmetry will be produced when equilibrium is realised. Very simple cases of particles in space are then taken, and it is shown that a large number of different kinds of symmetry are displayed by the equilibrium arrangements produced when there is variety in the relations between the repulsions. To illustrate "close packing," stacks of balls of various sizes are employed; but it is pointed out that the conditions of statical equilibrium of the particles are not always adequately expressed in this way, although every case of the latter kind can be represented approximately by a case of the former kind, possessed of the same order of symmetry. Very slight variation in the relations between the repulsions, alters the form of the equilibrium arrangement; sometimes merely changing the angle without affecting the type; sometimes, when it passes some critical point, bringing about an alteration in type. Changes of the first kind resemble the change in crystal form caused by variation of temperature, whilst those of the latter kind, especially when associated with rearrangement of the particles, are analogous to polymorphism. In many cases, the arrangement of the particles is such that some may be removed without affecting the distribution of the remainder, and without disturbing the "close packing"; if, therefore, other particles, exercising a slightly less repulsion, be substituted for the removed, *inoperative*, particles, the only resulting change consists in a diminution of the pressure on the particles surrounding them. A species of isomorphism is in this way realised. When the particles of an assemblage are partially connected by hypothetic linking in a symmetrical manner, similar groups are formed; but, in order that the formation of such groups may not be arbitrary, the partitioning which is produced must have as complete symmetry as that of the partitioned structure. In consequence of this, some kinds of groups are not directly obtainable by symmetrical partitioning of a homogeneous structure; but it is always conceivable that they may be included in the larger groups of some more complex constellation, and that they may be subsequently separated to form an assemblage by themselves. Consequently, very intricate results may be reached by successive steps; symmetrical intermixture, linking, and unlinking, succeeding one another until complicated groups are built up, for the production of which such an agency as "close packing" appears at first sight inadequate. Having called attention to a large number of arrangements, some capable and some incapable of symmetrical partitioning into groups of a single kind, some linked and some unlinked, the author contends to have established the following two propositions: (1) The nature of the symmetry displayed by a homogeneous assemblage of mutually-repellent particles of different kinds, in equilibrium, depends on the relations subsisting between the repulsions exercised by these particles. (2) The assemblages belonging to all of the thirty-two classes of crystalline symmetry, result from the fundamental law of "close packing," when the relations between the different repulsions take the widest possible range of variety. Links which restrain the action of the repulsions can be present between some of the particles in some cases. The author refers to crystal "twinning," and points out that the action of dimorphism is competent to produce analogous "twinning" of symmetrical assemblages of linked particles. A number of other properties of linked assemblages analogous to those of crystals are also described. In the domain of chemistry the author cites the continually accumulating experimental evidence of the existence of geometrical arrangement in the molecule, both that established stereochemically and that derived from the study of isomerism, as revealing a state of things precisely such as is arrived at by the law of "closest packing" in assemblages afterwards broken up into similar groups of particles. Attention is called to many groupings of the latter order fulfilling very exactly the conditions of disubstitution in the case of many carbon compounds. While he does not regard his work as throwing any light on the nature of change of state, or change of bulk, the author observes that the distribution in precise proportions of the constituents, which must obviously accompany or precede a chemical combination, may fairly be claimed as a resemblance to the regular intermixture brought about according to the law of "closest packing." He further suggests that the reason why some bodies do not readily interact may be due to the "close packing" of one or both. Prof. Herschel said he was particularly pleased with the models. He thought it probable that a very wide application would be found for the author's results. There was, no doubt, much to be learnt from models built up of spheres of two or more sizes, but it would be necessary to learn a great deal more about these symmetrical arrangements before they could be applied with any degree of certainty. Mr. Fletcher said it was impossible to criticise the paper without long and careful study. From certain hypotheses the author had deduced a law of "closest packing" that seemed adequate to explain many results observed by chemists and crystallographers; at the same time admitting that the law might be presumed from other reasoning. By his models he had tried to present a picture not of the forms of atoms or molecules, but merely analytical representations of the probable structure of particles. Hitherto, the research had been confined to determining the possible arrangements of particles all of one kind, but here were examples of packed spheres of various sizes. It was not quite clear how, in an elementary substance, there could be such a structure, although there certainly were cases of polymorphism awaiting explanation, as for instance with sulphur. The paper with its 188 pages of MS. represented a vast amount of clear thinking, and many years of admirable work. Prof. Adams called the attention of Fellows of the Physical Society to the museum at King's College, where were the original models as made and used by the early investigators of this branch of physics. Prof. Miers (communicated, too late for reading). The principle of "close packing" was not new, but Mr. Barlow was the first to extend it to explain solution, diffusion, and stereochemical problems. His remarks on the growth of curved crystals, vicinal faces, and pseudo-symmetrical crystals, were open to criticism. With regard to vicinal faces, however, lencite seemed to be a mineral in accord with his hypothesis. The author regarded a crystal as consisting of mutually repellent particles of different sorts; this seemed a very right way of attacking the problem of crystal structure, and would explain some recent observations of Rinne on crystals consisting of water particles and silicate particles. Further, Mr. Barlow had considered the way in which an assemblage might be broken up by the loosening of the ties, and the change of partners, among individual members. That is to say, he had considered crystallisation and solution; features quite ignored by ordinary theories. His view of crystal structure failed to explain why crystals should have faces, and gave no hint as to the controlling forces which keep mutually-repellent partlcles together. Nevertheless it suggested, among other striking analogies, those bearing on the relationship between crystal structure and chemical constitution; and the irregularities of crystals, such as were commonly neglected in accepted theories. Mr. Barlow had opened up a very promising line of inquiry. Mr. Barlow, in replying, said he greatly appreciated the interest shown in his work.—The President then proposed a vote of thanks to the author, and the meeting was adjourned until March 26. At the invitation of Dr. S. P. Thompson, the Society will on that occasion meet at the Technical College, Leonard-street, Finsbury.

