THURSDAY, FEBRUARY 23, 1893.

MAN AND EVOLUTION.

Evolution and Man's Place in Nature. By Henry Calderwood, LL.D., F.R.S.E., Professor of Moral Philosophy, University of Edinburgh. (London: Macmillan and Co., 1893.)

THIS work appears to have been written for the purpose of setting forth the author's views as to the twofold nature and origin of man. He admits, fully and unreservedly, that both the bodily organism and the lower mental nature of man have alike been developed by a process of evolution from a lower animal form; but he urges with much force, and often with both eloquence and dialectic skill, that the rational and moral nature of man has not been thus developed.

The book, however, has many defects; and one cannot but feel that the writer has undertaken a task somewhat beyond his powers. Most prominent is its extreme diffuseness and vagueness, the want of systematic treatment, the frequent reiteration of the same ideas under different forms of words, and the misconceptions arising from want of familiarity with many of the subjects discussed. We are also annoyed by the frequent reference to problems to be discussed or solved, which are yet only hinted at or talked about later on. Thus, in the first chapter, we are told that a "fuller study of human life" is now required, and that the crowning effort of science in the study of Nature must be "the solution of the problem of man's appearance" on earth. Yet no attempt is made in the whole volume, either to solve this problem or even to show what progress has been made towards solving it. At p. 154 we are told that—"We are now ready for consideration of Darwin's argument"—as to the relation of the mental nature of man and the lower animals. And on the next page—"The direction to be followed now becomes more obvious"—after which we have pages of general remarks on the intelligence of the dog and the ant. Then, at p. 162—"The method to be followed is clear: we must compare the higher animals with man"—and—"careful comparison of the two orders of life is the only course open for scientific inquiry," and again,—"The difficulties belonging to such a mode of inquiry are many; but no easier method is available." Then, at p. 167, we find that Darwin "has at least suggested the essential conditions of our inquiry." After this we have another series of vague general remarks, till at p. 171 we find another statement of the mode of inquiry, and we are told that "we must have in full view all that is common to man, as animal, with the higher mammals, making account of close approximation in organic structure." Yet we nowhere find any attempt to apply these principles or methods so laboriously set forth, but are put off with such statements as—"In proof of exercise of intelligence, examples are many and familiar, making it unnecessary to enter upon detailed references." Then we are interrupted by fifteen pages of remarks on instinct among insects, although it has been repeatedly stated that the relation of man to the higher animals was the problem to be discussed; and at p. 193, we are told that—"Now at length, after careful survey of lower levels, we advance towards the height, on which the grand problems of intelligence become visible. Study of comparative intelligence now becomes possible." Then follow again page after page of what can only be described as "general remarks" on horses, dogs, monkeys, and other animals. We are told, for example—"When the higher animals are compared with the lower, it is clear that a power of intelligence must be attributed to the higher, which cannot be credited to the lower. Phenomena of domestication come to our aid here, confirming this generalisation." And a little further on, as a proof that dogs can interpret signs and act upon them, we have the following concrete illustration, among the very few in the book, and therefore we may presume it is considered a valuable one. "'Go home' will send one dog back, but the Gaelic equivalent alone will be effective in the case of a dog reared in the Highlands of Scotland, where the Celtic tongue is in common use." And then, as if the intelligent reader might doubt this astounding fact, the author adds, "Observation affords ample testimony for this."

Although the author has evidently read very widely on the subject of evolution, his want of grasp of the subject is continually shown. Thus, when discussing the struggle for existence, he seems to think that this is usually considered to be limited to a struggle for food. He says:—"A general view of the relations of life and environment will guard against interpretation of facts exclusively by reference to struggle for existence consequent on the relations of numbers to food-supply." . . . "Life is too rich in variety to find adequate explanation of its history in the mere balancing of our numbers with food-supplies." . . . "In no life is progress to be explained exclusively by reference to amount of food-supply" . . . "environment must be read much more largely than could be suggested by mere dependence on materials for nutriment"—the above passages all occurring in a single paragraph.

We have to thank the author, however, for the very clear manner in which he admits, and even enforces the application of evolution to man. He states this conclusion in several places. Thus, at page 261, we find the following:—

"The novelty of the situation lies in this, that man's alliance with all animal life has been established with a clearness and fulness of representation never before possible in the history of the world. The long-hidden secrets of nature are disclosed, and, behold! man has his heritage among the beasts of the field. The discovery is indeed a large one; the demonstration has been worked out in minute detail till no place is left for doubt."

