THURSDAY, NOVEMBER 12, 1891.

THE HYGIENE OF WATER-SUPPLY.

An Elementary Hand-book on Potable Water. By Floyd Davis, M.Sc., Ph.D. (Boston, U.S.: Silver, Burdett, and Co., 1891.)

THE aphorism that "history repeats itself" is being very strikingly illustrated in the matter of hygiene at the present day. Questions respecting water-supply and the public health generally, which in this country were absorbing much of scientific attention some fifteen or twenty years ago, have only within the last decade begun to be seriously dealt with even in the most civilized of Continental countries and in the United States. Indeed, although we are indebted for much of the recent progress which has been made in what may be called the theory of hygiene to our Continental neighbours, yet in matters of actual practice we still hold, undisputedly, the first place among nations. The practice of hygienic principles cannot be introduced by Act of Parliament or Imperial ukase; it is the growth of years, or rather generations, and is quite independent of the establishment of hygienic institutes and bacteriological laboratories. In a few hours of Continental travel, it is possible to visit University towns provided with hygienic laboratories, munificently equipped, in which food-stuffs are daily submitted to elaborate analysis, whilst water and milk are searchingly interrogated as to the micro-organisms which they contain; and yet side by side with these refinements we find sanitary conditions, even in the houses of the well-to-do, which would hardly be found in the alleys and purlieus of one of our manufacturing centres. It is far from my wish or purpose to deprecate the establishment of institutions for the prosecution of hygienic inquiries on a scientific basis; on the contrary, such places are calculated to enormously accelerate the achievement of sanitary improvements, and to economize time, money, and human life, which are ruthlessly wasted when these improvements are attained as the result of empiricism and the operation of natural forces. Our position of supremacy in practical sanitation is mainly due to the long period of domestic repose and prosperity which we have enjoyed, and which has led us to turn our attention to the prevention of the unnecessary sacrifice of human beings even in civil life; but who can doubt that this position would have been much more rapidly gained if these endeavours had been always guided by scientific knowledge and systematic experimental inquiry? Even as it is, the path to our present position has been much shortened, and has been rendered less costly both as regards life and money, by the time and attention which have been bestowed upon sanitary matters by men of high scientific attainments. It is earnestly to be hoped that the recent Hygienic Congress held in our midst will have convinced those who control the purse of this country that a national effort must be made to maintain our position in the scientific as well as the practical progress of the century. We have not to deplore any shortcoming in the quality of the scientific work which emanates from us; in originality and as pioneers in all departments of science we are second to none; but quantitatively we are lamentably deficient, and in consequence, it is only too frequently the case that we have to leave to others the cultivation of those fields which we have ourselves had a large share in discovering. This is most conspicuously the case in the matter of hygiene; and after the highly discreditable obstruction, with which the foundation of our National Institute of Preventive Medicine was recently harassed, has now happily been swept away, we trust that public if not Government support will be forthcoming in the immediate future, to render that Institution, with its tremendous potentiality for benefiting mankind, second in usefulness and dignity to none in the civilized world. The State organization of science in the New World has made great strides during recent years, and scientific men in this country cannot fail to be impressed with the immense volume of work—more especially in applied science—which annually flows from the laboratories of the United States. The appearance of the book before us is, presumably, evidence of this great activity, showing as it does that there is a considerable body of men anxious to have presented to them in a concise and handy form all the main facts which have been accumulated—and which are dispersed in innumerable reports, blue-books, journals, and other forms of literature—concerning potable water. The difficulty of access to the original sources of this information renders such a work of great importance at the present time, but one which it is extremely difficult to do justice to. The present volume, we regret, does not come up to what we could wish for in a work of the kind. The questions which have to be discussed are in many cases necessarily more or less matters of opinion, in which conflicting evidence ought to be balanced and submitted to careful and critical analysis; unfortunately, however, for the exercise of this judicial power the author exhibits but little aptitude or inclination. The pages are sometimes filled with authoritative statements made by their respective authors on insufficient data, which statements have been copied, often not even from the original sources, without a word of elucidation or criticism. Such material, placed in the hands of the unwary reader, may lead to very serious consequences. Of this character is the statement that "the power of certain samples of water to dissolve lead is directly proportional to the number of micro-organisms that the samples respectively contain," which might well have been omitted from this work; and its introduction as almost the only piece of information concerning the action of water on lead is singularly inappropriate. Again, on another page, we are categorically informed that "even milk is sometimes the agent of this disease (typhoid fever), in which case the typhoid poison remains undestroyed in passing from the polluted water from which the cows drink, to the milk-secreting glands"; whilst no mention is made of the real mode of transmission by the watering of milk and the rinsing of cans with contaminated water. In most cases the principles laid down are sound and reasonable; but the author has permitted himself to be carried somewhat too far in his advocacy of pure water, when he says that "scientific investigation also reveals the fact that, as a community is supplied with pure water, there is not only a decrease in the disease and death-rate, but often a most surprisingly rapid increase in thrift, morality, and degree of civilization." We should be glad indeed if he were correct in his statement that since the introduction of an efficient health administration in England, the prevalence of typhoid has been reduced to such an extent that "for weeks and even months not a single case now occurs in the city of London." We can readily understand that our rivers must appear insignificant enough to the inhabitants of a country containing such mighty streams as the St. Lawrence, the Mississippi, and the Ohio; and although we are fully alive to some of them being disgracefully fouled, we certainly are somewhat startled to have our watercourses, which are dear to many of us, disposed of in the following sentences:—"The pollution of English streams is carried to such an enormous extent that the waters of many, where city sewage enters them, are actually offensive, and during the summer months, owing to the stench, the passenger traffic is forced to the railroads. In some of these streams the whole surface of the water, for some distance below sewage entrance, is in a state of commotion, owing to the evolution of gas bubbles, and the water is so foul that it cannot be used in the boilers of the little steamers that ply across the rivers. Immediately below the entrance of sewage no life can exist in the water, on account of the presence of ferrous sulphate (*sic*), which is a disinfectant." In dealing with the much vexed subject of the apparent self-purification of streams, the author shows a very just appreciation of the matter when he points out that there "is no guarantee that running water is perfectly wholesome at any distance below a point where it is certainly polluted with the contents of sewers and privy-vaults, or the decomposition of vegetable and animal matter. The question as to what extent must impure water be diluted or oxidized to render it safe for domestic purposes, cannot be answered. Mere dilution of polluted water does not render inoperative the action of living bacteria. . . ." We are glad to see that the author points out the importance of boiling all drinking-water which is open to suspicion, for it cannot be too frequently reiterated that perhaps the two most effective measures which the private individual can take in avoiding zymotic disease consist in boiling the water and milk that are used for drinking. The largely increasing consumption of ice, which in America has assumed enormous proportions, is a matter which also calls for very careful attention, since recent experiments have shown that, although the living bacteria in ice are considerably less numerous than in the water from which the ice has been derived, still the process of freezing, even if long continued, affords no sort of guarantee that the dangerous forms originally present in the water shall have been destroyed. Thus the bacillus of typhoid fever has been found still alive in ice which had remained continuously frozen for a period of 103 days.

PERCY F. FRANKLAND.

CAUSATION OF SLEEP.

The Intracranial Circulation and its Relation to the Physiology of the Brain. By James Cappie, M.D. (Edinburgh: James Thin, 1890.)

THE factors concerned in the production of sleep have from time to time engaged the attention of physiologists, and various theories have been advanced to explain the phenomena. The author of the work now before us, so far back as 1854, published a short essay on "The Immediate Cause of Sleep," which he subsequently expanded into a volume entitled "The Causation of Sleep" (Edinburgh, 1882). In the work now under consideration, although with a different title, the author travels over much the same ground as that surveyed in his previous writings on this subject, and adds to it some additional chapters.

In his successive publications Dr. Cappie accepts the position usually taken up by physiologists, that the state of sleep is accompanied by a diminished brain circulation; but he combats the view that sleep is due to a diminution of the whole mass of blood within the cranial cavity, and that the compensation for this diminution is got by an increase in the amount of cerebro-spinal fluid in the ventricular and sub-arachnoid spaces of the brain. His objection to this opinion is based upon its not being reconcilable with either the physics or the physiology of the parts situated within the cranium. As regards the physics, he adopts the view advocated by Drs. Alexander Monro (*secundus*), Abercrombie, and Kellie, that, inasmuch as the brain lies within a closed cavity, which possesses rigid bony walls, the contents cannot be affected directly by the pressure of the atmosphere, which can only influence the interior of the cranium through the blood-vessels, so that a force is constantly in operation to maintain the amount of blood within the intracranial vessels. The author believes that the effect of the pressure on the blood-vessels, say of the neck and head, is opposed to the movement of the blood in the veins, and that the tendency of the pressure is to keep the blood within the veins which ramify in the vascular membrane enveloping the brain, called the pia mater. At the same time, however, the arterial stream drives the blood onwards into the capillaries and the veins, which tends to dilate the latter vessels, and, in conjunction with the backward pressure on the great veins, to retard the flow of blood through the veins of the pia mater, and consequently through the great venous sinuses of the head, into the jugular veins. In this way he infers that, whilst the brain itself becomes less vascular, the mass of blood within the cranial cavity continues the same, but its mode of distribution is altered: a less proportion is within the arteries and capillaries, whilst an increase takes place in the contents of the veins of the pia mater.

The author acknowledges, in connection with the nutrition of the brain, that molecular actions of a subtile kind take place between the blood and blood-vessels and the nervous tissues, and that these are much less active during sleep than when awake. The lessened activity in the nutrition of the nerve protoplasm diminishes the activity of the capillary circulation. He regards, however, the change in the balance of the circulation between the arteries and capillaries on the one hand, and the veins on the other, as the key-stone of the theory of the causation of sleep. The altered balance of the circulation occasions a change in the balance of active pressure, which is not so much within the brain substance as on the surface. It is less expansive and more compressing, and with this compression consciousness is suspended.

In proof of his theory, the author adduces observations made by Dr. Hughlings Jackson and himself on the retina—the blood-vessels of which are so intimately connected with those of the brain—both during sleep and in a state of coma, from which it would appear that in these conditions the retina was paler, its arteries smaller, but its veins were larger, more tortuous, and distended. In another case recorded by Dr. Kennedy, where a portion of the skull and dura mater had been removed, and the pia mater consequently exposed, it was noticed that the veins in the latter were during sleep congested and assumed a dark hue.

In a concluding chapter, entitled "Some Points in Mental Physiology," which was not contained in his previous work "On the Immediate Cause of Sleep," the author considers how far the peculiarities of the encephalic circulation may affect the functional activity of the different parts of the brain. Starting from the position that the brain is a composite organ, and that distinct portions are put into a state of functional activity in connection with the discharge of their respective duties, the question of balance of the circulation has again to be considered. For the part which is more immediately concerned in the production of the particular cerebral operation must become the seat of vascular excitement, and the amount of blood flowing through its vessels will be greater than that transmitted through the vessels of those other parts of the brain which are for the time being not so functionally active. Hence a certain tension of the area or centre which is actively working must arise, and the encephalic circulation is focussed in the direction of activity. The parts which surround the operating centre would act as a background of resistance, and would afford such support as will secure the immediate liberating action in the discharging centre.

The author applies his views on the encephalic circulation to the explanation of the phenomena of Hypnotism. The first incident in the hypnotic state is a steady prolonged effort of volition in which the attention is concentrated in a very restricted direction. The immediate consequence is fatigue of the nerve-centres concerned in keeping up the strain. Their molecular motions become enfeebled, the circulation through them is less active, and a condition approaching that of sleep is produced. If then, in the form of a "suggestion" from another, some stimulus calls into activity a part of the brain not fatigued in the effort of attention, the vascular activity in it will be increased, and its function will be intensified. An assertion boldly made to a hypnotized person may influence belief in opposition to former experience, and if it be towards an ideational centre, some particular notion may so monopolize the consciousness that discrimination and judgment may become almost as completely in abeyance as in ordinary dreaming.

OUR BOOK SHELF.

Physiography: Elementary Stage. By J. Spencer B.Sc., F.C.S. (London: Percival and Co., 1891.)

AS an introductory science, physiography is one requiring very careful treatment. Its range is undoubtedly wide, but it is correspondingly shallow, and should rather lead up to scientific thought than aim at giving an incoherent collection of facts. In the book before us, the author, who is head master of one of our most successful technical colleges, begins well by recommending that teachers should endeavour to make the subject a practical one, by the performance of experiments, excursions into the neighbouring country, and the collection of specimens of rocks, minerals, and fossils. The experimental shape which the book has consequently taken is one of its most noticeable features; but it certainly falls short of the expectations raised. The chemical and physical parts appear to be excellent, but there is little to assist either teacher or student in gleaning information from the inspection of natural phenomena. A peat bog, for instance, is a fruitful subject for study under proper guidance; but this is not afforded by the scanty remarks on p. 89. In dealing with a wide subject, brevity is essential, but this does not necessitate the omission of the fundamental points, and looseness of expression. The book, however, shows many signs of a want of care in this respect. In the note on Foucault's pendulum (p. 210), for example, the whole point of the explanation is lost by the absence of a reference to the permanence of the plane of swing. On p. 113, it is stated that "submarine volcanoes produce new land, the erupted matter being piled up sufficiently high to form islands"; the omission of the qualifying word "sometimes" might obviously lead to a misconception. Test questions, original and selected, are given at the end of each chapter.

The book is well illustrated, and, with careful revision, should make a useful addition to existing text-books.

Mayhew's Illustrated Horse Doctor. Revised and Improved by James Irvine Lupton, F.R.C.V.S. (London: Griffith, Farran, and Co.)

THE continued existence of domestic medicine, whether the subjects of its application be human beings or domesticated animals, cannot well be doubted. We may, however, be permitted to doubt whether true economy lies in this direction. Nevertheless, as residents in the colonies, and even in many rural districts of our own country, are often far removed from the qualified veterinarian, and considerable time must necessarily elapse before his services when sought can be forthcoming, it is obviously advisable that whatever measures are taken by the stock-owner to ameliorate the sufferings of the animal during this interval of time should be rational, and follow lines similar to those which the professional man would adopt. Wrong methods of procedure would serve only to handicap and hamper his efforts. The book before us can be recommended to guide the horse-owner in such emergencies; though we note with pleasure that the reviser, on p. 553, points out that "the reader will always best consult his interest and pocket by at once consulting a qualified veterinarian." Agreeing with this proposition, we cannot but consider superfluous the introduction of minute directions for the performance of such delicate and difficult operations as the extirpation of the eye-ball, the division of the plantar nerves (neurotomy) in some forms of foot-lameness, and section of contracted tendons (tenotomy). We can scarcely conceive an owner, however intelligent and courageous he may be, proceeding to cast, chloroform, and perform any of the above-mentioned operations.

Horse-owners will do well to note the stress which is laid upon the construction, ventilation, and drainage of stables, and the varied information given on the prevention of disease. The reviser has scant sympathy with the use of the actual cautery; but here he is on debatable ground, and, notwithstanding his strictures, we fancy veterinarians will not lightly lay aside an agent which, rightly or wrongly, most of them believe to be potent for good.

The illustrations form the least satisfactory portion of the work. Many of them are grotesque and ludicrous to the last degree, and ought to have been eliminated from the present revised edition. Some, such as those indicative of the symptoms of colic, are good, and well convey their intended meaning. W. F. G.

Handleiding tot de Kennis der Flora van Nederlandsch Indië. Door Dr. J. G. Boerlage. Tweede Deel, "Dicotyledones Gamopetalæ." Eerste Stuk, "Inferæ—Heteromeræ; Caprifoliaceæ—Styracaceæ." (Leyden: E. J. Brill, 1891.)

PREVIOUS parts of this work have been noticed in these columns. It is more than thirty years since the last part of Miquel's "Flora Indiæ Batavæ" appeared, a work written chiefly in Latin; but the present publication cannot be regarded as replacing it, or as being a successor to it. So far as we have tested this "Manual," it is a Dutch translation of the descriptions of the natural orders and genera in Bentham and Hooker's "Genera Plantarum," followed by a list of the species inhabiting the Dutch Indies. Locally it may be serviceable; but what is wanted by botanists generally is a new descriptive elaboration of the species of the region in question. W. B. H.

By Sea-shore, Wood, and Moorland: Peeps at Nature. By Edward Step. (London: S. W. Partridge and Co., 1891.)

THE author of this book, under his pseudonym "James Weston," published in 1886 "Stories and Pictures of Birds, Beasts, and Fishes"; and, two years later, a companion volume, "Stories and Pictures of Animal Life." Both of these volumes, which were very popular, are now out of print. In the present work they have been amalgamated, and the author has added to them some brief "nature-papers" which he has contributed to various periodicals. The book is intended chiefly for young people, and it is so pleasantly written that children who have a chance of reading it can hardly fail to find it attractive. They will obtain from it much interesting information about all sorts of animals, and it will help them to realize that even the most familiar objects, when properly observed, may be worthy of close study. The book is very carefully illustrated.

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.*]

Note on the Chromosphere Spectrum.

WITH the new spectroscope of the Halsted Observatory, which has a 5-inch Rowland grating of 20,000 lines to the inch, I have repeatedly observed of late that the bright chromosphere line, Angström 6676·9 (No. 2 in my catalogue of chromosphere lines), is not coincident with the corresponding dark line of the solar spectrum, but is *less refrangible* by about one-third of a unit of Rowland's scale. This chromosphere line, therefore, can no longer be ascribed to iron, but must be due to some other substance as yet undetermined.

I think there can be no doubt as to the non-coincidence. The interval between the bright and dark lines varies to some extent with circumstances, being usually less in the chromosphere spectrum on the sun's eastern limb than on the western, and it is often affected by motions in the line of sight; but nine times out of ten the want of coincidence is perfectly obvious.

I may add that I have also obtained a considerable number of photographs of the ultra-violet spectrum of the chromosphere with the new instrument, and get complete confirmation of almost all Mr. Hale's results. I find not only the constant reversal of the H and K lines, but I have obtained, so far, five of the ultra-violet series of hydrogen lines; the first of them being the well-known "companion" of H (first visually observed by myself in 1880), and the other four in their regular succession above it.

The only point in which my plates fail to confirm Mr. Hale's is that I have not yet succeeded in catching the duplicity of the hydrogen α (3889). Several of his plates show at this point two lines near together; none of mine do so, and I conclude that the companion line makes its appearance only rarely. I first observed this line visually in 1883 (*American Journal of Science*, November 1883), and it has since been often seen here by my as istant, Mr. Reed, as well as by myself.

Of course the opinion is no longer tenable that H and K can be due to hydrogen, since the measures clearly show that the companion to H belongs to the hydrogen series. But I am still sceptical whether they are due to calcium, at least in its terrestrial condition. C. A. YOUNG.

Princeton, N.J., U.S., October 20.

Formation of a Temporary Cyst in the Fresh-water Annelid *Æolosoma*.