Chemical Society, February 18.—Mr. A. G. Vernon Harcourt, President, in the chair.—The Longstaff medal of the Society was awarded to Prof. Ramsay.—The following papers were read:—The formation of dithionic acid in the oxidation of sulphurous acid by potassium permanganate, by T. S. Dymond nd F. Hughes. In oxidising sulphurous acid by potassium permanganate the authors find that, in addition to sulphuric acid, a constant proportion of dithionic acid is produced; an explanation of this fact is suggested.—On the production of pyridine derivatives from ethylic β-amidocrotonate, by J. N. Collie. Ethylic β-amidocrotonate hydrochloride condenses on heating to give the ether of an oxylutidine $C_{10}H_{13}NO_3$; an isomeric ether is obtained on heating a mixture of the amidocrotonate and its hydrochloride. The corresponding acids decompose on heating, yielding pseudolutidostyril.—Sodamide and some of its substitution derivatives, by A. W. Titherley. Sodamide yields substitution derivatives with amines or amides of the composition NaNHR or NaNH.CO.R respectively.—Rubidamide, by A. W. Titherley. Rubidamide, or $RbNH_2$, is obtained by heating rubidium in ammonia; it is crystalline, melts at 285–287°, and is decomposed by water or alcohol.—On the spectrographic analysis of some commercial samples of metals, of chemical preparations, and of minerals from Stassfurt potash beds, by W. N. Hartley and H. Ramage. The spectroscopic examination of a large number of materials has enabled the authors, in continuation of their previous work, again to demonstrate the wide distribution of many of the rare metals.—Dissociation pressure of alkylammonium hydrosulphides, by J. Walker and J. S. Lumsden.—Supposed condensation of benzil with ethyl alcohol. A correction, by F. R. Japp.—The viscosity of mixtures of miscible liquids, by T. E. Thorpe and J. W. Rodger. The authors contribute the results of measurements made on mixtures of carbon tetrachloride and benzene, methyl iodide and carbon bisulphide, and of ether and chloroform. The densities of the mixtures cannot be calculated by the ordinary admixture rule, whilst the viscosity is rarely a linear function of the composition.—Magnesium nitride as a reagent, by H. L. Snape. The author has investigated the action of magnesium nitride on chloroform, perchlorethane and benzaldehyde, in the hope of obtaining hydrogen cyanide, cyanogen and $(C_6H_5.CH)_3N_2$ respectively; the experiments, however, were unsuccessful.—The identity of Laurent's amarone with tetraphenylazine, by H. L. Snape and A. Brooke. Tetraphenylazine is obtained by the action of magnesium nitride on benzaldehyde; it is identical with Laurent's amarone.—Studies on the interaction of highly purified gases in presence of catalytic agents, by W. French. In absence of light spongy platinum does not induce combination in a mixture of dry hydrogen and oxygen.—Contributions to the knowledge of the β-ketonic acids. Part iii., by S. Ruhemann.—Contributions to the knowledge of the β-ketonic acids. Part iv., by S. Ruhemann and A. S. Hemmy.—Oxidation of phenylstyrenyloxytriazole, by G. Young. Phenylstyrenyloxytriazole is oxidised by permanganate to phenyloxytriazolecarboxylic acid, which immediately decomposes, yielding phenyloxytriazole