By far the best portion of the work is that which is its special feature—the discussion of the rational as contrasted with the mere perceptive and intelligent nature of man and of the lower animals. A few quotations will explain the author's views, and show him at his best.

"The conditions of action are changed when rational self-direction comes into view. This change is so great as to amount to a complete contrast with all that has appeared in lower forms of life. Passion and appetite have not disappeared: they are present as before; but instead of determining conduct, a new exercise of power has appeared to control them. Life has here a duality within it, which has not been seen at any lower stage.

Life's history becomes in this way a history of conflict, of which no trace has appeared at any earlier point in natural history. The struggle between individuals has not disappeared, but a struggle within the individual life occurs, which has never been visible in the history of any inferior order of life" (p. 55).

Another aspect of the rational nature is thus defined :—

"The difference which severs man from the animals lies beyond the craving, and the cunning, and the consuming of what has been captured. We trace it in his plans for the day, in his preparation of his weapons, in his survey of the heavens, in his taking of reckonings for direction. He deals with the relations of means to ends ; he utilises past experience in his reflections over what has happened ; he reaches general conclusions" (p. 270).

Perhaps the finest passage in the book is at p. 287, tracing the moral element in the thought of all kinds of men and all diversities of race, as shown by the sense of wrong and injustice. We can only give here the concluding lines :—

"To this appeals the criminal in the heart of our surging crowds, placed under arrest, if he should be condemned on insufficient evidence. To this appeals every buyer in the market, defrauded by the thrusting of adulterated goods into his hands. And to this does every gentle one make appeal, defrauded in ways still worse, by false expressions of love, from whose falseness recoils a blighted life, bearing through long and weary years witness to the cruel wrong that has been done. Where, along the devious paths in which man is found, is justice not honoured, at least by outcry against harsh wrongs?"

There is much in this volume that will attract readers more disposed towards the esthetical and moral than towards the scientific aspects of evolution. Agreeing, as the present writer does, with most of the conclusions of the author, he can but regret that they have not been set forth in a manner more likely to attract scientific readers.

A. R. W.

POINCARÉ'S "THÉORIE MATHÉMATIQUE DE LA LUMIÈRE."

Théorie Mathématique de la Lumière. Par H. Poincaré, Membre de l'Institut. (Paris : G. Carré, 1889 and 1892.)

THIS work consists of two volumes, the first of which comprises a course of lectures delivered by the author in 1887–1888, whilst the second contains a further course delivered in 1891–1892.

The first volume commences with a discussion of the constitution of the luminiferous ether, in which the latter is regarded as a system of discret molecules in stable equilibrium under the action of molecular forces, and the author finally deduces equations of motion of the same form as those which are furnished by the ordinary theory of isotropic elastic media. He then adopts the hypothesis, originally due to Lord Kelvin, that the velocity of propagation of the longitudinal wave is practically zero. The principle of Huygens is next dealt with, and this is followed by a chapter on diffraction. A complete discussion of all the difficulties attending the resolution of waves would carry us too far, but the author does not appear to be acquainted with the masterly investigation of Sir G. Stokes, or the formula deduced by him, which gives the effect of an element of a plane wave at a distant point, and which enables the unsatisfactory reasoning on which the principle of Huygens depends to be dispensed with. The diffraction of light diverging from a focus is next discussed, and the intensity of light diffracted by a circular aperture or disc is obtained in the particular case in which the point of observation is the projection of the centre of the aperture or disc upon a screen ; but no mention is made of Prof. Lommel's able investigation in the general case of an excentric point. A few stock problems relating to the diffraction of parallel rays are also discussed, but nothing is said about the resolving power of optical instruments, or the theory of gratings, including Prof. Rowland's ingenious invention of concave gratings.

Chapter V. commences with the theories which have been proposed to explain the photogyric properties of quartz and certain organic substances, and concludes with an account of some of the theories of *ordinary* dispersion. This is followed by a long chapter which begins with Fresnel's theory of double refraction, and then proceeds to discuss the theories of Cauchy, Neumann, Sarrau and Bousinesq.