AS I am not aware that the formation of a temporary chitinous cyst has been described in any Oligochætous Annelid, the following observations may be of some little interest. A few days ago Mr. Latter, science master at the Charterhouse, kindly forwarded to me three tubes containing a quantity of *Æolosoma quaternarium*. They were so abundant that every drop of water contained several specimens; in the water I found also a still larger number of spherical bodies, which proved to be cysts, each completely filled by a single worm coiled once upon itself. The cysts were perfectly colourless and transparent, and very thin-walled; one cyst was found empty, and had been ruptured by the worm in escaping from it. Twenty-six years ago Maggi (*Mem. Soc. Ital. Sci. Nat.*, 1865) described and figured some bodies, oval in form, which he believed to be the cocoons of *Æolosoma*; embryos were found in these cocoons in different stages of development. Prof. Vejdovsky (*Entwickelungsgesch. Unters.*, Heft 1, Prag, 1888) suggested the possibility that these bodies were really cysts; my own examination of what are, I think, undoubtedly cysts in *Æolosoma* leads me to agree with Vejdovsky's suggested interpretation of Maggi's figures. If the structures which I describe here are really cocoons, their form differs from that of the cocoons of all other Oligochæta, in being spherical and without a narrow process at either pole; moreover, it is—on the hypothesis that they are cocoons—a remarkable coincidence that they should *all* contain completely adult worms; finally, and this is of course conclusive, the intestinal tract of the worms contained vegetable detritus. The cysts, as I believe them to be, are of about the size of a *Volvox globator*. In this encysted condition the worms might perhaps be easily transported from place to place; I have found that they survived the evaporation of the surrounding water upon a glass slide for a considerable period; the worms were in continual movement within their cysts, so that it was quite easy to be sure that they were alive. Now this very species has a wide distribution, which may perhaps be partially accounted for by this habit of encystment; with regard to other fresh-water Annelids which have a wide range, such as *Tubifex*, it is possible that birds may inadvertently transport the cocoons from country to country. It is not known yet whether *Æolosoma* forms a cocoon, though it is probable, as the worm develops a clitellum. But sexual maturity appears to be a comparatively rare occurrence in *Æolosoma*; very few observers appear to have seen the sexually mature worms. If this is so, the encystment of the worm may take the place of one of the secondary uses of the cocoon—namely, to aid in the diffusion of the species. FRANK E. BEDDARD.

Polytechnics and Recreation.

IN Mr. Oliver Dawson's article on Polytechnics in your issue of the 8th inst. (vol. xliv., p. 547) he says: "although those institutes which make much of athleticism and such matters attract the largest proportion of students, the attendance *pro ratâ* in the class-rooms would not favourably compare with an institute carrying out a purely educational programme." A Polytechnic is mentioned in which, though only seven students entered the class, "scores of young men could be found in the billiard-room and gymnasium"; and the opinion is expressed that even the excellent work of the Regent Street Polytechnic "would be still better if it could be relieved of the recreative element."

May I say a word for recreation, as the representative of a College which will eventually form part of the South London Polytechnic, and which has not been "started by a teacher," but has grown up out of a purely recreative institution, for the Victoria Hall (the parent of the Morley Memorial College) is nothing more, unless we use the word in a very narrow sense.

It is a commonplace truth that the aim of education should be to develop the whole man, not to make mere intellectual experts any more than mere manual experts. Surely recreation has not only a legitimate but a very important place in this, especially where sedentary workers are concerned. Those whose tastes are naturally studious may with comparative safety be left to take care of themselves. In these days, instruction of some sort may be had by most of those who set their minds on it, and if they miss much which books or the living teacher would have enabled them to gain, at least their energy is not likely to be turned into hurtful channels. Those who desire recreation can also get it, and with little exertion; but of what kind? If the gymnasium spoken of above had not been open, what would its scores of frequenters have been doing? Some, no doubt, might have been in class, improving their minds more than they are likely to do in a gymnasium; but others, whose youthful spirits need an outlet, would not have been much attracted by study not associated with recreation. The music-hall, or some of the many forms of betting now prevalent, would have been more likely to entice them. In the confined life of our towns it is no small good to provide athletic sports (apart from temptation to drink) as a safety-valve for boyish spirits, even if the good stops short there. But it need not stop short. Of course, there is danger lest the recreative side of an institute or Polytechnic should swamp the educational, unless care is taken to prevent it. A very simple rule, however, is sufficient for this. Our members are not allowed to use the gymnasium or recreation rooms unless they are *bonâ fide* students of at least one class. It is not sufficient that they should *take a ticket* for a class. The registers are occasionally looked over, and if frequent absence from class is combined with frequent attendance in the gymnasium or recreation rooms, a warning, suspension, or even expulsion, is the consequence. We have found that only in an insignificant number of cases is it necessary to proceed to the last resort. Our students as a rule receive an excellent character for steady work from such of our teachers as are in a position to compare them with other students. "I am tired of teaching lads who are trying not to learn," said one who held an important position in a large educational establishment; "your fellows mean business; it's a pleasure to teach *them*." And the testimony of others is to the same effect.

If the moving spirits of a Polytechnic love work themselves, and if they are careful to enlist the sympathy of students, so as to lead them by example rather than drive them by rigid rule, then there is little danger of the institution degenerating into a mere place of amusement. EMMA CONS.

Samuel Morley Memorial College, Waterloo Road, S.E., October 16.

"W = M*g*."

I SHOULD like to take exception to Prof. Greenhill's statement in your issue of September 24 (vol. xliv. p. 493) that "when goods are sold in commerce by weight, they are weighed in scales, and the weight is the same wherever the weighing is carried out, whether at the equator, or the poles, or in the Moon, Sun, or Jupiter." In this country it is the commonest thing in the world to see goods sold in commerce weighed in a spring-balance, which is also the universal kitchen weighing apparatus, and I respectfully submit that the weight indicated would *not* be quite the same in the Moon, Sun, or Jupiter.

The appeal to the scales seems to me to be an attempt to throw dust in our eyes, as what Prof. Greenhill really means is that two *equal* weights are *equal* (not each the *same*) wherever the weighing is carried on—a balance telling us nothing about the weight, or pull downwards, of either one.

I was fortunate in getting some of my first notions of dynamical measurements from Thomson and Tait, and hence the appearance of the "blooming g" did not seem unnatural, for after I had learned how to measure a force properly in dynamical units, I was told that a pound's weight $= g$ poundals, or a gram's weight $= g$ dynes, which suffices for reduction to non-absolute units. This, in my opinion, is virtually the same as Prof. Slate's suggestion. I never could see why g should appear in dynamical formulas: measure in absolute units, and at the end reduce to pounds' weight from poundals as above. Of course this involves knowing what an absolute dynamical unit is, and it strikes me that a few more "horizontal" experiments with spring-balances, graduated in poundals or dynes, and a little less thinking about arm balances, would go far to clear up difficulties in the minds of students. ARTHUR G. WEBSTER.

Clark University, Worcester, Mass., October 14.

[It will be interesting to see if Mr. Webster can devise a horizontal spring dynamometer which will record within 10 per cent. of the true value; also to know what corrections he would apply for the inertia, temperature, and fatigue of the spring, and how he would occasionally test the indications. These difficulties have to be met in Diagrams given by Steam-Engine Indicators. How does the Inspector of Weights and Measures test Spring-Balances in America?—A. G. G.]

Alum Solution.

PERHAPS the following evidence of the *practical* superiority of potash alum solution to distilled water in adiathermancy, *when the electric arc is the radiant* and the "radiometer" a Crookes, may be of interest. The same glass-sided cell was used throughout, and the difference of voltage between the carbons ("Apostle") was kept sensibly constant (40 volts) through the experiments. Between each observation on the liquids the radiation from the arc was observed unimpeded, save by the glass of the radiometer, as recorded below. The time was given by a metronome (previously examined for constancy) beating half-seconds. No lens was used.

	No. of revolutions of radiometer arms.	Time in half-seconds.
1. Unimpeded radiation ...	25	160
2. Through empty cell ...	25	254
3. Unimpeded radiation ...	25	152
4. Cell + water	25	820
5. Unimpeded radiation ...	25	164
6. Cell + water (second experiment)	25	832
7. Unimpeded radiation ...	25	160
8. Cell + alum solution ...	25 (time of two revolutions actually taken.)	43,200
9. Unimpeded radiation ...	25	160

The current throughout was 6·4 amperes, thickness of each glass plate 1·5 mm., thickness of solution 50 mm., distance of radiometer from arc 1 metre. T. C. PORTER.

Eton College, October 29.

The Salt Lake of Aalia Paakai.

I HAVE recently made an analysis of the water of the salt lake of Aalia Paakai, near Honolulu, and have thought that the results might be of interest to the readers of NATURE. The lake occupies the crater of an immense tufa cone, whose ejecta cover several square miles, and are especially remarkable for containing numerous aggregations of crystalline grains of pure olivine. The lake is just at mean sea-level, and is scarcely a mile distant from the ocean, but there is evidently no free communication with the waters of the sea.

During the dry months crusts of salt are deposited, sometimes six inches or more in thickness, on the bottom of the lake, and the salt has at times been taken out for use. In the rainy season the salt is wholly redissolved. The crust of salt is at the present time from one to three inches thick, and the water is, of course, a saturated brine. It is interesting to note, however, that it does not correspond in composition with the water from the ocean. Like the Dead Sea, the lake contains an excessive quantity of calcium salt.

The interior of the crater basin is crusted in many places with deposits of carbonate of calcium, proving that it was at one time occupied by a highly calcareous water, probably of high temperature. I have given in connection with the results of my analysis, which extends only to the constituents present in large amount, an analysis of concentrated sea-water from the salt works of Kakaako, and an average of a number of analyses that have been made of the waters of the Dead Sea. These latter sometimes contain a larger proportion of solids than the average figure, but in no analysis that I have seen has the quantity been as large as that found in the water of Aalia Paakai.

Constituents.	Water of the Salt Lake.	Water of the Dead Sea.	Concentrated sea-water.
	Grains per gallon.	Grains per gallon.	Grains per gallon.
Chloride of sodium ...	6989	5137	13239
Chloride of calcium ...	7742	2077	Absent
Chloride of magnesium	7790	8235	3779
Bromide of magnesium	99	208	57
Sulphate of magnesium	Absent	Absent	2478
Sulphate of calcium ...	34	58	22
Chloride of potassium	156	736	534
Total solids...	22,810	16,451	20,109
Weight of one wine gallon (approximate)	73,044	68,900	72,180

Honolulu, October 16. A. B. Lyons.

Meretrix, Lamarck, 1799, *versus Cytherea*, Lamarck, 1806.

In the notice of Mr. Newton's "List of Mollusca," in Nature of October 29 (vol. xliv. p. 610), I read as follows :—"Many old favourites have been thus relegated to obscurity, whilst fresh names, dug up from some forgotten corner, have, by the law of priority, taken their places. Thus, *Meretrix*, Lamarck, 1799, takes the place of his better-known *Cytherea* of 1806, the latter having been applied by Fabricius, in 1805, to a dipterous insect."

The Dipteron *Cytherea obscura*, Fab. 1805, was described nine years later than *Mutio obscurus*, Latreille (1796), which is the same species. Meigen, in his principal work (1820), acknowledged the priority, and the insect has been called *Mutio* ever since. As the typical species is the same for both genera, there is no chance whatever for *Cytherea* to be resuscitated, and it may well remain as the name of the Mollusk. I most heartily agree with the opinion of the reviewer, that "it would be an immense gain if every name proposed to be altered had to pass through a regularly-constituted committee of investigation before it was accepted and allowed to pass current." In such a committee, besides *priority*, two other paramount scientific interests should be consulted, and they are—*continuity* and *authority*. C. R. Osten Sacken.

Heidelberg, November 1.

A Plague of Frogs.

I have just read with great interest the letter in Nature of the 5th inst. (p. 8), signed R. Haig Thomas, *à propos* of frogs entering his cellar.

During the past seven years I have resided in three separate lodgings (no two being within half a mile of the other), each having a small garden at the back surrounded by a solid wall. The lowest of these was about 5 feet, and in two cases the walls were quite bare. In the third case there were creepers on both sides. But in all three cases has *one* frog suddenly made its appearance, and always during very wet weather. To account for their entrance has completely puzzled me.

B. A. Muirhead.

Pall Mall Club, Waterloo Place, November 8.

Red Light after Sunset.

There was at Lyons, N.Y., last evening, a magnificent display of red light similar to the sunset glows which attracted so much attention a few years ago. The entire western sky was of a deep lurid red, resembling a conflagration, for three-quarters of an hour or more after sunset. M. A. Veeder.

Lyons, N.Y., October 30.

Topical Selection and Mimicry.

Will you permit me to make a few remarks on Dr. A. R. Wallace's review of my book ("On the Modification of Organisms") which appeared in your journal on April 9 last (vol. xliii. p. 529)? I cannot disguise from myself the fact that in attempting any reply I labour under great disadvantages : first, in having to combat the statements of such a high authority as Dr. Wallace ; and secondly, in writing as I am from the Antipodes, my reply cannot reach your readers for at least three months after the publication of the review in question. Nevertheless there are two statements made by him which demand some notice from me.

The first is that I have misrepresented Darwin's views on the question of natural selection. My reply to this is distinct and emphatic. The references to Darwin in my book are absolutely correct : there is no misrepresentation ; there is no misquotation. In every reference to Darwin's views I gave the page and the edition from which the quotation was taken. In writing my book I was perfectly aware how important it was to start with a clear understanding of what Darwin meant by the term natural selection, and I was at the utmost pains to quote his exact words in every reference I made to him. It is not my fault if Darwin did not give a clear or consistent definition of natural selection, or that he confounded cause with effect, as when at one time he defined natural selection as "the struggle for existence," and at another time as "the survival of the fittest." I can therefore with the utmost confidence refer your readers to the book itself in confirmation of what I here state.

Dr. Wallace has also been good enough to give, as a sample of my "teaching," a part of a sentence of mine on the subject of mimicry. He says your readers "may estimate the value of Mr. Syme's teaching by his explanation of mimicry, which is, that natural selection has nothing to do with it, but that insects choose environments to match their own colours. He tells us that these extraordinary resemblances only occur among insects that are sluggish, and that 'to account for the likeness to special objects, animate or inanimate, we have only to assume that these defenceless creatures have intelligence enough to perceive that their safety lies in escaping observation.'"

Now I did not state that these extraordinary resemblances occurred only among insects ; what I said was that they occurred "chiefly" among insects. I am aware that, judging from Dr. Wallace's stand-point, I may have disposed of the subject of mimicry in a somewhat off-hand way, and for the simple reason that I regarded mimicry as a subordinate branch of the more important subject of protective coloration, which I had treated at some length ; and in adopting this course I was taking as my guide Dr. Wallace himself, who has elsewhere stated that "the resemblance of one animal to another is of exactly the same essential nature as the resemblance to a leaf, or to bark, or to desert sand, and answers exactly the same purpose" ("Natural Selection," p. 124, 2nd edition). So far, then, I may presume that I am in good company. To understand what I said about mimicry, therefore, it is necessary to know my views on protective coloration. Protective coloration I regarded as, in certain cases, the result of heat and light acting on the pigment cells, and, in other cases, the result of what, for want of a better name, I may call topical selection—that is, the selection by the animal of its environment. Obviously, this environment would be a cover or background which would enable the animal to escape observation, as by that means many animals, especially such as are not possessed of great speed or great powers of flight, might elude their enemies, or, if Carnivora, might steal upon their prey unawares. No doubt there is something captivating in the idea of a universal cause to which every change in the organic world may be referred ; but it is surely contrary to the rules of right reasoning to invoke the aid of a greater force than is necessary to account for a given result. This is what the Darwinist does, however, in order to explain the phenomena of protective coloration and mimicry. It is well known, however, and it has been pointed out by Dr. Wallace himself, that certain varieties of protectively coloured insects are frequently confined to very limited areas. Some will only be found on a certain species of tree or plant; others only on rocks or a stone wall of some particular colour; others, again, only on small patches of soil or gravel; while a short distance from these there may be other objects differently marked, which may be frequented by insects altogether different in colour, although belonging to the same or to an allied species. Are we to suppose that every tree, plant, rock, every stone wall, and every distinctive patch of soil or gravel, has been the scene of natural selection? There is no other conclusion open to the Darwinist. But when it is considered that natural selection may take hundreds of thousands or even millions of years, to effect a given result, the strain upon our forbearance must be great when we are asked to believe that this process is the only one we have to reckon with. If the phenomena can be accounted for by a shorter or simpler process, why should the longer and more complex one be insisted on? Is it not more reasonable to suppose that animals have sufficient intelligence to fly to, and remain in, the place where experience has shown they are least exposed to observation? Can anyone doubt that animals possess such knowledge? How otherwise are we to explain the action of the butterfly, for instance, in darting at once when disturbed to some object which resembles itself, and then lying perfectly still, when one might in vain attempt to find it, although within a few inches of it?

This view also receives corroboration from the fact that many unprotected animals render themselves inconspicuous by covering themselves with materials which resemble their environment. Thus certain Lepidopterous larvæ form cases for themselves out of the fragments of the substance on which they feed, the cases of the larvæ of the Psychidæ, for instance, being made of leaves or of brown grass stems; those of the Essex emerald moth of fragments of leaves spun together with silk; certain species of sea-urchins and many Mollusca cover themselves with grains of sand, shell, and bits of stone, while, according to Poulton, certain species of crabs fasten species of seaweed to their bodies for the same purpose.

Topical selection will also explain the protective coloration of certain vertebrates, as rabbits, hares, and deer. Thus Mr. H. A. Brydon, who has an extensive acquaintance with the habits of deer in South Africa, writes ("Kloof and Karoo," p. 298) as follows:—

"In some localities where the 'zuur veldt' clothes the upper parts of the mountains, and the 'rooi' grass the lower portions, the vaal and the rooi rhebok may be found on the same mountain-side, but each adhering to its own peculiar pasturage. When the hunters come upon the ground to shoot, the rooi rhebok immediately fly from their lower slopes to the higher ground of their grey brethren, and the two species are seen galloping in close company over the mountain heights. If the hunter rests quietly after his shot and looks about him, he will presently see the two kinds of antelope, as soon as they think they may safely do so, separating, the rooi rhebok quitting the 'vaal' pastures, and betaking themselves again to their own feeding-grounds. To this habit they invariably adhere, and will not delay their departure an instant longer than their safety admits of. If the vaal rhebok in turn are driven out of their own ground, they pursue exactly the same tactics, and will on no account remain for long in their red brethren's territory."

The occurrence of so many trimorphic and polymorphic varieties of the same species have always been a puzzle to Darwinists, as the numerous varieties which the Darwinian theory postulates would all be killed off by natural selection, except the "fit"; but according to the theory which I have advanced, most variations would find their appropriate environments and live. If this theory of topical selection be correct, its application to the phenomena of mimicry is obvious. We have only to suppose that one animal may find safety in associating with another animal to which it has some resemblance, without invoking the aid of either mimicry or natural selection.

I shall not attempt to reply to the other remarks of your critic further than this, that no one who contents himself with reading Dr. Wallace's review will be able to form the slightest idea of the views put forth in my book. That it has taken a lifetime, as Dr. Wallace correctly enough says it has, to build up "the vast edifice" of Darwinism is surely no guarantee of the truth of that system, and certainly no reason why it should be above criticism, as my reviewer seems to think it should be.

Melbourne, 1891. DAVID SYME.