$$\begin{array}{l} PhN.N\diagdown \\ \;\;| \qquad\quad >COH \\ HC:N\diagup \end{array}$$

.—Apiin and apigenin (preliminary notice), by A. G. Perkin. Apigenin $C_{15}H_{10}O_5$, the product of hydrolysis of apiin, the glucoside of parsley, contains no methoxy-groups, and yields a tribenzoyl-compound.—Note on the constitution of the so-called "nitrogen iodide," by J. W. Mallet.

Geological Society, February 24.—Dr. Henry Hicks, F.R.S., President, in the chair.—On the nature and origin of the Rauenthal serpentine, by Miss Catherine A. Raisin. This serpentine has been already described by Herr Weigand as one of those which occur in regions of gneiss or schist related in their origin to these rocks. In order to test this hypothesis as to the formation of the serpentine, the author examined the district and studied its rocks with the microscope. Herr Weigand asserted that transitions could be recognised from typical gneiss to a peculiar amphibolite, and that the latter rock had been changed to serpentine. The author could find in the field no evidence of a passage from gneiss to amphibolite, and called attention to the general difficulty of the supposition.—On two boulders of granite from the middle chalk of Betchworth (Surrey), by W. P. D. Stebbing. The author noticed cases of occurrence of boulders in chalk which have been previously described; and recorded the occurrence of two boulders which were obtained from the chalk of the *Terebratulina-gracilis* zone. The largest weighed 7 lb. 7 oz., measured 5″·8 × 6″·25 × 4″·125, and consisted of decomposed granite; valves of *Spondylus latus* and *Serpula* were still attached. The other, also granite, though of a different character, weighed 3 lb. 12 oz., and measured 3″·6 × 5″·8 × 4″·5. Prof. Bonney furnished a description of the microscopic characters of the two boulders, which are possibly of Scandinavian origin. The author discussed the mode of transport to their present position, and favoured the agency of floating ice.—Coal: a new explanation of its formation; or the phenomena of a new fossil plant considered with reference to the origin, composition, and formation of coal-beds, by W. S. Gresley. The author argued that the brilliant black laminæ in coal and similar materials to those that form these laminæ, which are found in earthy coals, shales, and clays, point to the former existence of an aquatic plant, having the general shape of the modern *Platycerium alcicorne*, which grow *in situ*. He believed that much coal was formed by this aquatic "coal-plant," which grew amongst the mechanical sediments and the débris of the terrestrial vegetation that accumulated on the floors of sheets of water.