In all these theories the ether is regarded as an æolotropic elastic medium, and in considering them the author is to be congratulated on having shown no sympathy with the small minority who regard the writing down of equations as a foolish process ; but although during recent years much time has been spent in elaborating such theories, it may be questioned whether the majority of them have contributed any very substantial addition to scientific knowledge. The theory of the propagation of waves in an æolotropic elastic medium was rigorously investigated by Green as long ago as 1839 ; and although a theory of this kind is useful in enabling the mind to form a mental representation of the mechanism which is required to produce double refraction, it is well known that Green's theory, and all others of a similar character, fail to furnish a satisfactory explanation of this phenomenon. The principal defects of such theories are, that although most of them lead to Fresnel's wave surface, or to one which is a very close approximation thereto, they require us to suppose that the vibrations of polarized light are parallel instead of perpendicular to the plane of polarization ; and they also fail to give results which explain crystalline reflection and refraction, unless certain additional assumptions of a very questionable character are made. Probably it will not be thought an exaggeration to say, that the only theory of elastic media which satisfactorily explains double refraction is the one which is due to the joint labours of Lord Rayleigh, Lord Kelvin, and Mr. Glazebrook.

At the commencement of Chapter VII., which deals with reflection, the following statement is made (see p. 320) :—

"La réflexion vitreuse a donné lieu à trois théories également confirmé par l'expérience, ce sont celle de Fresnel, celle de Neumann et MacCullagh et celle de Cauchy."

The theories of Neumann and MacCullagh depend upon the hypothesis that the *density* of the ether is the same in all media, and that it is the rigidity which

varies; and it is somewhat surprising that M. Poincaré does not appear to be aware of the investigations of Lorenz and Lord Rayleigh, who completely exploded this hypothesis twenty years ago by showing that it leads to two polarizing angles. The weak point in the investigations of most French mathematicians on the subject of reflection and refraction arises from the fact that, in consequence of their not having made a careful study of Green's papers and the subsequent developments by Lord Rayleigh and Lord Kelvin, they are unable to deal satisfactorily with the longitudinal or pressural wave. The difficulties arising from the existence of these waves may be got rid of either by assuming, as Green did, that the ratio of the velocity of propagation of the longitudinal wave to that of the transverse wave is very large, or, by adopting Lord Kelvin's hypothesis, that the above ratio is very small; but it cannot be too emphatically stated that the existence of such waves must not be disregarded, and that any attempt to ignore them will inevitably end in failure.

This chapter concludes with a brief account of metallic reflection, in which the author has adopted the equations of motion given by Voigt. The chief difficulty in trying to explain metallic reflection, by the introduction of a viscous term into the equations of motion, is due to the fact that Eisenlohr has shown that for certain metals the pseudo-refractive index is a complex quantity whose real part is negative.

Turning now to Volume II., which consists of a further course of lectures delivered in 1891–1892, we find that it commences with the theory of isotropic elastic media in its ordinary form. Next follows a chapter on the electromagnetic theory, in which the author confines himself to the case of an isotropic medium, and has given no account of the investigations of Glazebrook on crystalline reflection and refraction, in which it is shown that the intensities of the reflected and refracted waves satisfy the same equations as those deduced many years previously by MacCullagh from an erroneous theory, but which nevertheless explain the facts in a fairly satisfactory manner. M. Poincaré assumes that the vector potential satisfies the solenoidal condition; but although the employment of the vector potential is valuable as a mathematical artifice, its use requires extreme care, inasmuch as it contains an undetermined quantity; and I believe it can be proved that in certain cases the solenoidal condition is not satisfied. In the electromagnetic theory of light this difficulty can always be evaded by eliminating the vector potential from the equations, which is the preferable course to pursue.

In Chapter V., after discussing ordinary reflection and refraction, the author attempts to construct an electromagnetic theory of metallic reflection and refraction by taking into account the conductivity. This theory leads to Cauchy's formulæ, but requires that the real part of the pseudo-refractive index should be positive, whereas Eisenlohr has shown that for certain metals these formulæ cannot be reconciled with experiment unless the real part is negative. In the case of steel this quantity is positive throughout the whole range of the visible spectrum; but as thin films of iron, when magnetized, exhibit anomalous dispersion, it is doubtful whether this hypothesis is satisfactory even in the case of steel or iron.

The next four chapters are devoted to the principle of Huygens and to diffraction; and in Chapter X. the author has discussed Von Helmholtz's theory of anomalous dispersion. The advantage of theories of the class to which that of Von Helmholtz belongs is, that they endeavour to account for dispersion and absorption by taking into account the mutual reaction between ether and matter, and show that when one or more of the free periods of the vibrations of the matter coincides with one or more of the free periods of the rays of the spectrum, absorption and anomalous dispersion will be produced. By the aid of this theory the absorption produced by sodium vapour may be accounted for, as well as the anomalous dispersion and selective reflection produced by fuchsine and other aniline dyes. The author has not, however, developed the consequences of this theory as far as might be done.