MR. SYME now says: "The references to Darwin in my book are absolutely correct," and—"In every reference to Darwin's views I gave the page and the edition from which the quotation was taken." Assertions, however, are not proofs; but if Mr. Syme will point out where Darwin defines natural selection as "the struggle for existence," and where Darwin "insists that variations are created by natural selection," statements which occur at p. 8 and p. 15 of Mr. Syme's book, I will acknowledge that I have misrepresented him. Otherwise I see nothing that requires modification in my article. But as Mr. Syme claims to have taken "the utmost pains" to quote Darwin's exact words, I will refer to other cases. At p. 12 he says, "The second assumption is that favourably modified individuals should be few in number, 'two or more';" and for this he refers to "Plants and Animals under Domestication," vol. ii. p. 7. The true reference is to vol. i. p. 7, where Darwin says: "Now, if we suppose a species to produce two or more varieties, and these in course of time to produce other varieties, &c." Here we see that Mr. Syme puts "individuals" in the place of "varieties," and thus makes Darwin appear to say the exact reverse of his main contention, which is, that ordinary variability occurring in large numbers of individuals, not single sports, are the effective agents in the modification of species.

Again, at p. 102, Mr. Syme says, when discussing cross-fertilization and variability: "No doubt self-fertilization is a great factor in producing uniformity of colour. That this uniformity is not due to the plants having been 'subjected to somewhat diversified conditions,' as Darwin intimates, is shown by the fact, &c." But Darwin, as every student knows, said exactly the reverse of this—that the somewhat diversified conditions produced *variability*; and Mr. Syme's great efforts to understand him and to quote him correctly again fail of success.

One more example is to be found at p. 110, where he says: "Darwin has distinctly laid down the principle that if it can be proved, by a single instance, that one organism exists for the benefit of another organism, his whole system would fall to the ground." But the statement made by Darwin was, that if any part of the structure of one species could be proved to have been formed for the *exclusive* good of another species it would annihilate his theory ("Origin," 6th edition, p. 162). Mr. Syme omits the essential word "exclusively," and thus appears to have a strong case against the theory.

As an example of general misrepresentation, I will refer to p. 86, where Mr. Syme states that "the Darwinist" "carefully ignores the facts which point in the opposite direction" (of the necessity for insect fertilization of flowers); and on the next page, after referring to cleistogamic and other self-fertilized flowers, he asks: "Why does the Darwinist omit mention of such structures as these?" But he does not refer us to the Darwinists in question who, while discussing insect fertilization, "carefully ignore" self-fertilization; and as his statement will be taken to include all, or at least the majority of Darwinists, it must be held, by those who are acquainted with the facts, to be a very absurd misrepresentation.

Other examples might be given, but these are sufficient to support my statement that Mr. Syme has both misquoted and misrepresented Darwin.

The exposition of his theory of "topical selection" to explain the phenomena of mimicry, as given above, may be left to the judgment of the readers of NATURE.

ALFRED R. WALLACE.

PROF. PICTET'S LABORATORY AT BERLIN.

IT has often been remarked that purely scientific research frequently bears fruit of practical value. A fresh illustration of this fact is afforded by the work of Prof. Pictet, the eminent man of science of Geneva, who is turning to practical account the apparatus by which, in 1877, he first reduced hydrogen and oxygen to the liquid state. At Berlin, where he now resides, he has established, on the scale of a small factory, what he terms a "laboratoire à basses températures." The following account of the work carried on and the results obtained is taken from papers read by the Professor before different scientific Societies of Berlin.

The refrigerating machinery, driven by several powerful steam-engines, is intended to withdraw heat from the objects under observation, and to keep them at any temperature between -20° and -200° C. as long as may be required. Prof. Pictet's experience has led him to the conclusion that among the refrigerating agents known, such as rarefaction of gases, dissolution of salts, evaporation of liquids, the latter is to be preferred. A long course of research has further enabled him to choose the most convenient from amongst the great number of suitable liquids. In order to avoid the great pressure required in handling the highly evaporative substances of lowest boiling-point which serve to produce extreme cold, it is necessary to divide the difference of temperature into several stages. Each stage is fitted with especial apparatus consisting of an air-pump worked by steam, which drains off the vapours of the liquid from the refrigerator, and forces them into a condenser, whence, reduced to the liquid state, they are again offered for evaporation in the refrigerator. Thus the liquid, without any loss beyond leakage, passes through a continuous circuit, and the operations can be carried on for any length of time. The liquid made use of for the first stage is the mixture of sulphurous acid and a small percentage of carbonic acid called "*liquide Pictet.*" It is condensed at a pressure of about two atmospheres in a spiral tube merely cooled by running water. Oxide of nitrogen (laughing gas) is the liquid chosen for the second stage. Its vapours are condensed in the same way at a pressure about five or six times as great in a tube maintained at about -80° by the action of the first circuit. As medium for a third stage, in which, however, continuous circulation has not yet been attempted, atmospheric air is employed, which passes into the liquid state at a pressure of no more than about 75 atmospheres, provided the condenser is kept at -135° by the first two circuits. The evaporation of the liquefied air causes the thermometer to fall below -200°.

By this combination quite new conditions for investigating the properties of matter are realized. In various branches of science new and surprising facts have already been brought to light. Many laws and observations will have to be re-examined and altered with regard to changes at an extremely low temperature.

For instance, a remarkable difference was noted in the radiation of heat. Material considered a non-conductor of heat does not appear to affect much the passage of heat into a body cooled down to below -100°. Or, to state the fact according to Prof. Pictet's view: "The slow oscillations of matter, which constitute the lowest degrees of heat, pass more readily through the obstruction of a so-called non-conductor than those corresponding to a higher temperature, just as the less intense undulations of the red light are better able to penetrate clouds of dust or vapour than those of the blue." If the natural rise of temperature in the refrigerator, starting from -135°, is noted in a tracing, and afterwards the same refrigerator carefully packed in a covering of cotton-wool of more than half a yard in thickness, and cooled down afresh, and the rise of temperature again marked, on comparing the tracings hardly any difference will be found in the two curves up to -100°, and only a very slight deviation even up to -50°. On this ground it is clear that the utmost limit of cold that can possibly be attained is not much lower than that reached in the famous experiment of liquefaction of hydrogen. The quantity of warmth which hourly floods a cylinder 1250 mm. high by 210 mm. wide (the size of the refrigerator) at -80°, is no less than 600 calories, and no packing will keep it out. At a lower temperature, the radiation being even greater, the power of the machinery intended to draw off still more heat would have to be enormous. And as -273° is absolute zero, the utmost Prof. Pictet judges to be attainable is about -255°.

As an example of the surprising methods which the refrigerating machine permits the investigator to employ, it may be mentioned that, in order to measure the elasticity of mercury, Prof. Paalzow had the metal cast into the shape of a tuning-fork, and frozen hard enough for the purpose in view. On this occasion it appeared that quicksilver can be shown in a crystallized state, the crystals being of a beautiful fern-like appearance.

Glycerine was likewise made to crystallize; and cognac, after having been frozen, was found to possess that peculiar mellowness commonly only attained by long keeping.

But the most important application of the refrigerating machinery has been the purification of chloroform, undertaken by Prof. Pictet at the instance of Prof. Liebreich, of the Pharmacological Institute, Berlin. Chloroform has hitherto been considered a most unstable and easily defiled substance. The action of sunlight, the slight impurities retained from the different processes of manufacture, perhaps the mere settling down during protracted storage, have invariably resulted in a more or less marked decomposition. By the simple process of crystallization this unstableness is got rid of, and a practically unchangeable liquid is produced. The crystals begin to form at -68°, first covering the bottom of the vessel, and gradually filling it up to within one-fifth of the whole volume. This residue being drained off, the frozen part is allowed to melt under cover, so as to exclude the atmospheric moisture. Chloroform thus refined has, by way of testing its durability, remained exposed on the roof in a light brown bottle from November till June without the slightest sign of decomposition.

Prof. Pictet has already taken steps to introduce his process into manufacture, and proposes to apply the principle to various other chemical and technical objects. Sulphurous ether, for instance, has by a similar process been produced in a hitherto unknown degree of purity. At the same time, the Professor continues eagerly to pursue the various purely scientific inquiries with which he started.

R. DU BOIS-REYMOND.

RESULTS OF EXPERIMENTS AT ROTHAMSTED ON THE QUESTION OF THE FIXATION OF FREE NITROGEN.[1]

FROM the results of the experiments of Boussingault, and also of those made at Rothamsted under conditions of sterilization and inclosure more than thirty years ago, Sir J. B. Lawes and the author had always concluded that at any rate our agricultural plants did not assimilate free nitrogen. They had also abundant evidence that the Papilionaceæ, as well as other plants, derived much nitrogen from the combined nitrogen in the soil and sub-soil. Still, they had long recognized that the source of the whole of the nitrogen of the Papilionaceæ was not explained; that there was, in fact, "*a missing link*"! They were, therefore, prepared to recognize the importance of the results first announced by Prof. Hellriegel in 1886; and they had hoped to commence experiments on the subject in 1887, but they had not been able to do so until 1888. Those first results showed a considerable formation of nodules on the roots, and coincidently great gain of nitrogen, in plants grown in sand (with the plant-ash) when it was microbe-seeded by a turbid watery extract of a rich soil.

In 1889 and since, they had made a more extended series. The plants were grown in pots in a glass-house. There were four pots of each description of plant, one with sterilized sand and the plant-ash, two with the same sand and ash, but microbe-seeded with watery extract, for some plants from a rich garden soil, for lupins from a sandy soil in which lupins were growing luxuriantly, and

[1] Abstract of a paper read before the Agricultural Chemistry Section of the Naturforscher Versammlung at Halle a.S., by Dr. J. H. Gilbert, F.R.S., September 24, 1891.

for some other plants from soil where the particular plant was growing. In all, in 1889 and subsequently, they had grown in this way four descriptions of annual plants —namely, peas, beans, vetches, and yellow lupins; and four descriptions of longer life—namely, white clover, red clover, sainfoin, and lucerne. Enlarged photographs of the above ground-growth, and of the roots, of the peas, the vetches, and the lupins, so grown, were exhibited. Without microbe-seeding there was neither nodule-formation nor any gain of nitrogen; but with microbe-seeding there was nodule-formation, and, coincidently, considerable gain of nitrogen.

As, however, in this exact quantitative series, the plants were not taken up until they were nearly ripe, it was obvious that the roots and their nodules could not be examined during growth, but only at the conclusion, when it was to be supposed that the contents of the nodules would be to a great extent exhausted. Another series was, therefore, undertaken, in which the same four annuals, and the same four plants of longer life, were grown in specially made pits, so arranged that some of the plants of each description could be taken up, and their roots and nodules studied, at successive periods of growth: the annuals at three periods—namely, first when active vegetation was well established, secondly when it was supposed that the point of maximum accumulation had been approximately reached, and thirdly when nearly ripe; and the plants of longer life at four periods—namely, at the end of the first year, and in the second year when active vegetation was re-established, when the point of maximum accumulation had been reached, and lastly when the seed was nearly ripe. Each of the eight descriptions of plant was grown in sand (with the plant-ash), watered with the extract from a rich soil; also in a mixture of two parts rich garden soil and one part of sand. In the sand the infection was comparatively local and limited, but some of the nodules developed to a great size on the roots of the weak plants so grown. In the rich soil the infection was much more general over the whole area of the roots, the nodules were much more numerous, but generally very much smaller. Eventually the nodules were picked off the roots, counted, weighed, and the dry substance and the nitrogen in them determined.

Taking the peas as typical of the annuals, and the sainfoin of the plants of longer life, the general result was, that at the third period of growth of the peas in sand the amount of dry matter of the nodules was very much diminished, the percentage of nitrogen in the dry matter was very much reduced, and the actual quantity of nitrogen remaining in the total nodules was also very much reduced. In fact the nitrogen of the nodules was almost exhausted. The peas grown in rich soil, however, maintained much more vegetative activity at the conclusion, and showed a very great increase in the number of nodules from the first to the third period; and with this there was also much more dry substance, and even a greater actual quantity of nitrogen, in the total nodules at the conclusion. Still, as in the peas grown in sand, the percentage of nitrogen in the dry substance of the nodules was very much reduced at the conclusion. In the case of the plant of longer life, the sainfoin, there was, both in sand and in soil, very great increase in the number of nodules, and in the actual amount of dry substance and of nitrogen in them, as the growth progressed. The percentage of nitrogen in the dry substance of the nodules also showed, even in the sand, comparatively little reduction, and in soil even an increase. In fact, separate analyses of nodules of different character, or in different conditions, showed that whilst some were more or less exhausted and contained a less percentage of nitrogen, others contained a high percentage, and were doubtless new and active. Thus, the results pointed to the interesting conclusion, that, in the case of the annual, when the seed is formed, and the plant more or less exhausted, both the actual amount of nitrogen in the nodules, and its percentage in the dry substance, are greatly reduced, but that, with the plant of longer life, although the earlier formed nodules become exhausted, others are constantly produced, thus providing for future growth.

As to the explanation of the fixation of free nitrogen, the facts at command did not favour the conclusion that under the influence of the symbiosis the higher plant itself was enabled to fix the free nitrogen of the air by its leaves. Nor did the evidence point to the conclusion that the nodule-bacteria became distributed through the soil and there fixed free nitrogen, the compounds of nitrogen so produced being taken up by the higher plant. It seemed more consistent, both with experimental results and with general ideas, to suppose that the nodule-bacteria fixed free nitrogen within the plant, and that the higher plant absorbed the nitrogenous compounds produced. In other words, there was no evidence that the chlorophyllous plant itself fixed free nitrogen, or that the fixation takes place within the soil, but it was more probable that the lower organisms fix the free nitrogen. If this should eventually be established, we have to recognize a new power of living organisms—that of assimilating an elementary substance. But this would only be an extension of the fact that lower organisms are capable of performing assimilation-work which the higher cannot accomplish; whilst it would be a further instance of lower organisms serving the higher. Finally, it may here be observed that Loew has suggested that the vegetable cell, with its active protoplasm, if in an alkaline condition, might fix free nitrogen, with the formation of ammonium nitrite. Without passing any judgment on this point, it may be stated that it has frequently been found at Rothamsted that the contents of the nodules have a weak alkaline reaction when in apparently an active condition—that is, whilst still flesh-red and glistening.

As to the importance of the fixation for agriculture, and for vegetation generally, there is also much yet to learn. It is obvious that different Papilionaceæ growing under the same external conditions manifest very different susceptibility to, or power to take advantage of, the symbiosis. The fact, as shown by Prof. Nobbe, that Papilionaceous shrubs and trees, as well as herbaceous plants, are susceptible to the symbiosis, and under its influence may gain much nitrogen, is of interest from a scientific point of view as serving to explain the source of some of the combined nitrogen accumulated through ages on the surface of the globe; and also from a practical point of view, since, especially in tropical countries, such plants yield many important food materials, as well as other industrial products.

In conclusion, it will be seen that the experimental results which have been brought forward constitute only a small proportion of those already obtained or yet to be obtained at Rothamsted, but they have been selected as being to a great extent typical, and illustrative of the lines of investigation which are being carried out.

FOSSIL BIRDS IN THE BRITISH MUSEUM.[1]

IT is always a matter of extreme interest to trace back any group of beings to their first recorded appearance in geological history, and the task becomes the more attractive in proportion to the rarity of the organism sought for.

The fossil remains of birds, which form the subject of Mr. Lydekker's Catalogue, constitute nearly the smallest

[1] "Catalogue of the Fossil Birds in the British Museum (Natural History), Cromwell Road, S.W." By Richard Lydekker, B.A., F.G.S., F.Z.S. Pp. xxviii. and 368. (London: Printed by Order of the Trustees. Longmans and Co.; B. Quaritch; Asher and Co.; Kegan Paul and Co., 1891.)

group of vertebrate fossils known; indeed, it is only within the last thirty-five years that any considerable number of species had been recorded.

That the existence of birds at the period of the Secondary rocks should have been first intimated by their *foot-prints* may seem strange; but as far back as 1835 a notice appeared in *Silliman's American Journal of Science* stating that Dr. Deane had discovered *impressions resembling the feet of birds* upon some slabs of Triassic sandstone from Connecticut. Dr. Hitchcock, who was the first to submit these tracks to careful scientific examination, concluded that they had been produced by the feet of birds which must have been at least four times larger than an ostrich. The great size of some of these foot-prints, however, presented at the time an obstacle to their acceptance, notwithstanding the fact of their exhibiting the same characteristic number of toe-joints as exist in the feet of living tridactylous birds—namely, three phalangeal bones for the inner toe, four for the middle, and five for the outer one.

The subsequent discovery of the entire skeletons of great wingless birds in New Zealand has, to some extent, destroyed the force of this objection as to their size; nevertheless, it seems more probable that these impressions were made by some of those gigantic Dinosaurs whose remains have been in later years met with in such abundance in the Secondary rocks of the American continent, many of which were bipedal in their method of progression, their fore-limbs being exceedingly short, and but ill adapted for use in walking. The hind-foot in *Iguanodon* and in some others was tridactylous, and agreed in the number of toe-bones with the foot of the *Dinornis* and other flightless birds. But between the discovery of the reputed foot-prints of birds in the Connecticut Valley sandstones, and the finding of true bird-remains in Secondary rocks, a long interval of time has elapsed. Some supposed bird-bones from the Chalk of Burham, near Maidstone, were figured and described as long ago as 1845 by Dr. Bowerbank, under the name of *Cimoliornis*, but these proved to belong to a gigantic Pterodactyle, and not to an albatross. The same fate befell Dr. Mantell's Wealden bird (*Palæornis cliftii*, 1844), now also transferred to the Ornithosauria by Mr. Lydekker.

Passing over some fragmentary remains, discovered in 1858 by Mr. Lucas Barrett in the Greensand of Cambridge, referred to birds, we come in 1861 to the discovery, announced by Dr. H. von Meyer, of the impression of a single feather upon a slab of lithographic stone from Solenhofen, Bavaria, followed in 1862 by the description by Prof. Owen of the skeleton of a remarkable long-tailed bird from the same formation and locality, the *Archæopteryx macrura*. This, which is still the earliest-known avian fossil, is also the most generalized bird known; and the discovery, twenty years later, of a second example only serves to confirm the correctness of the conclusions which had been arrived at from a study of the first-found example.

That it was clothed in feathers serves to prove the true avian character of the fossil, no reptile having been met with possessed of such epidermal structures. The remarkable features are that the jaws were armed with conical enamelled teeth implanted in distinct alveoli (see Fig. 1); the three metacarpals in the manus are separate and the phalanges are free (not anchylosed, as in modern birds), and each of the three digits was armed with a terminal claw; the centra of the vertebræ are amphicœlous; there are twenty free vertebræ in the tail, which is longer than the body, each vertebra bearing a pair of feathers, and the tail does not terminate in a pygostyle, like most modern birds.

From these, and other anatomical characters, *Archæopteryx* has been placed in a distinct order, the SAURURÆ, or lizard-tailed birds.

The next important bird discoveries from the Secondary rocks were those made in North America by Prof. O. C. Marsh, in 1870, from the Upper Cretaceous strata of Kansas, U.S., by which we became acquainted with two most distinct and important types, the *Hesperornis* and the *Ichthyornis*. Both of these birds are remarkable as having their jaws armed with teeth. The former (*Hesperornis*) had the teeth implanted in grooves, it had only rudimentary wings, a flat keel-less sternum, and saddle-shaped vertebræ. It was a huge fish-eating diver, nearly 6 feet high, probably resembling in appearance the loons and grebes (see Fig. 2).

The latter (*Ichthyornis*) was a bird of powerful flight, having well-developed wings and a strongly-keeled sternum; its jaws were armed with teeth in distinct sockets, and the vertebræ were biconcave (see Fig. 3).