Zoological Society, March 2.—Dr. W. T. Blanford, F.R.S., in the chair.—The Secretary exhibited two specimens of a new viper, recently discovered by Captain A. H. McMahon during the recent survey of the Indo-Persian frontier, and named *Eristicophis macmahoni* (gen. et sp. nov.) by Dr. Alcock. This snake had been met with only in the sandy portions of the desert between Mushki and Persia, where it was almost impossible to detect its presence, owing to its habit of lying buried in the sand with only its head visible.—Mr. Gambier Bolton gave an account (illustrated by photographs shown by the oxy-hydrogen light) of a recent visit that he had made to the Bird Islands in Saldanha Bay, South Africa. The photographs illustrated the life of the black-footed penguin (*Spheniscus demersus*) on these islands, showing these birds in groups, nest-building, sitting on their eggs, and moulting. Mr. Bolton also gave an account of the guano- and egg-industry carried on by the Cape Government in the Bird Islands and other adjacent islands.—Mr. W. B. Tegetmeier exhibited and made remarks upon a specimen of a starling (*Sturnus vulgaris*) with enormously elongated mandibles.—Mr. H. M. Wallis read a paper entitled "The Growth of Hair upon the Human Ear, and its testimony to the Shape, Size, and Position of the Ancestral Organ."

Entomological Society, March 3.—Mr. R. Trimen, F.R.S., President, in the chair,—Mr. George W. Bird, Mr. Alfred H. Martineau, Mr. Hubert C. Phillips, Mr. William A. Vice, and Mr. Colbran J. Wainwright were elected Fellows of the Society.—Mr. Champion exhibited, on behalf of Messrs. Godman and Salvin, a portion of the Elateridæ, and the Cebrionidæ and Rhipidoceridæ recently worked out by him in the "Biologia Centrali-Americana." The Elateridæ included 531, the Cebrionidæ 29, and the Rhipidoceridæ 14 species, a large proportion of which were described as new. He called attention to the excessive rarity of the males in the Elaterid genera *Chalcolepidius* and *Semiotus* (the contrary being the case in the genus *Scaptolenus* of the Cebrionidæ, and also in many Elateridæ). One species, *Meristhus scobinula*, Cand., was common to Central America and China.—Mr. Jacoby showed a Halticid beetle, taken in Mashonaland by Mr. G. A. K. Marshall, and remarkable for a prolongation of the hind tibia beyond the tarsal articulation into a very long serrated process.—Mr. Elwes showed a series of Papilionidæ of the *Machaon* group, from North America, including *P. machaon* and *P. oregonia* from British Columbia, *P. brucei*, *P. bairdii*, and *P. zolicaon* from Glenwood Springs, Colorado, and the latter species from British Columbia. He stated that there was a tolerably complete gradation from *P. oregonia* (= *machaon*) through *P. brucei* to *P. zolicaon*, that none of the characters which had been relied on for separation were of real value, and that the structure of the genitalia afforded no assistance.—Mr. O. H. Latter read a paper on "The prothoracic gland of *Dicranura vinula*, and other notes," in continuation of his previous communications on the subject. A fresh use of the formic acid secreted by the larva was described; it was employed to alter the silk secreted in spinning the cocoon, in order to convert it into the well-known horny mass. If the acid was prevented from acting, as by supplying the larvæ with bits of blotting-paper soaked in an alkali to be utilised in making the cocoon, the silk thus protected from the action of the acid retained its usual fibrous structure.—Sir George Hampson communicated a paper on "The Classification of two subfamilies of Moths of the Family Pyralidæ—the *Hydrocampinæ* and *Scopariane*."

CAMBRIDGE.