By far the greater proportion of avian remains known are of Tertiary age; many are referable to existing birds, but a few of them are of almost as great interest to the ornithologist as those already referred to, either as representing, like them, extinct forms, or because they tell of important changes during Tertiary times in the geographical distribution of many genera of birds. The oldest of these remains have been obtained from the London Clay. A single skull of a large ostrich-like bird was obtained from the Lower Eocene of the Isle of Sheppey, and described by Owen in 1869 under the name of *Dasornis londiniensis*. Two limb-bones of a bird as large as an ostrich, but more robust, and with affinities to the Anserine type, as well as to the Ratitæ, were obtained about six years ago from the Lower Eocene near Croydon, and described by Mr. Newton under the name of *Gastornis klaasseni*. Two other species of *Gastornis* had previously been described from the Eocene of Meudon and Rheims, in France, so that the Ratitæ were doubtless well represented in Western Europe in Tertiary times.

Another remarkable discovery in the London Clay of Sheppey is that of the *Odontopteryx toliapicus*, a bird with a powerfully serrated bill, well adapted for seizing fish, which probably formed its prey.

The interest attaching to the discovery, fifty years ago, of the bones of extinct ostrich-like birds in New Zealand, remains unabated; their former abundance may be imagined from the fact that there is hardly a museum in the world where remains of the "moa" are not to be found, and they still continue to be sent to Europe for sale. The series of skeletons of *Dinornis* set up in the Vienna Museum is even finer than that in the British Museum. In the latter, six almost complete skeletons may be seen, beside an immense series of detached bones (see Fig. 4). The tallest skeleton is probably 10 feet, and the smallest 4 feet in height. Specimens showing the skin and feathers still attached to the bones are also preserved, evidencing the comparatively modern date at which they were exterminated.

Another island, which possessed a now extinct flightless bird, is Madagascar. Bones and eggs of this great bird, the *Æpyornis*, which probably rivalled the *Dinornis* in size, are preserved in the British Museum; but, owing to the lack of exploration in the island, we know as yet of only a few odd bones, where entire skeletons doubtless exist, perhaps as abundantly as in New Zealand. The egg of *Æpyornis* is the largest bird's egg known, its liquid contents being rather more than two gallons.

The close affinity existing between birds and reptiles has long ago been an accepted fact in zoology; the finding, therefore, of such primitive birds as *Archæopteryx*, *Hesperornis*, and *Ichthyornis* on the one hand, and of the numerous bird-like Dinosaurs in Europe and America on the other—indeed, the whole tendency of this branch of modern palæontological discovery—has been to strengthen the relationship of the two, and to confirm their association in one primary group of the Vertebrata, the SAUROPSIDA.

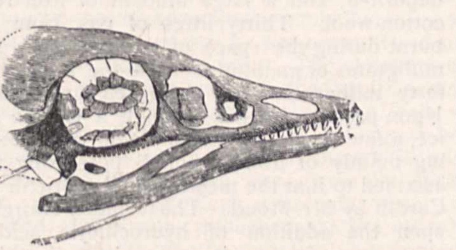

FIG. 1.

FIG. 1.—Right lateral aspect of the skull of *Archæopteryx macrura*, Owen, from the Lithographic stone, Lower Kimmeridgian, Solenhofen, Bavaria (1/1). (After Dames, "Paläontologische Abhandlungen," vol. ii., 1884.)

FIG. 2.—Restored skeleton of *Hesperornis regalis*, Marsh (1870), from the Cretaceous of Kansas, North America (about 1/8 natural size). (Reproduced, by permission, from Prof. O. C. Marsh's "Extinct Toothed Birds of North America" (folio), New Haven, Conn., U.S., 1880.)

FIG. 3.—Restored skeleton of *Ichthyornis victor*, Marsh (1872), from the Cretaceous of Kansas (1/2 natural size). (Reproduced, by permission, from Prof. Marsh's "Extinct Toothed Birds of North America" (folio), New Haven, Conn., U.S., 1880.)

FIG. 4.—Restored skeleton of *Dinornis* (*Pachyornis*) *elephantopus*, Owen, from Pleistocene deposits, Oamaru Point, South Island, New Zealand (about 1/18 natural size). (Original in British Museum, N.H.)

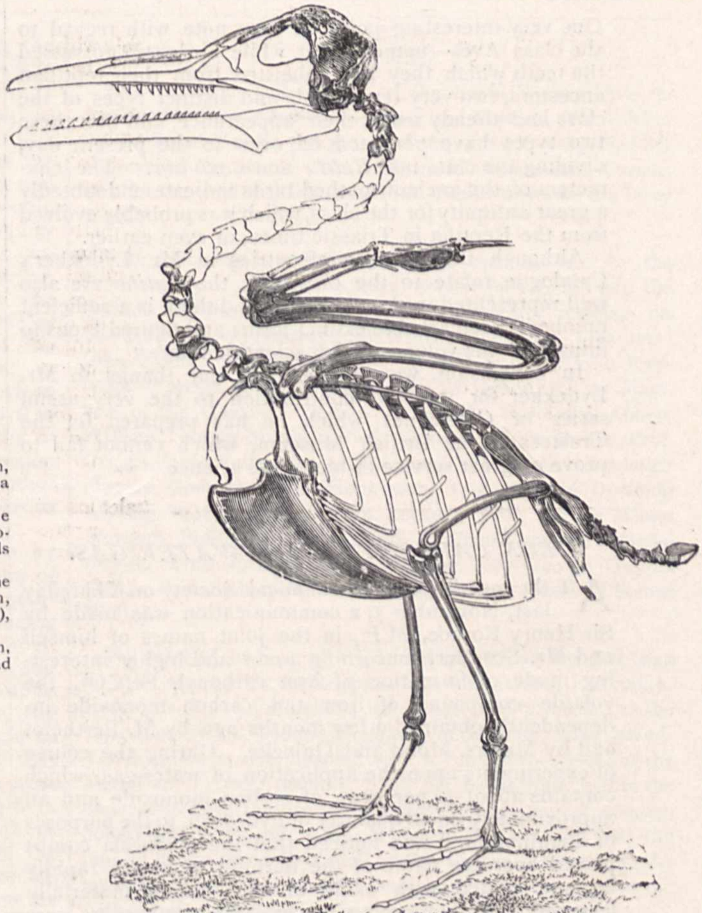

FIG. 3.

FIG. 2.

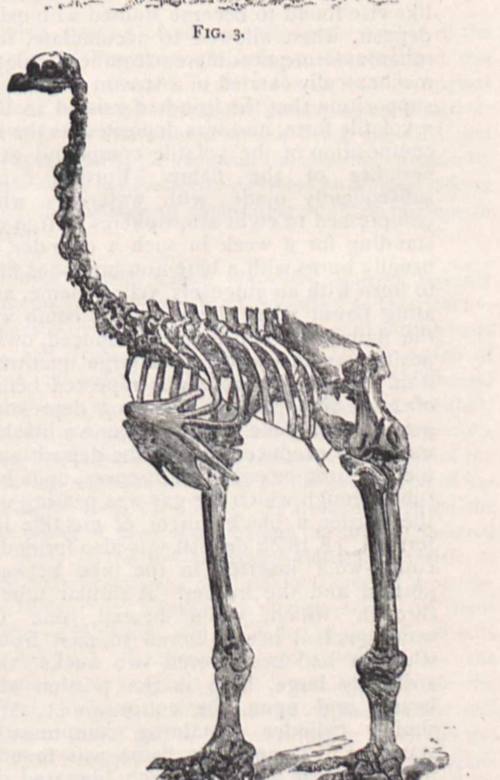

FIG. 4.

One very interesting point we may note with regard to the class Aves—namely, that while birds still possessed the teeth which they had inherited from their reptilian ancestors, two very remarkable and distinct types of the class had already made their appearance, and that these two types have persisted on, even to the present day, dividing the class into *Ratitæ* and *Carinatæ*. The characters of the ancient toothed birds indicate undoubtedly a great antiquity for the class, which was probably evolved from the Reptilia in Triassic times, or even earlier.

Although the majority of entries in Mr. Lydekker's Catalogue relate to the *Carinatæ*, the *Ratitæ* are also well represented in the collection, and there is a sufficient number of remarkable extinct forms and figured types to impart to this volume a high scientific interest.

In conclusion, we must express our thanks to Mr. Lydekker for this last contribution to the very useful series of Catalogues which he has prepared for the Trustees of the British Museum, which cannot fail to prove of great service to biological science.

IRON CARBONYL FROM WATER GAS.

AT the meeting of the Chemical Society on Thursday last, November 5, a communication was made by Sir Henry Roscoe, M.P., in the joint names of himself and Mr. Scudder, concerning a new and highly interesting mode of formation of iron carbonyl, $Fe(CO)_4$, the volatile compound of iron and carbon monoxide independently obtained a few months ago by M. Berthelot and by Messrs. Mond and Quincke. During the course of experiments upon the application of water-gas, which contains about 40 per cent. of carbon monoxide and an approximately equal quantity of hydrogen, to the purposes of illumination, it was noticed that the magnesia combs placed over the flame of the burning water-gas rapidly became coated with oxide of iron, which materially lessened the illuminating power. Steatite burners were likewise found to become stained with oxide of iron. The deposit, when allowed to accumulate, took a coralloid tuberous form quite different from accumulations of particles mechanically carried in a stream of gas This led to the supposition that the iron had existed in the water-gas in a volatile form, and was deposited as the result of the decomposition of the volatile compound at the high temperature of the flame. Further experiments were subsequently made with water-gas which had been compressed to eight atmospheres in iron cylinders. After standing for a week in such a cylinder, the gas, which usually burns with a blue non-luminous flame, was found to burn with an intensely yellow flame, and the illuminating power when the magnesia comb was placed over the flame was considerably reduced, owing to the deposition upon the comb of large quantities of oxide of iron. The experiment was repeated before the Fellows of the Society present, and upon depressing the lid of a porcelain crucible upon the flame a black stain was immediately produced, due to the deposition of particles of metallic iron or oxide. Moreover, upon heating the glass tube through which the gas was passing upon its way to the burner, a black mirror of metallic iron was rapidly formed. A thick deposit was also formed upon a plug of cotton-wool inserted in the tube between the heated portion and the burner. A similar tube was exhibited, through which, while heated, one cubic foot of water-gas had been allowed to pass from a cylinder in which it had been stored two weeks; the deposit was strikingly large, both in the portion which had been heated and upon the cotton-wool. After allowing a similar cylinder containing compressed water-gas to stand for five weeks, the flame was found to be smoky, from the large amount of iron liberated during the combustion. The smokiness, and, indeed, the whole luminosity, disappeared upon heating the tube, the gas burning with its ordinary blue flame; a thick mirror was at once deposited, and a large amount of iron retained by the cotton-wool. Thirty litres of gas from this cylinder, burnt during the space of half an hour, gave thirty-two milligrams of metallic iron in the form of a mirror, and forty milligrams were deposited upon the cotton-wool. Upon passing the gas through a U-tube surrounded by ice, a few drops of a turbid liquid were obtained, consisting mainly of iron carbonyl, possessing the properties ascribed to it at the meeting of the British Association at Cardiff by Mr. Mond. The turbidity entirely disappeared upon the addition of hydrochloric acid. From the above experiments it is evident that iron carbonyl is produced in the cold by the action of the carbon monoxide contained in the water-gas upon the iron of the containing cylinder, for the greater the length of time during which it has been stored, the greater is the amount of the compound present It is interesting to learn that the same deposit of metallic iron or oxide is found upon steatite burners from which ordinary coal-gas is burnt, pointing to the existence of iron carbonyl in our common illuminating gas. This conclusion is strengthened by the fact recorded by Dr. Thorne, that coal-gas which has been compressed in iron cylinders and allowed to stand some time is rendered unfit for use for lantern projection, owing to the deep stain of iron formed upon the lime cylinders. It is also interesting, in view of the fact that iron carbonyl is capable of formation in the cold, to note that the nickel compound, $Ni(CO)_4$, described by Messrs. Mond, Langer, and Quincke last year (*vide* NATURE, vol. xlii. p. 370), is also readily formed in the cold, provided the metallic nickel has been previously heated in a current of hydrogen. A. E. TUTTON.

CAPE GUARDAFUI AND THE NEIGHBOURING SEA.[1]

THIS work consists of monthly charts which illustrate the sea surface temperature, the wind, ocean currents, sea disturbance, and weather in the immediate vicinity of Cape Guardafui, extending down the Somali coast so as to include Ras Hafún, and covering the sea to 53° E. Some years ago the Admiralty issued a "Notice to Mariners," indicating the precautions necessary in rounding Cape Guardafui from the southward, in consequence of the Committee of Lloyd's having drawn attention, through the Board of Trade, to the large number of wrecks which had taken place in the neighbourhood. It was pointed out that the wrecks occurred chiefly during the period of the south-west monsoon, which blows from April to September, when the weather on the African coast is stormy and accompanied by a heavy sea; the currents are strong, and the land is generally obscured by a thick haze. The principal recommendation adopted by the Admiralty was the necessity for every precaution in verifying the vessel's position by soundings; and with this precaution it is asserted that the vessel's safety is assured, as the water rapidly deepens northward of the parallel of the cape. Ignorant of the exact position, many seamen have mistaken the high land at the back of Ras Jard Hafún, ten miles south of Cape Guardafui, for the latter, which, being lower and lighter in colour, is often invisible at any considerable distance. Believing the cape to be passed, ships have been steered into the comparatively low bay between the two headlands, and have struck on the sandy beach before any warning has

[1] "Meteorological Charts of the Portion of the Indian Ocean adjacent to Cape Guardafui and Ras Hafún." (London: Published by the authority of the Meteorological Council, 1891.)

been given. An idea was mooted that a change in the sea temperature could be trusted to indicate the position of the ship in latitude, and some experienced captains in the mercantile marine advocated warmly this test, holding that a sea temperature of 80° F. was never found at this season south of Cape Guardafui. The attention of the Meteorological Office was called to these statements, and it was evident that an investigation into the facts would be of great service to the mariner. A preliminary inquiry threw doubt on the view in question, though it was apparent that the temperature was, generally speaking, lower to the south of Cape Guardafui than to the north. The charts now published are the outcome of the inquiry. So far as the practical bearing of the investigation on navigation is concerned, the result, in brief, is that in every month of the year a sea surface temperature above 80° may be found to the southward of Cape Guardafui; and that, although in the months of June, July, and August, when the south-west monsoon is at its height, this occurrence is rarer than at other seasons, the thermometer would prove a very dangerous guide for the purpose suggested.

The primary object of the discussion undertaken by the Meteorological Office was to show the difference of sea surface temperature near Cape Guardafui in comparison with that over the sea to the southward during the south-west monsoon months, from April to September, but more especially in the months of June, July, and August, when the monsoon is most pronounced. In spite of this being the period of the northern summer, the surface water is coldest at this season, and from June to September are the only months during the year that temperatures below 70° are experienced within the area dealt with. It is clear that during the full strength of the south-west monsoon the cold water of the southern hemisphere is driven north of the equator; but on the other hand, although low temperatures are experienced, readings of 80° and above are met with in these months at a considerable distance to the southward of Cape Guardafui; and for a vessel, making a passage from the southward, to reason that she had passed Cape Guardafui because the thermometer indicated a temperature of 80° would be altogether misleading. The temperatures are without doubt more uniformly high in the vicinity of Cape Guardafui than further to the southward during the months of June to September, and this justifies to a very great extent the opinion formed by many leading captains of the merchant service that a safe course might be shaped by the thermometer; but this view is now proved to be erroneous. The sea surface temperature reaches its highest point in the district discussed during the months of March, April, and May, when nearly the whole area is above 80°.

The winds and ocean currents, which are plotted in position on the charts, give features of especial interest. The change of monsoon is well shown, and the effect produced by the adjacent land on the direction of the wind, also the variations in the strength of the monsoon, especially the intensified force of the south-west wind, which reaches its maximum in July, when the winds frequently blow with the force of a whole gale. The direction during the south-west monsoon is generally more southerly near the land than over the open sea. The surface current during the south-west monsoon almost invariably sets off the land to the eastward and north-eastward, and it sometimes attains the velocity of 80 to 100 miles in the 24 hours. In the north-east monsoon the conditions are generally much quieter, but the monthly charts show interesting and important differences; and the work, embracing, as it does, the whole twelve months, illustrates very fully the changes which occur, and afford very valuable material both for the man of science and the sailor.

NOTES.

THE President and Council of the Royal Society have recommended Prof. Charles Lapworth and Prof. A. W. Rücker for the Royal Medals this year, and the Queen has signified her approval of the award. The other medallists are Prof. Cannizzaro for the Copley Medal, and Prof. Victor Meyer for the Davy Medal.

THE following is the list of names recommended by the President and Council of the Royal Society for election into the Council for the year 1892, at the anniversary meeting on November 30:—President: Sir William Thomson. Treasurer: John Evans. Secretaries: Prof. Michael Foster, Lord Rayleigh. Foreign Secretary: Sir Archibald Geikie. Other Members of the Council: Captain William de Wiveleslie Abney, William Thomas Blanford, Prof. Alexander Crum Brown, Prof. George Carey Foster, James Whitbread Lee Glaisher, Frederick Ducane Godman, John Hopkinson, Prof. George Downing Liveing, Prof. Joseph Norman Lockyer, Prof. Arthur Milnes Marshall, Philip Henry Pye-Smith, William Chandler Roberts-Austen, Prof. Edward Albert Schäfer, Sir George Gabriel Stokes, Prof. Sydney Howard Vines, General James Thomas Walker.

WE are glad to hear of a splendid gift which has just been formally accepted by the Regents of the Smithsonian Institution. It is a gift of 200,000 dollars, which has been presented to the Institution by Mr. Thomas Hodgkins, of Setauket, Long Island. The donation is accompanied with a condition—which, as the New York *Tribune* remarks, "will not be onerous"—that the donor shall have the option of giving another sum of 100,000 dollars within the year. Mr. Hodgkins has arranged that the interest of 100,000 dollars shall be "permanently devoted to the increase and diffusion of more exact knowledge in regard to the nature and properties of atmospheric air."

THE opening meeting of the seventy-fourth session of the Institution of Civil Engineers was held on Tuesday, and was very fully attended. Awards were made for various original communications submitted during the past session, for various papers printed in the Proceedings without being discussed, and for various papers read at the supplemental meetings of students. Mr. George Berkley, the President, delivered an address, taking as his subject the advance of engineering work in relation to social progress.

THE following, briefly stated, are prize subjects recently proposed by the Dutch Academy of Sciences, at Haarlem:—(1) Molecular theory of internal friction of gases departing from Boyle's law, and if possible, of liquids. (2) Determination of the duration of electric vibrations in various conductors. (3) Try inoculation of *Viscum album* on apple, pear, chestnut, and lime trees, and explain its preference for certain species. (4) Criticism of opinions on structure and mode of growth of the cell-wall, having regard to continuity of the protoplasm of the adjacent cells (in some cases). (5) New experiments on the reproductive power of parts of plants, and the polarity observed in it. (6) Study of the low organisms appearing (usually as filaments) in bottles containing solutions of chemical products, after long standing. (7) Significance of peptones for the circulation of nitrogen in plants. (8) Oxidation of ammoniacal salts in the ground, and transformation into nitrates. Do the microbes found by Winogradsky and Frankland exist in the soil of Holland? (9) Researches on the organism concerned in production of marsh gas, or the conditions in which the gas is formed, if life has only an indirect influence on the phenomenon. Liberation of the gas from manure. (10) Study of the microbes involved in ensilage of green fodder, and of the variations of sugar and acidity with temperature and time. (11) The development of Triclades. (12) The development of the spleen. The prize offered in each case is a gold medal or a sum of 150 florins. Memoirs may be written in Dutch, French, English, Latin, Italian, or German (not German characters), and they are to be sent in, with sealed packet, to the secretary before January 1, 1893. (Further particulars in the *Revue Scientifique*, October 10, 1891.)

According to an official report which reached the Japanese Legation, London, on November 6, the earthquake of October 28 affected the prefectures of Aichi and Gifu. It was calculated that the number of persons killed was 6500, and of persons injured 9000; that 75,000 houses were destroyed, and 12,000 damaged.

In its review of the weather during October, the U.S. Pilot Chart notes that the latter part of September and nearly the entire month of October were characterized by exceptionally severe weather in the North Atlantic. Tropical hurricanes passed north between Hatteras and Bermuda on October 3, 12, and 18. The heavy weather that prevailed between Newfoundland and the British Channel in the last week of September was followed by comparatively moderate weather during the first two days of October, but a storm that apparently moved eastward in high latitudes on the 2nd and 3rd caused increasing westerly gales in mid-ocean, and the force of these gales was very greatly increased by the formation of a secondary on the 4th, a short distance west of Rockall. This secondary remained central about the same place for three days, the 4th, 5th, and 6th, and during all of this time there was very severe weather almost all the way from the North Sea to the Grand Banks. There were also later storms, and altogether, when the facts are fully known, it will probably be found that the month was one of the most severe on record.

We take from *Symons's Monthly Meteorological Magazine* for October the following interesting details of the climate of the British Empire during 1890. The tables for the year exhibit some exceptional features. For the first time in the 17 years that the figures have been published, the highest shade-temperature occurred at an East Indian station, 105°·6 at Calcutta, instead of in Australia. The highest sun-temperature was, however, recorded at Adelaide, 163°·9, although it is not exceptional for this to occur at Calcutta, while the mean temperature of the East Indian stations far exceeds that of Australia. The lowest shade-temperature occurred, as usual, at Winnipeg, −39°·4, the extreme rigour of whose winters far exceeds the cold at the other Canadian stations. The greatest range in the year, 135°·9, as well as the greatest mean daily range and the lowest mean temperature, 32°·8, also occurred there; while the least yearly range, 25°·4, and the highest mean temperature, 80°·5, occurred at Colombo, Ceylon. The driest station was Adelaide, mean humidity 62, and the dampest London, mean humidity 80. The greatest rainfall for the places quoted was 82·90 inches at Trinidad, and the least, 19·96 inches at Jamaica. The most cloudy station was Hobart, in Tasmania, and the least cloudy Malta. A large amount of cloud occurs at most insular stations, as well as great humidity, and small range of temperature; and, at one time or another London, Ceylon, Barbados, and Mauritius have recorded the extremes of most of these elements.

At the distribution of prizes in the Sheffield Technical School last week, Dr. Sorby, the President of the Council of Firth College, spoke vigorously and opportunely on a subject which is likely to become one of increasing importance—the true relation of technical education to the study of pure science. He feared, he said, not that technical education would not succeed, but that the public might forget that there might be something else besides. He hoped that in the efforts that were being made to insure education in everything which was required for the trade of the country they would not forget that there were other things besides that. Some of the greatest discoveries made by Davy, Faraday, and Pasteur, were not made for trade purposes, but in the interests of abstract science. If they did anything to delay the development of science as a whole, they would hinder trade in the long run. Abstract science might sometimes appear at first to be very abstract, but all at once it might turn out to be of the utmost value in connection with trade. He would be very sorry indeed if in the future technical instruction should push other education out of the field altogether. There was a danger of this, because the funds available for education and objects of that kind were limited, and what was devoted to one institution was to some extent taken from others.

The annual report on the technological examinations of the City and Guilds of London Institute has just been published. It is signed by Mr. G. Matthey, F.R.S., chairman of the examinations committee, and Sir Philip Magnus, superintendent of technological examinations. The facts set forth in the report are, upon the whole, satisfactory. At the recent examination the total number of worked papers was 7416, as against 6781 in 1890, showing an increase of 635, the corresponding increases in the two previous years being 175 and 440. This year, too, there is not only an increase in the number, but also in the proportion of candidates who have succeeded in satisfying the examiners, the number of passes being 4099 as against 3507 in 1890, and the percentage of passes 55·3 as against 51·8. Moreover, the examinations were held this year in 53 as against 49 subjects in the previous year, and in 245 as against 219 different centres throughout the country.

Writing to the *Times* on the place due to horticulture in technical education, Mr. W. Wilks, honorary secretary of the Royal Horticultural Society, says that that Society is ready to co-operate with the County Councils in any attempt to promote the serious study of the subject. The Society has already entered into arrangements with the County Council of Surrey for holding examinations and awarding certificates, &c., after a series of lectures in various centres; and the County Council of Cambridgeshire is in communication with the Society as to the provision of practical demonstrations of scientific methods applied to orchards, allotments, and cottage gardens. Mr. Wilks is also in correspondence with a gentleman in Somersetshire, with the object of sending round an itinerant instructor and adviser to some of the cider orchard districts of that county.

At a meeting of the Ashmolean Society in the Museum, Oxford, on Monday, November 9, under the presidency of Prof. Odling, Colonel Swinhoe read a paper on silk-producing moths. The author exhibited specimens of *Bombyx mori* and of their cocoons, showing the changes produced by variation of climate and domestication on members belonging to the Bombycidæ. Several specimens of the tussur silkworm were exhibited, illustrating in some respects the effects of cross-breeding, which, in the opinion of the author, had done much to depreciate the commercial value of the silk produce of India. Much greater care—a care which the Chinese appreciated—was needed on the part of the native breeders of the silkworm to insure in the silk the peculiar qualities which enhance its market value. A discussion followed, in the course of which Prof. Legge described briefly the method of culture of the mulberry-tree in China, and some of the methods employed in winding and securing the silk.

The Christmas lectures to juveniles, at the Royal Institution, will this year be on "Life in Motion, or the Animal Machine" (experimentally illustrated), and will be delivered by Prof. John G. McKendrick, F.R.S., Professor of Physiology in the University of Glasgow.

A MAMMALIAN tooth has just been discovered by Mr. Charles Dawson, of Uckfield, in a Wealden bone-bed near Hastings. The fossil much resembles one of the lower molars of *Plagiaulax*, a genus well known from the Purbeck Beds of Swanage. It is the first evidence of a mammal from the Wealden formation, and will be exhibited and described by Mr. Smith Woodward at the next meeting of the Zoological Society, on the 17th inst.

DE CANDOLLE states, in his "Origin of Cultivated Plants," that maize is unknown in the wild condition. Some light may possibly be thrown on the origin of cultivated maize, by the discovery of a wild species, the only one of the genus, in Mexico. It is described by Prof. Sereno Watson, in the "Contributions to American Botany," under the name *Zea nana*.

WE learn from the *Journal of Botany* that the great Index of Genera and Species of Flowering Plants, on which Mr. B. Daydon Jackson has been continuously engaged for nearly ten years, is now ready for the printers' hands, and will be issued by the Clarendon Press, under the title "Index Kewensis nominum omnium plantarum phanerogamarum, 1735–1885." The work has been carefully revised by Sir Joseph Hooker, who, besides annotating the manuscript, has undertaken the care of the geographical distribution.

IF the weather during the approaching winter be as severe as that which we had last winter, many persons will be likely to take some interest in an invention which is attracting notice in America. This is an electric snow-sweeper—a snow-sweeper driven by an electric motor. The *Engineering Magazine*, of New York, says that while the machine is driven along the track of an electric railway by a motor of 30 horse-power, taking its current through the trolly wire, the two sweeping brushes are each driven by an independent motor, and all the three motors are reversible. It is stated that this plough is competent to remove from a track snow having a depth of from 3 to 12 inches, while running at a speed of from 4 to 10 miles an hour. The independent action of the brush-motors enables them, when necessary, to be run at a high rate of speed while the plough is moved slowly along the track, and thus to cut away hard, compacted snow, or drifts. It is said that the machine was thoroughly tested last winter, and its effectiveness thereby completely demonstrated.

IT is known that ozone can be abundantly produced by the electric silent discharge, and many years ago Siemens devised an "ozone-tube" for the purpose, consisting of two thin glass tubes, one within the other; the inner lined, and the outer coated, with metal, to which alternating currents of high tension are brought, acting on the gas to be ozonized within. From recent experiments in Siemens and Halske's laboratory, it appears that a good result may be had with only one dielectric, and for this not only glass, but mica, celluloid, porcelain, or the like, may be used. Thus the ozone-tube may be arranged with a metallic tube within, and the outer tube a metal-coated dielectric; or the inner metal tube may have a dielectric coat, while a metal tube is the inclosing body. As metals that are little or not at all attacked by ozone, platinum, tin, tinned metals, and aluminium are recommended. Through the inner tube flows cold water, and through the space between the tubes air, dried and freed from carbonic acid. Several such tubes may be combined in a system, and worked with alternate currents (for single tubes the continuous current with commutator is best). An apparatus of this kind is now at work in the laboratory, yielding 2·4 mg. of ozone per second. Experiments are being made in supplying compressed ozone for technical use; and this has been accomplished with a pressure of nine atmospheres. One use of ozone, on which Herr Frölich lays special stress (in the recent lecture from which these data are taken), is the disinfection and sterilization of water. And doubtless with an abundant supply of the substance, the use of it would be greatly extended.

MR. A. CRAWFORD, the manager of the travelling dairy connected with the Department of Agriculture, Victoria, is able to give a very favourable report of the results of the operations of the dairy during the last two years. It has been the means, he says, of very largely improving the general average of both cheese and butter sent to market. A good many pupils have been taught who had never made butter or cheese before, and several of them are now managing factories. In nearly all the places he has visited Mr. Crawford has lectured on dairy farming; and in many cases he has gone to outlying districts as well as to important centres.

AT the recent general meeting of the German Anthropological Society, Prof. Montelius, of Stockholm, delivered two remarkably interesting archæological lectures. In the first he dealt with the chronology of the Neolithic Age, especially in Scandinavia. The monuments of that age, he said, belonged to three different periods. First, were free-standing dolmens without passages; next, passage-graves; finally, stone cists. The last are later in proportion to the completeness with which they are covered by the mounds heaped over them. Behind the periods represented by these classes of monuments was a Neolithic period from which no grave of any kind is known to have survived. It has left traces, however, in its implements, which are of an earlier form than the various sorts found in the different groups of monuments. The Scandinavian forms of Neolithic weapons, implements, and ornaments are closely akin to those which have come down to us in the rest of Europe, especially in North Germany, England, Italy, and even Cyprus. This may be held to prove that there was a more or less active commercial intercourse between Scandinavia and the Continent at a very remote time. To this commercial intercourse Prof. Montelius is disposed to attribute the relatively high civilization of Scandinavia in the Neolithic Age. Prof. Montelius also contends that the various periods of the Neolithic Age in Scandinavia were more nearly contemporaneous with those of other parts of Europe than has hitherto been generally supposed.

IN his second lecture Prof. Montelius treated of the Bronze Age in the East and in Southern Europe. He distinguished the following periods:—(1) A copper period without bronze, represented by the finds of Richter in Cyprus and those obtained by Schliemann from the first city at Hissarlik. (2) The bronze period in the islands of the Ægean Sea, Rhodes, Crete, &c. (3) A later bronze period—(*a*) with shaft tombs at Mycenæ, (*b*) with bee-hive tombs in the neighbourhood of Mycenæ, Orchomenos, &c. These cities had not a pure Hellenic civilization, but must be regarded rather as Oriental colonies. The knowledge of bronze certainly came to Europe from the East; not by way of Siberia and Russia, nor across the Caucasus, but probably through Asia Minor and the Mediterranean to Italy and Spain, whence it rapidly spread to Gaul, Britain, and other countries.

A PENINSULA called Keweenaw Point, jutting into Lake Superior from the southern shore towards the north-east, is famous as the centre of a vast copper-mining industry. Last year the mines produced no less than 105,586,000 pounds of refined copper, and it is estimated that during next year production will be increased by at least 20 per cent. Mr. E. B. Hinsdale, who contributes to the latest Bulletin of the American Geographical Society an article on the subject, has much that is interesting to say about the numerous prehistoric mines which have been found in this region. These ancient mines—judging from their extent—must have been worked for centuries. Who the workers were, no one can tell. They seem to have known nothing of the smelting of copper, for there are no traces of molten copper. What they sought were pieces that could be fashioned by cold hammering into useful articles and ornaments. They understood the use of fire in softening the rocks to enable them to break away the rock from the masses of copper. They could not drill, but used the stone hammer freely. More than ten cart-loads of stone hammers were found in the neighbourhood of the Minnesota mine. In one place the excavation was about 50 feet deep, and at the bottom were found timbers forming a scaffolding, and a large sheet of copper was discovered there. In another place, in one of the old pits, was found a mass of copper weighing 46 tons. At another point the excavation was 26 feet deep. In another opening, at the depth of 18 feet, a mass of copper weighing over 6 tons was found, raised about 5 feet from its native bed by the ancients, and secured on oaken props. Every projecting point had been taken off, so that the exposed surface was smooth. Whoever the workers may have been, many centuries must have passed since their mines were abandoned. Their trenches and openings have been filled up, or nearly so. Monstrous trees have grown over their work and fallen to decay, other generations of trees springing up. When the mines were rediscovered, decayed trunks of large trees were lying over the works, while a heavy growth of live timber stood on the ground.

The last two parts of the *Izvestia* of the Russian Geographical Society (vol. xxvii., 3 and 4) contain M. Grum-Grzimailo's report on his journey to Central Asia, and General Tillo's calculations of the heights determined by the Russian traveller during his journey. The report, which adds little to the information given in the explorer's letters, is accompanied by a map embodying the results of the extensive surveys made by the two brothers in the Eastern Tian Shan, the Hashun Gobi, the Barkul oasis, and the region in the south-east of it, as far as the 36th degree of latitude and the 72nd degree of longitude. It was already known that during this journey the brothers Grum-Grzimailo had discovered, some fifty miles to the south-east of Turfan, a depression situated between the two chains of the Eastern Tian Shan and the Kuruk-tag Mountains, the level of which proved to be very near to the sea-level, or even below it. At the spot, Lukchin-chir, their barometer rose (on October 27) to 771·7 mm. On the same day, the pressure of the atmosphere, reduced to the sea-level, attained 784 mm. at Krasnoyarsk, 787·7 mm. at Yeniseisk, 774 mm. at Irkutsk and Tomsk, and 767 mm. at Przevalsk and Narynsk; so that there may be some doubt as to the pressure in the latitude and longitude of Lukchin-chir (at the sea-level) really being 767 mm., as adopted by General Tillo, which would give for that spot 50 metres below the level of the sea. But the possible error cannot be very great, and we thus have, between the two above-named chains of mountains, an undoubted depression, the surface of which is very near to the level of the ocean.

Mr. L. Stejneger describes, in the Proceedings of the American National Museum, a new North American lizard of the genus Sauromalus. It is very large, the total length of four specimens averaging 540 millimetres. This enormous lizard is closely allied to the much smaller species which inhabits the arid regions of the mainland to the north of the Gulf of California, viz. *Sauromalus ater*, with which it has been confounded. It may be readily distinguished by the characters given in Mr. Stejneger's diagnosis.

Some time ago the Educational Museum of Tokyo was abolished, and the collections were transferred to the Science College of the Imperial University. Dr. I. Ijima, Professor of Embryology and Comparative Anatomy, who volunteered to take care of the ornithological collection, offered to send it to Mr. L. Stejneger, of the U.S. National Museum, in instalments for identification and study, and the proposal was gladly accepted. Dr. Stejneger has made some progress with the work, and has just issued "Notes" in which he presents the results of his examination of the first instalment. He has had the satisfaction of finding "quite a number of interesting additions to the Japanese avifauna."

We have received Nos. 7–9 of vol. i. of "Illustrations of the Flora of Japan, to serve as an Atlas of the Nippon-Shokubutsushi," by Tomitaro Makino, a monthly publication, brought out in Tokyo, apparently somewhat on the plan of the "Icones Plantarum." Each number contains about six plates (uncoloured), with descriptions, of new or remarkable species, natives of Japan. The drawings are exceedingly well done, and the descriptions (in English) would compare favourably, in accuracy and completeness, with those of some works published in this country. The species described appear to be taken at random, those in the same number having no affinity with one another.

Messrs. Baillière, Tindall, and Cox have issued the fifth edition of the "Manual for the Physiological Laboratory," by V. D. Harris and D'Arcy Power. The work has been enlarged, the increase being due mainly to the more detailed account which has been given, for junior students, of microscopes and their properties; and to the description, for senior students, of the latest methods of histological research. The parts relating to physiological chemistry have been thoroughly revised, and many additional illustrations have been inserted.

Mr. James Stirling, Assistant Government Geologist, Victoria, has published at Melbourne some valuable and interesting notes on the hydrology of the Mitta Mitta. The following are the leading conclusions to which he has been led by his observations:—(1) That there is considerable inequality in the amount of rainfall over different portions of the same watershed area in each of the various streams flowing from the Australian Alps, the Mitta Mitta being cited as an instance of this; and that as the recording stations at present established are all below the normal line of cloud flotation (under 4000 feet), where the rainfall is greater, the actual quantity which falls in the several watershed areas is really greater than that shown in the records. (2) That the low percentage of discharge to rainfall is due in all probability to a complexity of causes, among which may be cited the excessive evaporation in certain areas, largely due to the great range of temperature; the different heat-radiating powers of different rock-masses; and percolation along fault lines, contacts of the igneous and sedimentary formations, &c.; and, in some areas, the absorption by certain species of the prevailing eucalyptus vegetation. (3) To determine the actual quantity of rainfall and the causes affecting its local distribution, it has become necessary to establish meteorological stations at the higher altitudes in the Australian Alps. (4) And in order to supply further trustworthy data, it is, Mr. Stirling thinks, imperative that a system of complete topographical survey should be instituted.

The Annual Report, for 1888–89, of the Geological and Natural History Survey of Canada has been issued. It forms the fourth volume of the new series, and includes reports and maps of various investigations and surveys. The volume opens with summary reports, by Mr. Alfred R. C. Selwyn, the Director, on the operations of the Geological Survey for the year 1889. Then come the following reports:—On a portion of the west Kootanie district, British Columbia, by G. M. Dawson; an exploration in the Yukon and Mackenzie basins, by R. G. McConnell; exploration of the glacial Lake Agassiz in Manitoba, by Warren Upham; the mineral resources of the province of Quebec, by R. W. Ells; the surface geology of Southern New Brunswick, by R. Chambers; chemical contributions to the geology of Canada from the laboratory of the Survey, by G. C. Hoffmann; mining and mineral statistics of Canada, by H. P. Brumell; division of mineral statistics and mines, by E. D. Ingall and H. P. Brumell; annotated list of the minerals occurring in Canada, by G. C. Hoffmann.