Philosophical Society, February 22.—Mr. F. Darwin, President, in the chair.—On the diffraction pattern near the focus of a telescope, by Mr. R. H. D. Mayall. The diffraction pattern dealt with in this paper is supposed to be formed by the light from a star, upon a screen placed near the focus of a telescope. Series have been given by Lommel for the calculation of the intensity of illumination at any point of the pattern, but these become useless when the screen is more than a millimetre distant from the focus of a telescope of ordinary aperture. The series may, however, be transformed into a shape from which approximate values of the intensity may be found. This is shown in the present paper. It appears from the results that the pattern consists of a bright and comparatively broad ring surrounding a series of fainter and narrower rings, these latter fading away rapidly into a uniformly illuminated space. Further inwards towards the centre the uniform illumination disappears and another series of rings is formed.—On the marks made by stars on photographic plates exposed near the focus of a telescope, by Mr. H. F. Newall. In this paper an account is given of some of the appearances presented by photographs of star images taken near the focus of a telescope, with special reference to the concentration of light near the boundaries of the images when the aperture of the telescope is partly obstructed. The observations recorded are in the main supplementary to those which were published in the *Monthly Notices* of the Royal Astronomical Society in 1894 and suggested the theoretical investigation undertaken by Mr. Mayall.—Theorems on the contacts of spheres, by Mr. W. McF. Orr.—Change of the independent variable in a differential coefficient, by Mr. E. G. Gallop.—On a method of Lie for solving partial differential equations, by Dr. A. C. Dixon.

PARIS.

Academy of Sciences, March 8.—M. A. Chatin in the chair.—Researches on the earths contained in the monazite sands, by MM. Schutzenberger and Boudouard.—The sulphate of cerium obtained from monazite sand gave numbers on analysis indicating an atomic weight sensibly higher than the cerium sulphate obtained from cerite. It was found possible to break up the former into three fractions, one not precipitated from solution by cupric oxide, with an atomic weight of 138, another precipitated from the solution of its sulphate by both cupric oxide and by sodium sulphate (atomic weight about 148), and the third precipitated by cupric oxide, but not by sodium sulphate (atomic weight about 157).—On the apparatus employed to collect samples of air at a great height, in the ascent of the *Aérophile* on February 18, 1897. Analysis of the air collected, by M. L. Cailletet. The vacuous reservoir was fitted with a special tap, worked by a clock, so arranged as to open at one hour and a quarter after commencing the ascent, previous experiments having shown that this corresponded with the maximum height. The results of the analysis showed that the composition of the air at these high altitudes (51,000 feet) is practically the same as on the ground. Observations on the subject of the preceding communication, by M. A. Müntz. The slight diminution in the oxygen found, and the slight increase in the carbonic acid, may possibly be due to a slight oxidation of the grease used to lubricate the tap.—M. G. Bonnier was elected a member in the Section of Botany, in the place of the late M. Trécul.—On the reduction of the general problem of integration, by M. Riquier.—Theorem on entire series, by M. Hadamard.—On the centres of gravity of surfaces parallel to a closed surface, by M. Ernest Duporcq.—On permanent deformation of glass, and displacements of the zero of thermometers, by M. L. Marchis. Experiments are cited showing that alternate heating and cooling of a thermometer is more efficacious in displacing the zero of a thermometer than long heating at a fixed temperature.—Application of the Röntgen rays to measure the electromotive force of contact, by M. Jean Perrin.—The action of phosphorus upon gold, by M. A. Granger. At a temperature of about 400° C. phosphorus vapour combines with gold, forming a phosphide, Au_3P_4. To isolate this it is necessary to cool the tube rapidly, as the temperature limits between which the compound is stable are very narrow.—On the estimation of antimony in the state of peroxide, by M. H. Baubigny. Sb_2O_5 is fairly stable at 357°, begins to lose oxygen at 440°, and leaves a constant residue of Sb_2O_4 at 800°, the purity of which was tested by dissolving in hydrochloric acid in presence of potassium iodide, and weighing the antimony as the trisulphide.—Action of free bases on salts, by M. Albert Colson. From an experimental study of the replacement of diisobutylamine and piperidine by ammonia, it is concluded that the decomposition of ammoniacal salts by fixed bases is a phenomenon of heterogeneous dissociation.—On a new derivative of phenylisindazol, obtained by the action of salicylic aldehyde upon phenylhydrazine, by M. H. Causse.—Action of tannin upon some alkaloids, by M. Oechsner de Coninck. Pyridine and piperidine can be readily distinguished by their reactions with an aqueous solution of tannin.—On the use of cryoscopic methods in the analysis of milk, by MM. Bordas and Génin. This is a reply to a note on the same subject, by M. Winter. The results obtained, although fairly constant, are opposed to the exclusive use of the freezing-point method for milk; its only value is as a method of control.—On the carbohydrates remaining in beer, by M. P. Petit.—On oxidation and the decolourisation of wines, by M. V. Martinand. This oxidation can take place sometimes in the absence of an oxydase, if the wine is acid.—Mineralogical study of the action of volcanic sulphuretted fumerolles upon serpentine, by M. A. Lacroix. The minerals observed include epsomite, marcasite, melanterite, and copiapite, all directly attributable to the action of the sulphuric acid and hydrogen sulphide upon the serpentine.—The geological constitution of the mountains about the sources of the Bléone and the Var, by M. Kilian.—Parallelism between the cretaceous beds of Mondégo and Lisbon, by M. Paul Choffat.—Note on the treatment of articular diseases by electricity, by M. Danion.—Note on the numerical relations between the masses of the planets, by M. Delauney.