THE administration of forests seems to be, on the whole, one of the most satisfactory departments of public activity in India. Dr. Ribbentrop, in his report for the year 1889–90, states that over 4200 square miles were added to the area of forest estates under control, thus bringing the total area up to nearly 105,500 square miles. The gross revenue exceeded 153 lakhs of rupees, giving a surplus over expenditure of nearly 73 lakhs, or an increase in a single year of 15 lakhs. The surplus in 1885 was only 41 lakhs. It is believed that this rate of increase may be maintained, as the rich forests of Upper Burma have still to be opened out.

IN a recent communication from Alta Verapaz, a department in Guatemala (*Met. Zeit.*), Dr. Sapper describes the climate. The position is on the north slope of a hill-range stretching east and west, and the large rainfall (it has a rainy season in winter, as well as that in summer common to the whole of Central America) apparently affects the frequency of earthquakes. For the district is of limestone and dolomite, and honeycombed with caverns and subterranean watercourses, and heavy rains lead to a collapse of such cavities, so that towards the end of the summer rain season, and still more towards that of winter, the number of earthquakes and tremors is distinctly increased. The winter of 1889–90 had unusually heavy rains, and the earthquakes were also unusually numerous (seventeen in 1890 as against five the previous year).

A PAPER upon the sulphides of boron is communicated by M. Paul Sabatier to the September number of the *Bulletin de la Société Chimique*. Hitherto only one compound of boron with sulphur has been known to us, the trisulphide, B_2S_3, and concerning even that our information has been of the most incomplete description. Berzelius obtained this substance in an impure form by heating boron in sulphur vapour, but the first practical mode of its preparation in a state of tolerable purity was that employed by Wöhler and Deville. These chemists prepared it by allowing dry sulphuretted hydrogen gas to stream over amorphous boron heated to redness. Subsequently a method of obtaining boron sulphide was proposed by Fremy, according to which a mixture of boron trioxide, soot, and oil are heated in a stream of the vapour of carbon bisulphide. M. Sabatier finds that the best results are obtained by employing the method of Wöhler and Deville. The reaction between boron and sulphuretted hydrogen only commences at red heat, near the temperature of the softening of glass. When, however, the tube containing the boron becomes raised to the temperature, boron sulphide condenses in the portion of the tube adjacent to the heated portion; at first it is deposited in a state of fusion, and the globules on cooling present an opaline aspect. Further along the tube it is slowly deposited in a porcelain-like form, while further still the sublimate of sulphide takes the form of brilliant acicular crystals. The crystals consis of pure B_2S_3; the vitreous modification, however, is usually contaminated with a little free sulphur. Very fine crystals of the trisulphide may be obtained by heating a quantity of the porcelain-like form to 300° at the bottom of a closed tube whose upper portion is cooled by water. The crystals are violently decomposed by water, yielding a clear solution of boric acid, sulphuretted hydrogen being evolved. On examining the porcelain boat in which the boron had been placed, a non-volatile black substance is found, which appears to consist of a lower sulphide of the composition B_4S. The same substance is obtained when the trisulphide is heated in a current of hydrogen; a portion volatilizes, and is deposited again further along the tube, while the residue fuses, and becomes reduced to the unalterable subsulphide B_4S, sulphuretted hydrogen passing away in the stream of gas.

Two selenides of boron, B_2Se_3 and B_4Se, corresponding to the above-described sulphides, have also been prepared by M. Sabatier, by heating amorphous boron in a stream of hydrogen selenide, H_2Se. The triselenide is less volatile than the trisulphide, and is pale green in colour. It is energetically decomposed by water, with formation of boric acid and liberation of hydrogen selenide. The liquid rapidly deposits free selenium, owing to the oxidation of the hydrogen selenide retained in solution. Light appears to decompose the triselenide into free selenium and the subselenide B_4Se.

SILICON SELENIDE, $SiSe_2$, has likewise been obtained by M. Sabatier by heating crystalline silicon to redness in a current of hydrogen selenide. It presents the appearance of a fused hard metallic mass incapable of volatilization. Water reacts most vigorously with it, producing silicic acid, and liberating hydrogen selenide. Potash decomposes it with formation of a clear solution, the silica being liberated in a form in which it is readily dissolved by alkalies. Silicon selenide emits a very irritating odour, due to the hydrogen selenide which is formed by its reaction with the moisture of the atmosphere. When heated to redness in the air it becomes converted into silicon dioxide and free selenium.

THE additions to the Zoological Society's Gardens during the past week include a Macaque Monkey (*Macacus cynomolgus* ♂) from India, presented by Mr. G. E. Lidiard; two Senegal Touracous (*Corythaix persa*), a Madagascar Porphyrio (*Porphyrio madagascariensis*) from West Africa, presented by Mr. J. B. Elliott; a Blue-fronted Amazon (*Chrysotis æstiva*) from Brazil, presented by Mrs. H. R. Warmington; two Puff Adders (*Vipera arietans*) from South Africa, presented by Messrs. Herbert and Claude Beddington; two Tree Boas (*Corallus hortulanus*) from St. Vincent, W.I., presented by H.E. the Hon. Sir Walter F. Hely Hutchinson, K.C.M.G.; a Tree Boa (*Corallus hortulanus*) from Demerara, presented by Mr. J. J. Quelch, C.M.Z.S.; a Black-headed Lemur (*Lemur brunneus*) from Madagascar, a Brown Capuchin (*Cebus fatuellus*) from South America, a Black-headed Caique (*Caica melanocephala*) from Demerara, a Red and Blue Macaw (*Ara macao*) from Central America, deposited; a Black-headed Caique (*Caica melanocephala*) from Demerara, purchased.

OUR ASTRONOMICAL COLUMN.

OUTBURST OF DARK SPOTS ON JUPITER.—Attention has been called by several observers to a number of dark spots which have appeared lately on the first belt north of the north equatorial belt of Jupiter, in about latitude 20°. Mr. Denning derived a period of rotation of 9h. 49m. 27·2s. from his observations of one of these objects between August 21 and September 15 (*Observatory*, October 1891). A change then occurred, for this spot, and others near it, were found to have a rotation period of 9h. 49m. 44·2s. from September 15 to October 15. This sudden change of 17 seconds in the rate of motion of a region of some extent is most remarkable. A series of photographs of Jupiter were taken at Lick Observatory in August, which, according to Mr. Stanley Williams, "are of such a degree of excellence that an examination of them is almost like looking at the planet itself" (*Observatory*, November 1891). These photographs show six or seven dark spots, and a comparison of them with a sketch made about one rotation later clearly indicates a displacement of the spots with reference to the great red spot, owing to the more rapid movement of the belt in which they occur. Prof. E. E. Barnard observed the spots so early as May last (*Astronomische Nachrichten*, No. 3063). He found in September that they were decreasing their longitudes about 10° daily. At this rate they would describe a complete rotation round Jupiter, relative to the great red spot, in about 36 days. The daily loss derived from Mr. Denning's observations in August and September would bring the two spots in conjunction in about 39 days.

WOLF'S PERIODIC COMET.—The following ephemeris is from one given by Dr. Thraen in *Astronomische Nachrichten*, No. 3064:—

Ephemeris for Berlin Midnight.

1891.	Right Ascension. h. m. s.	Declination. ° ′ ″	Brightness.
Nov. 14	4 35 16	−8 29 28	10·2
,, 17	33 27	9 36 16	
,, 20	31 31	10 36 44	9·3
,, 23	29 31	11 30 38	
,, 26	27 31	12 17 51	8·3
,, 29	25 31	12 58 22	
Dec. 2	23 37	13 32 15	7·4
,, 5	21 48	13 59 40	
,, 8	20 8	14 20 51	6·5
,, 11	18 39	14 36 10	
,, 14	17 22	14 45 59	5·7
,, 17	16 17	14 50 41	
,, 20	15 26	14 50 38	4·9
,, 23	14 49	14 46 14	
,, 26	4 14 27	14 37 52	4·3

Although the comet is getting fainter and moving south, it may probably be followed to the last date in the above ephemeris with instruments of moderate aperture. The greatest southern declination of 14° 51′ 8″ is reached on November 18.

THE TOTAL LUNAR ECLIPSE OF NOVEMBER 15.—If atmospheric circumstances permit, a total eclipse of the moon may be observed over all Europe on Sunday next, November 15. The following are the times of contact with the earth's shadow given in the *Nautical Almanac*:—

	G.M.T. h. m.
First contact with the penumbra	9 36·7
,, ,, ,, shadow	10 35·1
Beginning of total phase	11 37·4
Middle of eclipse	12 18·9
End of total phase	13 0·4
Last contact with the shadow	14 2·7
,, ,, ,, penumbra	15 1·1

The first contact with the shadow occurs at 55° from the most northern point of the moon's limb counting towards the east, the last contact at 95° from the same point counting towards the west.

THE ELEMENTS OF THE MINOR PLANETS.—The *Vierteljahrschrift der Astronomischen Gesellschaft* (first volume) contains two interesting compilations, on the planets discovered in the year 1890, and on the appearances of comets in the same year. The first paper is contributed by Dr. Paul Lehmann, and informs us that no less than fifteen new members of our minor planet system were discovered last year between February 20 and November 14. In the table that follows a summary of all the days on which each individual planet was observed is given, and this is succeeded by another which shows their chief elements. By combining the elements of some of the old planets with those of the new ones, some striking combinations are thus brought to light, of which we give the two following cases, in which the new planets are 292 and 288:—

Planets.	☊ °	i °	φ °	a
152	☊ = 41·3	i = 12·2	φ = 4·4	a = 3·15
13	43·2	16·5	5·0	2·58
99	42·0	13·9	13·8	2·80
155	43·1	14·1	14·8	2·91
292	43·1	14·7	2·4	2·53
268	☊ = 121·7	i = 2·0	φ = 7·9	a = 3·09
288	121·6	4·4	11·6	2·75
113	123·1	5·0	5·0	2·38
213	122·4	6·8	8·3	2·75

The next table shows the values that have been obtained after computing the mean brightest and darkest magnitudes that the planets can attain. In the last form the tabulation is so arranged that the following numbers can be directly seen:—(1) The number of oppositions in which, up to the present time, places have been found, with the number of appearances since observed. (2) The number of every known opposition in which the planet has been observed. (3) Every planet to which the foregoing statement refers. (4) The number of these planets.

SOME EXPERIMENTS MADE WITH THE VIEW OF ASCERTAINING THE RATE OF PROPAGATION OF INDUCED MAGNETISM IN IRON.

THE question, considered in a simple form, may be put thus: Suppose a magnet were suddenly brought up to one end of a long iron rod, what length of time intervenes between the occurrence of magnetization at the near end and at the far end?

Everyone, probably, would at first be inclined to say that the speed along the bar would undoubtedly be about the same as the velocity of light, and this supposition would naturally follow if the energy to places along the bar be supposed transmitted through the surrounding space; but, on the other hand, the speed may be much less if the energy of magnetization is transmitted from particle to particle in the iron—the orientation of the molecular magnets being, as it were, passed from each to the next along the bar. In such case we would, of course, expect the velocity of propagation to be comparable in speed with that of molecular phenomena rather than that of disturbances in the ether.

The velocity of sound, with which we may, perhaps, compare it, is in iron about 16,000 feet per second. The transmission of sound resulting from vibratory movement can be said to depend on the mass of the molecule, and on the mutual forces keeping the molecules in position; while the rate of propagation of a magnetic disturbance of the kind supposed would depend on the moment of inertia of the particles (assumed to be molecular magnets) round their axes of rotation, and on their mutual magnetic moments.

The propagation of such a disturbance can be observed in Prof. Ewing's magnetic model. The model, which consists essentially of a great number of small compass needles placed within each other's action, but not near enough to touch, can be disturbed at one place by bringing a magnet near, or otherwise. The disturbance then is seen to spread throughout the model, much in the same manner as we have suggested a magnetizing disturbance to be propagated in iron.

The method proposed to test matters depended upon the principle of the interference of waves travelling in opposite directions observed through the production of stationary waves.

Thus, if a bar of soft iron have two coils of wire placed one at each end, and if the same alternating current be passed through both coils, disturbance of opposite signs travelling in opposite directions along the bar should interfere, provided the rate of alternation and the length of the bar are chosen suitable to the rate of propagation.

It was proposed to detect the nodes or places of interference by means of a telephone in circuit with a third coil which could be slid along the bar.

Instead of employing two alternating coils, the bar can be bent round to form a ring, and one coil will be then sufficient.

Some preliminary experiments with a straight bar having given faint indications of the existence of places of minimum intensity, closed magnetic circuits or rings, formed of a great number of turns of soft iron wire,[1] were then tried with more decided results. When the alternating coil was in certain positions on the ring the telephone coil could be placed at points where no sound, or if any very slight, could be heard—the sound reaching a maximum in places somewhere between these points. These nodes and internodes occupied about half the ring—the opposite half of the ring from that in which the alternating coil lay. On approaching nearer the alternating coil, apparently the very unequal length of the paths prevented any effect being observed.

It was without difficulty ascertained that these were not the

[1] Two rings were made of No. 21 soft iron wire, one about 10 feet and the other 14·5 feet in circumference. Both had 8 pounds of wire wound on. The wire used in a third ring was No. 32. This ring was about 12 feet in circumference. There was about 4 miles of wire put on. The wire of this and the 14-feet ring was well coated with shellac before winding, so as to minimize Foucault currents.

nodes looked for, because the distances between them remained unaffected on changing the rate of alternation. The distances from node to node also were found to measure different amounts (though on the whole there was a decided tendency towards regularity). The average distance apart of the nodes in the different rings tried lay between 10 and 18 inches.

The occurrence of the nodes might have been very well attributed to the ring being locally irregular in its susceptibility to induction, but for the irreconcilable fact that the effects on either side of a node were found to be of opposite phase, just as it would be, were the phenomenon due to stationary interference waves.

This was ascertained by means of two coils connected in the same sense in series with the telephone. When these coils were arranged at places of equal intensity, one on each side of a node, no sound was to be heard in the telephone, the effects neutralizing one another. A commutator, to throw in the coils singly or together as desired, is convenient for making this experiment.

From this, one would naturally assume that the currents induced on either side of a node must be of opposite sign, seeing that they neutralize each other in the telephone; but experiments with the galvanometer show it not to be the case. To test this, the galvanometer is connected up through a commutator arrangement fixed to the originator of the primary current in such a way as only to admit of the currents induced in one direction passing. Tried in this way, no difference in the direction of the current on either side of a telephone node was found, or, indeed, any trace of a minimum effect at these points. The thing can also be tested by means of a ballistic galvanometer, and a reversing key with battery, for, with a reversing key and telephone, the nodes, which are quite independent of the speed, are to be found, as well as the opposite phase effect. The ballistic galvanometer gives no indication of there being any difference at the nodes from elsewhere, and the deflection everywhere is in the same direction.

It was thought that perhaps the telephone effect was in some way connected with the fact that the form of the alternating current was not a simple wave or sign curve, owing to the method employed in producing it. This consisted of a rotating commutator, which threw in circuit alternately two cells connected up singly and in opposite directions. For this reason, the effect, when using a small alternating machine with about 40 alternations per second, was compared, and was found to be in no way different. Also what must have been a very regular variable current of the simple harmonic type was procured by means of a microphone and an organ-pipe. This gave like results.

One is thus left apparently to suppose the sound in the telephone to be due to a peculiarity in the character of the curve representing the rise and fall of the current, probably something of the nature of a subsidiary oscillation; this subsidiary oscillation being absent at the nodes, and of opposite sign on either side.

As mentioned before, it is necessary for the alternating coil to be placed at definite positions, in order that the system of nodes and internodes should occur. These positions of the alternating coil are at about the same average distance apart, and are of very much the same character with respect to regularity as the nodes of the telephone coil. In fact, if the alternating coil and the telephone coil change places round the ring, the best position for the alternating coil will always be between two nodes, and the nodes will be found situated between two old positions of the alternating coil. If the alternating coil be placed at a point where a node was found in some other position of the alternating coil, the system of nodes and internodes generally completely disappears, and now on moving the telephone coil round the ring the intensity uniformly diminishes until the diameter is reached, and then increases round the other half of the ring. This gives the phenomenon a distinctly resonant character. The induced current, as observed by a galvanometer, is always of the latter character—that is to say, a uniform fall, and then a rise on going round the ring.

As a rule the permanent magnetism of these large rings is irregular, and apparently apt to change frequently. A determination of the permanent magnetism was easily made by means of one of the coils connected with a ballistic galvanometer. By moving this through a given amount at a time, say an inch, and noting the throw of the needle, one was able to plot out a representation of the state of the permanent magnetism. In this way, places where no throw occurs were found, while to either side of such a point the throw changed sign. It was sometimes found that there was a decided tendency for the position of no throw to occur between two telephone nodes, the throw changing sign on either side of these points. But further experiments showed that this arrangement of the permanent magnetism was probably accidental, and due to the very currents employed in making the telephone observations. For when only very feeble currents had been used on a ring, these consequent poles were absent.

It is possible, as one would expect, to artificially make a minimum intensity position, at any point on a ring, by winding on a few turns of thick copper wire. But the fact that the phases on either side of such a point (found as before by means of two coils in circuit with a telephone) are the same, precludes the idea that the nodes can be due to Foucault currents.

Obviously, however, the phenomenon depends on some permanent peculiarity round the ring which happens to occur fairly regularly. What this peculiarity is, or how it is brought about, I have not yet been able to discover.

FRED. T. TROUTON.

OYSTERS AT THE ANTIPODES.

SO much attention has been given in England to the various questions connected with oyster-fisheries that it may be of interest to note some facts relating to the oyster-fisheries of our Australian kinsfolk. The subject was admirably dealt with in a lecture delivered by Mr. Saville-Kent before the Christchurch meeting of the Australasian Association for the Advancement of Science. This lecture is entitled "Oysters and Oyster-Culture in Australasia," and has been published separately.

Mr. Saville-Kent devotes attention chiefly to Australia and Tasmania, as, at the time when his lecture was prepared, he had not had an opportunity of personally studying the question in New Zealand. Beginning with Tasmania, where for five years he was officially connected with the oyster-fisheries, he points out that the oyster of Tasmania corresponds closely with the type *Ostrea edulis*, produced and cultivated in British waters. Formerly, this oyster was so abundant in Tasmanian waters, that, according to the report of a Royal Commission of Fisheries in 1882, about twenty years previously a quantity representing at current prices a retail value of no less than £90,000 had been exported in a single year to Victoria and New South Wales. At that time, oysters were so plentiful that it was a common practice to burn them in large quantities for the purpose of making lime. The strain was, of course, too severe, and by and by the Tasmanians found that, although there was still a demand for oysters, there was no longer a home-supply, and that it was necessary for them to go elsewhere for the commodity which they had so recklessly wasted. In 1884, when Mr. Saville-Kent reached the colony, the oyster-fisheries of Tasmania had for some years been an obsolete industry. Profiting by the information which had been made accessible through the International Fisheries Exhibition and associated Conferences in London in 1883, and by Prof. Hubrecht's testimony as to the oyster-fisheries of the Schelde, Mr. Saville-Kent recommended the establishment, in suitable localities, of efficiently-protected Government reserves, upon which breeding-stocks of oysters of the best quality should be carefully cultivated and permanently retained. These reserves were to fulfil the double purpose of breeding-centres, from whence the surrounding waters might be restocked, and also of model oyster-farms, around which private beds might be established on similar lines. The scheme recommended being approved, sites formerly associated with the most prolific oyster production were selected. The operations were necessarily conducted on a very modest scale. Oyster stock, suitable for laying on the reserves, could be accumulated only by slow and laborious processes, and some 20,000 to 50,000 oysters represented the approximate numbers that were gradually collected and placed under cultivation. In order that the largest possible amount of spat produced by the oyster stocks laid down might be caught, various methods were adopted, the principle being that which has been followed with so much success by M. Coste on the west coast of France. In addition to dead oyster-shells, or "cultch," which has, from the earliest days of oyster-culture, been recognized as representing a most natural and prolific catchment material for the adhesion of the spat, artificial collectors of various descriptions were introduced. In France, tiles cemented on their lower surfaces have been found to constitute the most productive and economic collectors. In Tasmania, as in all the other Australasian colonies, tiles being much too expensive for such a purpose, a cheap and efficient substitute for them was effectually improvised out of the thin roughly-cleft boards known as "split palings," which can be produced in timber-producing districts at a cost of from 8*s.* to 10*s.* per 1000. These paling collectors are coated on their under surface with cement, a brick or stone is fastened underneath at each end to give them stability, and a wire loop secured through the centre of their upper surface forms a convenient handle by which they can be manipulated on shore or raised with a boat-hook from beneath the water.

The results have been most satisfactory. Last year oysters had become so plentiful at Spring Bay that the Hobart market was glutted, and the sale price was reduced 50 per cent. Thus an important industry has been revived, and there can be little doubt that by the due maintenance of the breeding-reserves the oyster-fisheries of Tasmania will be restored to more than their former prosperity. In accordance with Mr. Saville-Kent's recommendations, all holders of private oyster-beds in Tasmania are bound by the terms of their leases to retain a certain amount of breeding-stock—not less than 10,000 mature oysters to the acre—permanently on their oyster-beds. This regulation contributes materially towards the distribution of spat throughout the surrounding water, and to the re-establishment of the oyster-fisheries upon a durable basis.

Referring next to Victoria, Mr. Saville-Kent says that the specific form of oyster indigenous to the Victorian coast-line is a so-called mud oyster, identical with that produced in Tasmanian waters, and to all outward appearance indistinguishable from the British native, *Ostrea edulis.* In former years vast quantities of this oyster were obtained from Western Port Bay, Port Albert, and Corner Inlet. Over-dredging, however, has reduced these prolific natural beds to the very verge of extinction, so that Victoria has for many years been dependent upon New South Wales, Queensland, South Australia, and New Zealand, for her oyster supplies. Some time ago Mr. Saville-Kent was invited by the Government of Victoria to make a tour of and report upon the fisheries of the colony, giving special attention to the practicability of reviving the oyster-fisheries. As a result of that tour of inspection, he strongly recommended the adoption, at Western Port and Port Albert more particularly, of the methods which had proved so effective in Tasmania. One such reserve with a very small stock of oysters was formed at Port Albert. Unfortunately, however, the Government omitted to make provision for periodical skilled supervision, and the reserve dwindled away. As Mr. Saville-Kent says, unless such reserves can be maintained in efficient working order, and the operations periodically required thereon be supervised by a practical ostreculturist, the money expended on their establishment is simply wasted.

At various parts of the Victorian coast-line, Mr. Saville-Kent observed considerable numbers of oyster-shells, evidently derived from deep water, that had recently been cast upon the shore by storms. He consequently predicted that more or less extensive beds would be found off the coast; and off-shore beds have in fact been since discovered. Mr. Saville-Kent points out that a most favourable opportunity is thus afforded for the restocking of the in-shore fisheries.

In New South Wales a separate species of oyster has to be taken into consideration. The commercial species of this colony is the rock oyster, *Ostrea glomerata.* At the same time a mud oyster, identical with or most closely allied to the Victorian and Tasmanian type, *Ostrea edulis*, occurs in some numbers upon the coast, but in consequence of the hitherto profuse abundance of the rock variety it has not been considered worthy of commercial attention. In form and general aspect the New South Wales rock oyster somewhat resembles the Portuguese oyster, *Ostrea angulata*, and also the American *Ostrea virgineana.* With these two species it further corresponds in its breeding habits, which are essentially distinct from those of the English, Victorian, and Tasmanian mud oyster, *Ostrea edulis.* In the case of the Australian rock oyster there is no nursing of the young brood, which is turned out to shift for itself, not only in a shell-less but even in an unfertilized condition. Like the spawn of many fishes, these ova are fertilized in the water. They can be readily fertilized artificially, and Mr. Saville-Kent has found that four days after fertilization the shells, which make their appearance on the second day, become so dense that the embryo oysters can no longer support themselves in the water, but sink to the bottom, where they assume their permanently fixed condition. Such is the fecundity of this oyster that the rocks and every available hiding-place in the bays, estuaries, and inlets of the districts it affects become literally plastered with the embryo brood; and until quite recently, artificial culture in the scientific sense has in New South Wales been usually regarded as an unprofitable and unnecessary superfluity. Lately, however, the oyster-fisheries of the colony have been seriously damaged by a disease which either destroys the oyster or makes it unfit for food. Mr. Saville-Kent attributes this disease to the pollution of rivers. If he is right in this view, in support of which he has much to say, the oyster-growers of New South Wales will, as he says, have to make the most of the water area left to them where the water is pure. They may also have to turn their attention to the cultivation of the New South Wales variety of the mud oyster.

In Queensland, as in New South Wales, the only oyster used in commerce is the rock variety, which may be said to attain its maximum development in both quantity and quality in the Moreton and Wide Bay districts. In these areas the species is so abundant that large consignments, above those required for home consumption, are exported to New South Wales and Victoria. The disease which has so seriously depleted the fisheries of New South Wales has not yet affected the Queensland beds. Mr. Saville-Kent thinks that this immunity is probably due to the circumstance that the Queensland oyster-fisheries are chiefly located in bays and channels in close proximity to the open sea, from whence, even after heavy floods from the tributary rivers, they are speedily revived by an inflow of sea-water. He urges the Queensland authorities to preserve these tributary streams as far as possible from pollution by chemical or other noxious works, which if allowed to increase to any considerable extent cannot fail to exert a very deleterious effect upon both the oyster and all other fisheries of the bays into which the rivers flow. Artificial oyster-culture, with the exception of one or two small experiments, has been so far carried out in Queensland waters on the simple lines only of transporting the young brood or ware, locally known as "cultivation," from one locality and laying it down on ground where it will develop more speedily to maturity. Mr. Saville-Kent believes, however, that it would be profitable to use split palings as spat collectors. One advantage possessed by this form of collector is the shelter from the sun's heat afforded to the young brood when left high and dry by the receding tide. Millions of the Australian rock oyster are destroyed annually through exposure to the overpowering heat of the subtropical sun in the early days of their attachment to exposed rocks near high-water mark. The overhanging ledges of larger rocks and the shady sides of stone jetties or embankments are invariably found to attract and support the greatest amount of oyster brood, and this shelter, which is naturally sought, plainly indicates the lines that may be most profitably followed in operations connected with the artificial cultivation of the species.

We may note that since Mr. Saville-Kent's lecture was published a report by him on "Oysters and Oyster-fisheries of Queensland" has been issued by the Queensland Government. In this report, which is carefully illustrated, full details are given as to the conditions which must be specially taken into account by all persons connected with Queensland oyster-fisheries. Referring to the "split paling" collectors, Mr. Saville-Kent emphatically repeats what he says in their favour in his lecture. After considerable experience he expresses his conviction that they are the most convenient and economic form for use in Australian waters, and that they may be characterized as an essentially Australian product. About half-tide mark represents the zone within which—at all times of the year, but especially in the months of February and August—they gather the most abundant harvest of spat. On their first attachment to the cemented collectors, the young oysters adhere to the cement by the entire surface of the attached shell. After attaining to about half an inch in diameter, the free edges of the shells begin to grow outwards, and this direction of their growth is continued until at an age of about six months they project an inch and a half or two inches from the collector. At this stage the young oysters may be easily detached with or without the cement, and be laid on the banks as ordinary "cultivation." The collectors may then be re-cemented and re-laid for the catchment of a second crop.

Of the oyster-fisheries of South and West Australia Mr. Saville-Kent is not able, in his lecture, to give precise details. He says, however, that excellent oysters of fine quality and magnificent proportions, allied to *Ostrea edulis*, are exported from Spencer's Gulf in South Australia to the Victorian markets, and more especially to Ballarat. Some of these South Australian oysters are of such Brobdingnagian dimensions that it is customary to cut them in four pieces f. r sale at the oyster saloons, the quarters thus divided being severally allotted to separate shells of ordinary size and sold as single oysters.

Mr. Saville-Kent congratulates New Zealand upon her abundant stores of oysters of various kinds. The days for the systematic artificial cultivation of the oyster in that colony have not yet arrived, and if she carefully husbands her natural resources they may, he thinks, be long delayed.

THE TIBET EXPEDITION.

AT an extraordinary meeting of the Russian Geographical Society on October 14, General Pevtsoff made his report about the Tibet Expedition, of which he was the commander after the death of Przewalsky. Having crossed the main Tian-shan ridge by the Bedel Pass, the Expedition went southwards, through an extremely narrow gorge of the Kara-teke ridge. In some places the gorge has only the width of 30 to 35 feet, while its walls are 700 feet high. The first Kashgarian village reached was Kalpyn, whence the travellers went to Yarkend. From Yarkend they moved on the great Khotan high-road into the northern spurs of the Kuen-lun. There they stayed for some forty days, at a height of 10,000 feet above the sea, at Tokhtahon, collecting many interesting plants and birds, while the geologist of the expedition, M. Bogdanovitch, made a long excursion into the region between the Yarkend-daria and the Tyznan Rivers. On September 13 they left the highlands, and after a three weeks' journey arrived at the Khotan oasis, the population of which (120,000) are skilful in the manufacture of carpets, felts, silks, and so on. From Khotan they went to Keria, and next to Niya, where they left their superfluous luggage, and whence they started to explore the Kuen-lun, in order to try to find a good pass to Tibet. The pass was found at the sources of the Tillan-hadji stream, not far from the Minjilin-khanum monastery. It proved to be quite available both for horses and camels. The winter was spent at Niya. On May 7, the work of exploration was resumed, and next week the Expedition reached the Kara-sai village. Followed by two men only, M. Roborovsky went up the Saryk-tuz Pass (discovered during the preceding autumn), and attained the sources of the Keriya-daria on the Tibet plateau. Its altitude proved to be there 16,500 feet, and its surface was an absolute desert. The want of food for the horses compelled M. Roborovsky soon to return to Kara-sai. He soon made a second attempt at further exploration, but, after having marched some 50 miles southwards on the plateau, he was again compelled to return. During the same time, M. Kozloff went across the border-ridge, following for some 100 miles the Bastan-tigrak River. He passed by Lake Dashi-kul and went up the river which flows into the lake from the east, through a wild desert, 14,000 feet above the sea. He also was soon compelled to return to Kara-sai. The next attempt was made by all three explorers together, accompanied by four Russians and a few natives. They went up the Aksu River, and soon were on a plateau, 15,000 feet high and almost quite devoid of vegetation. Terrible snow-storms were raging in the first days of July. The only mammals seen were two antelopes, and the only bird met with was a lark. Finding no food for the horses, the Expedition had nothing to do but to return to Kara-sai. Thence they started for Tchertchen, and at Atchan they were rejoined by M. Bogdanovitch, who had explored in the meantime the geological structure of the two passes of Saryk-tuz and Aksu. After a short stay at Mandalyk, where good grazing-grounds were found, and the horses recovered, the Expedition crossed again the Kuen-lun *viâ* the Muzluk Pass (15,500 feet high), and after having crossed it they divided into two parties, one of which, under M. Roborovsky, went south-east, and the other, under General Pevtsoff, moved southwards, up the little River Uluk-su, which is the source of the Tchertchen-daria. They soon came to an immense chalky mountain ridge, which rose to about 20,000 feet in the south, while a wide valley stretched south-westwards between that ridge and the Kuen-lun. The party stopped at the foot of this ridge, at a small lake, Yamil-kul. From some natives who were engaged in gold-mining in a gorge of the ridge, they learned that its name is Akka-tai, and that its summits are covered with perpetual snow. The party did not proceed further, and from Yamil-kul they returned to Mandalyk, and thence began their journey to Lob-nor, which journey took no less than one month. From Lob-nor the Expedition went up the Yarkend-daria, visiting on the way the great settlement of Kurla (4000 inhabitants), the fort of Karashar (10,800 inhabitants in the fort and the oasis), and the town Uruntchi, situated at the foot of the Tian-shan, and residence of the Governor-General of West China. On their way to the Russian frontier the travellers visited also the oasis of Sa-tsan, peopled by Chinese, and crossed the Malas River as well as the desert Khatyn-ula. On January 15, 1891, they entered the Russian post of Zaisan.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The Rev. Andrew Clark, M.A., Fellow of Lincoln College, has been elected by Congregation a Curator of the Bodleian Library, in place of Prof. Max Müller, whose term of office had expired.

The Provost of Oriel College has been re-elected a Delegate of the University Museum.

Mr. F. Liddell, B.A. Christ Church, has been elected to a Fellowship at All Souls' College. Mr. Liddell, who is a son of the Dean of Christ Church, was placed in the first class by the examiners in the Final Classical Schools. Mr. A. H. Hardinge, M.A., formerly Fellow of All Souls' College, has been elected to a Fellowship under Statute 3, Clause 10, of the College Statutes.

There was no candidate for election to the Burdett-Coutts Scholarships. The scholarships are of the annual value of about £115, tenable for two years, for the promotion of the study of geology, and of natural science bearing on geology. This is the fifth occasion since the foundation of the scholarships that there has been either no candidate or no election.

In consequence of the requirements of the Civil Service Commissioners for the limited competition for assistantships in the Royal Observatory, Greenwich, the Savilian Professor of Astronomy has offered a short course of lectures on Newton's "Principia." The study of Newton has been practically abolished from the requirements of the Oxford Mathematical Schools for some time past.

A studentship, provided out of the funds of the Newton Testimonial Fund, having been offered to the University by the Managing Committee of the British School at Athens, the Craven Committee will proceed to make the appointment in the course of the present term. The studentship is of the value of £50, and is tenable for one year. The holder will be required to reside at Athens for not less than three months during the ensuing winter and spring. Candidates should apply to the Secretary of the Board of Faculties, Clarendon Buildings.

CAMBRIDGE.—The first award of the Isaac Newton Studentship in Astronomy and Physical Optics has been made to Ralph Allen Sampson, B.A., Fellow of St. John's College, Cambridge.

Prof. Thomson, F.R.S., has been elected Chairman of Examiners for Part II. of the Mathematical Tripos.

The vacancy of the office of Superintendent of the Museum of Zoology will take place on January 1, 1892. The stipend is £200. Applications are to be sent to Prof. Newton before November 19.

The State Medicine Syndicate report that this year there were 64 candidates for the Diploma in Public Health, of whom 45 were successful. They propose, on account of the large number of candidates, to hold a second examination in the first week of April 1892. The Syndicate have resolved to transfer to the University a sum of £150 from their accumulated funds.

SCIENTIFIC SERIALS.

American Journal of Mathematics, vol. xiv. No. 1 (Baltimore, Johns Hopkins Press).—This number, which contains an excellent likeness and autograph of Prof. Klein, opens with articles by Goursat, "Sur une problème relatif à la déformation des surfaces," and by Appell, "Sur une expression nouvelle des fonctions elliptiques par le quotient de deux séries."—Major MacMahon, F.R.S., contributes a fourth memoir on a new theory of symmetric functions. The author has extended the subject of these memoirs in a paper with the title "Memoir on symmetric functions of the roots of systems of equations" in the Philosophical Transactions, A. (1890).—The next paper, by C. P. Steinmetz, was read before the New York Mathematical Society, and is entitled "Multivalent and univalent involutory correspondences in a plane determined by a net of curves of *n*th order."—The following note, also read before the same Society, is on the algebraic proof of a certain series. It supplies a "temporary lack," which was regretted by the author, E. McClintock, in a memoir which will be found in vol. ii. p. 108. The same writer furnishes another addition to the memoir just referred to (vol. ii.), on independent definitions of the functions log x and e^x.—H. B. Newson writes on a pair of curves of the fourth degree, and their application in the theory of quadrics; and H. P. Manning finishes this instalment with a note on linear transformation, which was suggested by a method employed by Prof. Cayley, F.R.S., in vol. v. of the *Amer. Journal.*

THE articles in the numbers of the *Journal of Botany* for October and November are mostly of interest to specialists in local floras. Mr. A. Fryer describes and figures a new English *Potamogeton* (or, rather, hybrid). Mr. T. H. Buffham describes and figures the hitherto unknown plurilocular sporanges in two sea-weeds, *Asperococcus bullosus* and *Myriotrichia clavæformis*. Mr. F. N. Williams contributes a synopsis of the primary characters in the species of *Rheum.*

THE last number received of the *Botanical Magazine* published at Tokyo, Japan (for June), contains an interesting article, illustrated, on a new Japanese *Prasiola*, *P. japonica*, by Dr. R. Yatabe, which, the author states, is collected in large quantities in the districts where it grows, and is sold as an article of food under different names in different localities. It is eaten either slightly broiled or with vinegar, the mode of preparation being very similar to that of the ordinary purple and green lavers. Other articles in the same number are on the reproduction of *Laminaria japonica*; on a recent problem in vegetable physiology (apparently the greatly discussed question of the direct absorption of nitrogen from the air by plants); and on the colours and scents of flowers; but as all these are unfortunately in Japanese, they are inaccessible to the English reader.

THE number of the *Nuovo Giornale Botanico Italiano* for October is chiefly occupied with the Proceedings of the Italian Botanical Society. The attention of Italian botanists is still directed to the interesting phenomena connected with the pollination of the Aroideæ: Signor Caleri has a paper on the flowering of *Arum Dioscoridis*, and Prof. Arcangeli one on the fertilizers of *Helicodiceros muscivorus*. He is unable to discover any evidence that the latter plant is really carnivorous.—Signor Martelli discusses a vine-disease which has lately appeared in the neighbourhood of Florence, and which he identifies with the "black rot" of the American grape, caused by a Pyrenomycetous fungus, *Physalospora Bidwelli.*

SOCIETIES AND ACADEMIES.

LONDON.