DIARY OF SOCIETIES.

THURSDAY, MARCH 18.

ROYAL SOCIETY, at 4.30.—Cultural Evolution of the Cyclamen: W. T. Thiselton-Dyer.—On the Conditions which render Absolute the Readings of the Mercurial Thermometer: S. A. Sworn.—Experiments on the Flame Spectrum of Carbon Monoxide: Prof. Hartley, F.R.S.

ROYAL INSTITUTION, at 3.—Greek History and Extant Monuments: Prof. Percy Gardner.

LINNEAN SOCIETY, at 8.—Further Observations on Stipules: Right Hon. Sir John Lubbock, Bart., M.P., F.R.S.—On the Origin of Transfusion-tissue in the Leaves of Gymnospermous Plants: W. C. Worsdell.

CHEMICAL SOCIETY, at 8.—On the Atomic Weight of Carbon: Dr. Alexander Scott.—On a New Series of Mixed Sulphates of the Vitriol Group: Dr. Alexander Scott.—The Action of Alkylhaloids on Aldoximes and Ketoximes: Wyndham R. Dunstan, F.R.S., and Ernest Goulding.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Fifth "James Forrest" Lecture—Bacteriology: Dr. G. Sims Woodhead.

SANITARY INSTITUTE, at 8.—Infectious Diseases and Methods of Disinfection: Dr. H. R. Kenwood.

CAMERA CLUB, at 8.15.—Geographical Pictures: Dr. H. R. Mill.

FRIDAY, MARCH 19.

ROYAL INSTITUTION, at 9.—Greek and Latin Palæography: Sir Edward Maunde Thompson.

EPIDEMIOLOGICAL SOCIETY, at 8.—The Prevention of Tuberculosis: Dr. James Niven.

SATURDAY, MARCH 20.

ROYAL INSTITUTION, at 3.—Electricity and Electrical Vibrations: Lord Rayleigh, F.R.S.

MONDAY, MARCH 22.

IMPERIAL INSTITUTE, at 8.30.—The Timber Supply of the British Empire: Dr. W. Schlich.

SOCIETY OF ARTS, at 4.30.—Alloys: Prof. W. Chandler Roberts-Austen, C.B., F.R.S.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The North Polar Problem: The President.

SANITARY INSTITUTE, at 8.—Water Supply, Drinking Water, Pollution of Water: Prof. W. H. Corfield.

CAMERA CLUB, at 8.15.—A Run through Portugal and Madeira, to the Great River Amazon: W. Wethered.

TUESDAY, MARCH 23.

ROYAL INSTITUTION, at 3.—Animal Electricity: Prof. A. D. Waller, F.R.S.