Entomological Society, October 7.—Dr. D. Sharp, F.R.S., Vice-President, in the chair.—The Chairman referred to the death, on September 14 last, of Mr. E. W. Janson, who had been a member of the Society since 1843, and who had formerly filled the offices of secretary and librarian respectively.—The Rev. Dr. Walker exhibited a long series of several species of *Erebia*, and of *Argynnis pales*, which he had recently captured near Roldal, in Norway.—Mr. W. L. Distant exhibited specimens of *Danais chrysippus*, with its two varietal forms, *alcippus*, Cram., and *dorippus*, Klug., all which he found together in the Pretoria district of the Transvaal. Mr. Jenner Weir and Colonel Swinhoe took part in the discussion which ensued as to these forms and their distribution.—The Rev. W. F. Johnson sent for exhibition specimens of *Velia currens* from stagnant water near Armagh; also a specimen of *Nabis limbatus*, killed whilst holding on to its prey, a very hard species of Ichneumon. Mr. Saunders thought that, from the nature of the Ichneumon, the only chance the *Nabis* had of reaching its internal juices would be through the anal opening, as recorded by Mr. E. A. Butler in a similar case, in the *Entomologist's Monthly Magazine*, October 1891.—Mr. F. P. Pascoe exhibited two British species of Diptera, unnamed. He said they had been submitted to Mr. R. H. Meade, but were unknown to him, and are probably new to the British list.—Mr. R. Adkin exhibited two specimens of a supposed new species of Tortrix (*Tortrix donelana*, Carpenter), bred from larvæ found on pine-trees at Tuam. Mr. C. G. Barrett said he examined the specimens with great care, but he did not consider that they belonged to a new species. He was unable to distinguish them from *Tortrix viburnana*.—M. A. Wailly exhibited preserved larvæ, in various stages, of *Citheronia regalis*, which he had bred from ova received from Iowa, United States. He said that the natives called this larva the Hickory Horned Devil, and that the specimens exhibited were the first that had been bred in this country. M. Wailly further exhibited three female specimens of *Antheræa yama-mai* bred from cocoons received from Japan; also a nest of cocoons of *Bombyx radama*, received from the west coast of Madagascar. Prof. J. B. Smith, of the United States, and Colonel Swinhoe took part in a discussion on the habits of the larvæ of *Citheronia regalis*, and as to the period at which they dropped their spines prior to pupating.—Dr. Sharp exhibited several specimens of a weevil, *Ectopsis ferrugalis*, the ends of the elytra of which bore a close resemblance to the section of a twig cut with a sharp knife. He said he had received the specimens from Mr. G. V. Hudson, of Wellington, New Zealand, who stated that they were found resting in large numbers on dead trunks and branches of *Panax arborea* in the forests.—Mr. G. C. Champion stated that the species of *Forficulidæ*, captured by Mr. J. J. Walker, R.N., in Tasmania, and exhibited by himself at the meeting of the Society in April last, was, he believed, referable to *Anisolabis tasmanica*, Bormans, described in the *Comptes rendus* of the Ent. Soc. Belgique, 1880.—The Rev. A. E. Eaton made some remarks on the synonymy of the *Psychodidæ*, and stated that, since August 1890, he had identified all of the British species in Mr. Verrall's list, except *Sycorax silacea*.—Mr. Gervase F. Mathew, R.N., communicated a paper entitled "The Effect of Change of Climate upon the emergence of certain species of Lepidoptera." A discussion followed, in which Mr. Stainton, F.R.S., Mr. Barrett Dr. Sharp, F.R.S., and Mr. McLachlan, F.R.S., took part.

Royal Microscopical Society, October 21.—Dr. R. Braithwaite, President, in the chair.—The President said that the pleasure with which he met the Fellows after the vacation was very sadly marred by the death of one of their Secretaries, Mr. John Mayall, Jun. The loss they had sustained was one which the Society could hardly hope to replace, because perhaps there was no living person who knew more about the microscope and its applications than their deceased friend Mr. Mayall. The difficulty in which they were placed had, however, for the present been met by the kindness of Dr. Dallinger, who had undertaken to fill up the vacant place until the end of the current session.—Mr. A. D. Michael proposed, and Mr. T. H. Powell seconded, that a special vote of thanks be given to Dr. Dallinger for his kindness in accepting the office of Secretary. The vote of thanks was carried by acclamation.—Mr. F. Chapman read his paper on the Foraminifera of the Gault.—Sir Walter J. Sendall exhibited and described a new apparatus which he had devised for making accurate measurements with the camera lucida, the inherent faults of which were explained by drawings on the blackboard. Mr. E. M. Nelson said there could be no doubt that camera lucida measurements when made in the ordinary way as described were grossly incorrect, and that the apparatus that had been devised was most ingenious and thoroughly scientific in principle. He thought, however, that there was a much simpler method of obtaining measurements by projecting the image for a distance of 5 feet; the curve would with so large a radius be practically reduced to a straight line. The camera lucida and neutral tint reflector were only rough-and-ready means, and useful only for ready reference; where correctness was of importance, the eye-piece micrometer would best meet the requirements; the ruling of eye-piece micrometers was now done so perfectly that it was possible to arrive at measurements even as small as 1/500,000 of an inch with far greater accuracy than could be attained with any machine. Dr. W. H. Dallinger thought there could be no doubt of the value of the apparatus within certain limits, but it would require great care for use with high powers, partly on account of its weight if made in brass, as the specimen before them; perhaps it might be made in aluminium or some other light material. The discussion was continued by Messrs. A. D. Michael, C. Beck, and Sir Walter J. Sendall.—Mr. W. I.

Chadwick described the Leach lantern microscope as follows. The microscope can be applied to any oxy-hydrogen lantern. It is screwed on the front in place of the ordinary lantern objective, the size of flange required being $2\frac{1}{2}$ inches; when the lantern objective flange is larger than this, an adaptor must be provided; and when the draw-tube of the lantern is "ricketty," a rigid lengthening tube may be adapted. The lantern condenser should be about 4 inches or $4\frac{1}{2}$ inches in diameter, and of the triple form. The stage of the microscope is open at both sides, and at the top also, and serves for all classes of objects, whether ordinary microscopic slides or polariscope crystals, shown with either narrow angle rays or by the convergent system of lenses. The stage being so constructed, it is extremely accessible for the introduction of sub-condensers, with which the instrument is provided. The object-holder is quite a novel idea, the principal mechanism of it is placed under the stage (to be out of the way); two arms passing through slots in the bottom of the stage, actuated by a spring and manipulated by a milled head, serve to hold the objects flat against the inside surface of the front of the stage. The diaphragm, or compound wheel of diaphragms, is rotative on a pivot attached to the plate arm in such a manner that the whole may be raised out of the field altogether, and dropped into it again, in an instant; when the wheel is raised, a spring catch holds it in position. When in this position the whole field of the microscope can be utilized for showing objects up to $1\frac{1}{2}$ inches in diameter. When, as in using polarized light, it is desired not to be incommoded with the diaphragms, the detachable plate carrying the compound wheel can be instantly removed from the stage, and when again required it can be as quickly restored. The arms of the object-holder projecting through the bottom of the stage have sufficient lateral movement to admit any zoophyte trough or wooden frame or combination of wooden frames up to 1 inch in thickness. Thus the advantages of this arrangement are clearly manifest. The two sub-condensers with which the instrument is provided are found to give satisfaction with all objectives of from $2\frac{1}{2}$ to $\frac{4}{10}$ inch focus. When the light has been properly concentrated, high powers can be used. It should also be observed that when high powers are used the front lens of the objective is open to the view of the manipulator, a great convenience when inserting the object, by enabling it to be immediately adjusted within the area of the lens. When polarized light is to be used, the polarizing prism must be pushed into the rotating tube of the instrument by removing the concave lens at the back, and after inserting the prism this concave lens may be replaced in an instant. The rotating tube is an advantage over fixed tubes, as the polarizing prism can by this arrangement be placed in any desired azimuth which best suits the object. The convergent system of lenses for use with polarized light in transmitting rays through biaxial crystals was worked out by Mr. Leach. It gives powerful illuminations, and includes an angle of 170°. The front focussing arrangement was introduced by Mr. Leach in 1883. Before that time several supplementary lenses had to be kept in readiness for use, as different classes of crystals were placed in the polariscope. Mr. Leach discovered how these supplementary lenses might be dispensed with, and fitted up his system accordingly; and now all makers of first-class polariscopes attach to their instruments this great improvement. The concave field lens, with which the instrument is provided, is absolutely necessary when the polarizing prism is in use. With all powers it enlarges the field, and equalizes the distribution of illumination. The three objective adaptors with which the instrument is provided admit of any microscope power with the standard screw; they are made to slide in the front tube of the microscope, which is provided with a rack and pinion, and also with a fine screw movement. Thus, by having the various powers already screwed into the adaptors, one may be changed for another almost instantaneously. And into the front or tube portion of these adaptors the tube of the amplifier is made to slide. The amplifier which is provided is a Barlow lens, and being achromatic, it enhances the aplanatic qualities of the objective. It has been asserted "that high power cannot be used in the lantern microscope; that it is unable to exhibit fine detail upon the screen, and that no alum trough is required." No doubt this is all true so far as applied to inefficient instruments. But the Leach microscope does require an alum trough, because where great light is concentrated from the oxy-hydrogen luminant, great heat must, from the very nature of the means employed, be concentrated with it, and the alum trough is the only practical thing which can be used to absorb the heat rays. The alum trough is of large size, and is used in the ordinary slide stage of the lantern. At the conclusion of the paper, Messrs. Chadwick and Leach gave a demonstration with common and polarized light.

CAMBRIDGE.

Philosophical Society, October 26.—Prof. G. H. Darwin, President, in the chair.—The officers for the ensuing session were elected as follows:—President: Prof. G. H. Darwin. Vice-Presidents: Prof. Hughes, Prof. Thomson, Mr. J. W. Clark. Treasurer: Mr. R. T. Glazebrook. Secretaries: Mr. J. Larmor, Mr. S. F. Harmer, Mr. E. W. Hobson. New Members of Council: Mr. H. F. Newall, Mr. C. T. Heycock, Mr. A. E. H. Love.—The following communications were made to the Society:—On the absorption of energy by the secondary of a transformer, by Prof. Thomson.—On an experiment of Sir Humphry Davy's, by Mr. G. F. C. Searle. Two copper wires are passed up through holes about 5 centimetres apart in the bottom of a flat trough, their ends being level with the surface of the trough. Mercury is then poured into the trough to a depth of about 4 millimetres. On sending a powerful current through the mercury by means of the two wires the mercury in the immediate neighbourhood of the electrodes was elevated into a small cone 2 or 3 millimetres in height.—Some notes on Clark's cells, by Mr. R. T. Glazebrook and Mr. S. Skinner. In addition to the causes of variation indicated by Lord Rayleigh, the authors find that the state of amalgamation of the zinc pole may cause a fall in force if the zinc does not show a bright surface. This is worked out by means of a testing cell into which the faulty zincs are transplanted. The result is confirmed by Swinburne's experiments on zinc rods in zinc sulphate solution. To correct this fault previous amalgamation in the presence of dilute sulphuric acid is recommended, or immersion of the zinc in the paste. Dr. Hopkinson's method of testing cells by tapping was shown.—Illustrations of a method of measuring ionic velocities, by Mr. W. C. D. Whetham.—On gold-tin alloys, by Mr. A. P. Laurie.

PARIS.

Academy of Sciences, November 2.—M. Duchartre in the chair.—On aberration, by M. Mascart.—Note on Mont Blanc Observatory, by M. J. Janssen. This is a brief report of the attempt to reach the rock through the snow on the summit of Mont Blanc, in order to obtain a foundation for a proposed Observatory. In spite of circumstances which rendered the proposed building impossible, M. Janssen believed that an edifice of some kind resting on the snow would permit the necessary observations to be carried on, and had one constructed according to his ideas. No displacement of the erection occurred during the twenty days previous to M. Janssen's departure from the summit of the mountain. The construction of a similar but more important building is therefore contemplated for next year.—Note by M. Armand Gautier, accompanying the presentation of his work on "Biological Chemistry."—On the Arago Laboratory, by M. de Lacaze-Duthiers.—Contribution to the natural history of the truffle: parallelism between the Terfaz or Kama (*Terfezia, Tirmania*) of Africa and Asia and the truffles of Europe, by M. A. Chatin. In the comparison the points considered are geographical distribution, climate, soil, nutritious plants, periods of ripening, depth in soil, and numerous other characteristics.—An excursion in the Rocky Mountains, by M. Albert Gaudry. At the end of the recent Geological Congress at Washington a party was organized to visit the Rocky Mountains. An account is given of some of the objects of geological interest observed by the excursionists.—Note on the storm that visited Martinique on August 18, 1891 (an extract from the *American Journal of Meteorology*), by M. Faye.—Researches on butylene monobromides, by M. E. Reboul. There are three butylene monobromides known besides the isobutylene of Boutlerow. The author describes the preparation and properties of one of these, to which he assigns the constitution CH_3—CH_2—CBr=CH_2. He proposes to term it ethyl-acetylene α-hydrobromide.—Observations of two new asteroids discovered at Nice Observatory on September 24 and October 8, 1891, by M. Charlois. Observations of position are given.—On the dimensions and form of the section of a stream (*veine*) of gas under limited counter-pressure during a limited delivery, by M. Parenty.—On a model of a luminous fountain, by M. G. Trouvé.—On the direct combinations of metals with chlorine and bromine, by MM. Henri Gautier and Georges Charpy.

With the exception of aluminium, most of the metals are hardly attacked by dry chlorine and bromine at the ordinary temperature. Aluminium, however, is acted on very energetically by liquid chlorine and bromine, whilst magnesium particularly resists the action. The reactions are very slow when the dry halogens are used. When water is present the action becomes more rapid, hydrogen being generally liberated owing to its decomposition, but in some cases the water remains unaltered.—Contribution to the chemico-physical study of the function of the kidney, by M. C. Chabrié.—On the chronology of the eruptive rocks of Jersey, by M. A. de Lapparent.—New geological observations of the Island of Sardinia, by M. Charles de Stefani.—New considerations on the Vertebrate fauna of the Upper Miocene in the Isle of Samos, by M. Forsyth Major.—The gravels of Montfort, by M. Ed. Piette.

BERLIN.

Physiological Society, October 16.—Prof. du Bois-Reymond, President, in the chair.—Dr. Lüderitz gave an account of an investigation of the changes of blood-pressure in the left ventricle and right carotid which result from gradual compression of the aorta.—The President exhibited three very successful photographs of the posterior (retinal) surface of the eye.—Doctor Wertheim recorded the disappearance of the indirect image of an illuminated disk when the object itself, as seen directly, is suddenly darkened.—Dr. Lilienfeld gave an account of a chemical examination of blood-platelets, which showed that they consist of a compound of albumin and nuclein, whose behaviour speaks against their being preformed structures.

Physical Society, October 23.—Prof. du Bois-Reymond, President, in the chair.—The Society resolved to present to Prof. von Helmholtz, on November 2, in celebration of his seventieth birthday, an address prepared by Prof. von Bezold.—Messrs. Haensch described a modification which they had made in a spectrophotometer.—Dr. Rubens gave an account of a new method of determining dispersion and refraction in the ultra-violet rays, a method which, unlike that employed by Langley, yields more accurate results by very simple means. He has already made determinations with a series of glasses, with water and with carbon bisulphide. The curve of dispersion he finds to be, on the whole, the same as that obtained by Langley for rock-salt.—Prof. Preyer enunciated his hypothesis as to the genealogy of the chemical elements.

AMSTERDAM.

Royal Academy of Sciences, September 26.—Prof. van de Sande Bakhuysen in the chair.—Prof. Franchimont showed a little bottle filled with a new chemical compound, obtained and examined by Dr. C. A. Lobry de Bruyn. This hydroxylamine is a crystalline matter without colour and smell. It is prepared by the action of natrium-methylate on the methyl-alcoholic solution of the compound of hydroxylamine and HCl, and by distillating and fractionating the result *in vacuo*. The specimen is pure to 99·6 per cent; it melts at 31°·5, and distillates under a pressure of 35 mm. between 63°·5 and 65°·5.—Mr. Behrens spoke of the microscopic structure of hard steel. If high microscopic powers are used, the network in hardened steel may be made visible on polished slices without etching or annealing. The dark sinuous lines answering to the bright ones shown by Sorby and Wedding on etched slices, it is proved that hardened steel contains hard granules bound up in a matrix of soft iron. Some varieties of grey iron from small castings may be hardened like steel, most of the graphite disappearing. After annealing the hardened metal at a red heat, the slices were dotted with blackish dust, which formed circles round the globules of the crystallites and little heaps in the midst of them. It is to be presumed that graphite has reappeared in the course of the annealing. Full details will speedily be given in the *Recueil des travaux chimiques des Pays-Bas.*

BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Pflanzenleben, Zweiter Band: A. K. von Marilaun (Leipzig, Bibliographisches Institut).—British Fungi: G. Massee (L. Reeve).—Studies in American History: M. S. Barnes and E. Barnes (Boston, Heath).—A Text-book of the Science of Brewing: E. R. Moritz and G. H. Morris (Spon).—The Universal Atlas, Part 8 (Cassell).—Geological and Natural History Survey of Canada, Annual Report, vol. iv., 1888–89 (Montreal, Foster, Brown).—Daily Weather Charts to illustrate the Tracks of Two Cyclones in the Arabian Sea (Eyre and Spottiswoode).—Meteorological Charts of the portion of the Indian Ocean adjacent to Cape Guardafui and Ras Hafún (Eyre and Spottiswoode).—Arithmetical Physics; Part 2*a*, Magnetism and Electricity; 3rd edition: C. J. Woodward (Simpkin).—A Graduated Course of Natural Science, Part 2: B. Loewy (Macmillan).—Delagoa Bay, its Natives and Natural History: R. Monteiro (Philip).—Observations made at the Hong Kong Observatory in the Year 1890: W. Doberck (Hong Kong).—Light, an Elementary Treatise: Sir H. T. Wood (Whittaker).—A First Book of Electricity and Magnetism: W. P. Maycock (Whittaker).—The Alkali-Maker's Hand-book; 2nd edition: G. Lunge and F. Hurter (Whittaker).—The Practical Telephone Hand-book: J. Poole (Whittaker).—The Plant World: G. Massee (Whittaker).—T. Cooke and Sons' Catalogue of Astronomical and Scientific Instruments, 1891 (York).—A Text-book of Physiology, Part 4, 5th edition, revised: Prof. M. Foster (Macmillan).—Iconographia Floræ Japonicæ, vol. i. Part 1: Dr. R. Yatabe (Tokyo, Maruya).—Catalogue of the Michigan Mining School, Houghton, Michigan, 1890–91 (Houghton).—Manual for the Physiological Laboratory; 5th edition: Drs. Harris and Power (Baillière).—Die Entstehung der Landtiere, ein Biologischer Versuch: Dr. H. Simroth (Leipzig, Engelmann).—Revisio Generum Plantarum, Pars 1: Dr. O. Kuntze (Dulau).

PAMPHLETS.—Proposed Railway through Siberia: W. M. Cunningham (London).—Molecular Motion in the Radiometer, in Crookes' Tubes and in some other Phenomena: D. S. Troy (New York, Hodges).—Oysters and Oyster-Fisheries of Queensland (Brisbane).

SERIALS.—Quarterly Journal of the Geological Society, No. 188, vol. xlvii., Part 4 (Longmans).—Morphologisches Jahrbuch, 17 Band, 4 Heft (Leipzig: Engelmann).—Quarterly Journal of Microscopical Science, No. 128 (Churchill).—Boletim da Commissão Geographia e Geologica do Estado de S. Paulo, Nos. 4–7 (S. Paulo).—Mittn. des Vereins für Erdkunde zu Halle a/S (Halle a/S)—Geological Magazine, November (K. Paul).—Jahrbuch der Meteorologischen Beobachtungen der Wetterwarte der Magdeburgischen Zeitung, Band ix. Jahrg. x., 1890 (Magdeburg).—Records of the Australian Museum, vol. i. No. 8 (Sydney).—Journal of the Chemical Society, November (Gurney and Jackson).—Sitzungsbericht der k. Akademie der Wissenschaften Math. Naturw. Classe, xcix. Band, Abthg. 1, Heft 4–10; Abthg. 2*a*, Heft 4–10; Abthg. 2*b*, Heft 4–10; Abthg. 3, Heft 4–10 (Wien).

CONTENTS.