ROYAL HORTICULTURAL SOCIETY, at 1.—Fruit-bud Transference.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Paper to be discussed: The Mond Gas-Producer Plant and its Application: H. A. Humphrey.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Polar Exploration: A. Montefiore Brice.

ROYAL VICTORIA HALL, at 8.30.—Marine Food Fishes: Gilbert C. Bourne.

WEDNESDAY, MARCH 24.

SOCIETY OF ARTS, at 8.—The Transmission of Power by Alternating Electric Currents: W. B. Esson.

GEOLOGICAL SOCIETY, at 8.

INSTITUTION OF CIVIL ENGINEERS, at 4.—Dr. G. Sims Woodhead will repeat the Fifth "James Forrest" Lecture on Bacteriology.

THURSDAY, MARCH 25.

ROYAL SOCIETY, at 4.30.—Meeting for Discussion. *Subject*: The Chemical Constitution of the Stars, introduced by J. Norman Lockyer, C.B., F.R.S., with a Communication "On the Chemistry of the Hottest Stars."

ROYAL INSTITUTION, at 3.—The Relation of Geology to History: Prof. W. Boyd Dawkins, F.R.S.

SOCIETY OF ARTS (Imperial Institute), at 8.—The Cultivation and Manufacture of Rhea Fibre: Thomas Barraclough.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—On some Repairs to the South American Company's Cable off Cape Verde, 1893 and 1895: H. Benest. (Continuation of Discussion.)

CHEMICAL SOCIETY, at 8.—The Pasteur Memorial Lecture: Prof. P. F. Frankland, F.R.S.

CAMERA CLUB, at 8.15.—From Mont Blanc to the Matterhorn: Lamond Howie.

FRIDAY, MARCH 26.

ROYAL INSTITUTION, at 9.—Early Man in Scotland: Sir William Turner, F.R.S.

PHYSICAL SOCIETY, at 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Re-signalling of the Liverpool Street Terminus of the Great Eastern Railway: W. J. Griffiths.

SATURDAY, MARCH 27.

ROYAL INSTITUTION, at 3.—Electricity and Electrical Vibrations: Lord Rayleigh, F.R.S.

ROYAL BOTANIC SOCIETY, at 4.

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Bis an's Ende der Welt!: Dr. F. J. Studnička, Zweite Ergänzte Auflage (Prag).—A Handbook for Travellers in Lower and Upper Egypt, 9th edition (Murray).—Results of Rain, River, and Evaporation Observations made in New South Wales during 1895: H. C. Russell (Sydney).—Through Unknown African Countries: Dr. A. Donaldson Smith (Arnold).—A Handbook to the Order Lepidoptera: W. F. Kirby. Vol. iv. Moths, Part 2 (Allen).—Annuaire de L'Observatoire Royal de Belgique, 1897 (Bruxelles).—Theory of Physics: Dr. J. S. Ames (New York, Harper).

PAMPHLETS.—Quantitative Estimation of Urine: J. B. Smith (Baillière).—Essai sur la Représentation Analytique de la Direction: C. Wessel (Copenhague).—Instinct und Intelligenz im Thierreich: C. Wasmann (Freiburg, Herder).

SERIALS.—Journal of the Anthropological Institute, February (K. Paul) Journal of the Institution of Electrical Engineers, March (Spon).—Proceedings of the Physical Society of London, Vol. xv. Part 3 (Taylor).—Psychological Review, March (Macmillan).—Zeitschrift für Physikalische Chemie, xxii. Band, 2 Heft (Leipzig, Engelmann).—History of Mankind: F. Ratzel, translated, Part 17 (Macmillan).—Botanische Jahrbücher, Zweiundzwanzigster Band, 4 and 5 Heft (Leipzig, Engelmann).—Die Natürlichen Pflanzenfamilien, 146, 147, 148 Liefg. (Leipzig, Engelmann).—Bulletin de L'Académie Impériale des Sciences de St. Pétersbourg, September (St Pétersbourg).—Journal of the Franklin Institute, March (Philadelphia).—Engineering Magazine, March (Tucker).

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