It is not unnatural that M. Poincaré should have given special prominence to the writings of his own countrymen; his treatise would, however, have been much improved had he not confined himself so exclusively to the writings of French mathematicians, but had given a fuller account of the work done by mathematicians of other nationalities.

A. B. BASSET.

THE MOTHS OF INDIA.

The Fauna of British India, including Ceylon and Burma. Published under the authority of the Secretary of State for India in Council. Edited by W. F. Blanford. "Moths." Vol. i. By G. F. Hampson. (London: Taylor and Francis, 1892.)

MR. HAMPSON is already favourably known to entomologists by his work on the "Lepidoptera Heterocera of the Nilgiri District," which forms Part viii. of the series of "Illustrations of typical specimens of Lepidoptera Heterocera in the collection of the British Museum." In the work before us he has undertaken a far more important task; nothing less than a descriptive handbook of the moths of India, which, when complete, will prove as useful to Indian entomologists as the well-known work on the butterflies of India by Marshall and De Nicéville.

Hitherto the available information on the moths of India has been scattered over a great variety of books and periodicals, far too numerous and costly to be easily available out of London or Calcutta, and extremely difficult to use satisfactorily, even if accessible. But Mr. Hampson has been given the fullest facilities for examining all the principal public and private collections of Indian moths, from that of the British Museum downwards, and has also made free use of the libraries of the British Museum at South Kensington, which now contain the finest series of entomological books in the world; and the result is a work which can hardly fail to give an enormous impetus to the collection and study of Indian moths.

Much attention has been paid to the classification of moths, and the introductory pages are occupied with details of structure, illustrated by woodcuts of parts of the head, antennæ, legs, and neuration. This is followed by a genetic tree of the families of moths, and by a

tabular key based chiefly on neuration and antennæ. Mr. Hampson admits thirty-four families of Indian moths, of which the first twenty-three, including 1158 species, are dealt with in the volume before us. The earlier families of moths are, however, much less numerous in species than the later ones, and it must not be supposed that Mr. Hampson has dealt with anything like half the Indian species in his first volume, which comprises the series of families usually classed under Sphinges and Bombyces, extending, according to the author's classification, from *Saturniidæ* to *Hypsidæ*. The important Bombycide families, *Arctiidæ*, *Agaristidæ*, and *Uraniidæ*, are, however, relegated to the second volume, while several families of more or less doubtful position find a place in vol. i., such as the *Cymatophoridæ*, *Thyrididæ*, *Sesiidæ*, and *Tinægeriidæ*. We observe that Mr. Hampson closes the series of moths with the *Tineidæ*, *Pterophoridæ*, and *Alucitidæ*, and in this adopts the usual classification, though in the main he has struck out an entirely new classification of his own, and the very first innovation which meets the eye is the novelty of commencing the moths with the *Saturniidæ*.

We hope that Mr. Hampson will take an opportunity of discussing the various systems of classification of moths which have been proposed by Guenée, Herrich-Schäffer, Plötz, and other entomologists, not forgetting the strange system proposed by Zebrawski, in his work on the Lepidoptera of Cracow, in which the butterflies are placed in the middle instead of the beginning of the series of Lepidoptera. Such a discussion would be un suitable in the present work, but if published elsewhere might be very useful.

Long descriptions of genera and species in a work of this character would have been out of place, and we are glad to find that they have been avoided. Each family or subfamily is succinctly characterised, and usually illustrated by a figure of the larva. This is followed by a tabular key to the genera, and then by a notice of the genera and species. The notice of each genus consists of synonymy, type, range, and a brief indication of the principal characters. That of the species includes synonymy, description, including both sexes, and transformations when necessary, range and expanse. An excellent woodcut is usually given of one representative of each genus, showing the wings and body on one side, and the neuration on the other, extra figures of antennæ and legs being sometimes added.

No book, however useful or carefully compiled, can be free from errors, but these cannot be detected at a glance, and the only technical mistake of importance which we have noticed in turning over Mr. Hampson's work is that the broad-bordered Australian *Macroglossum kingii*, Macl., is included among the synonyms of the narrow-bordered *Cephonodes hylas*, Linn.

Much, no doubt, remains to be said about Mr. Hampson's classification, his use of generic names, and his placing together insects regarded as distinct by other authors as synonyms. But these are all points admitting of great difference of opinion, and we do not propose to discuss them further in the present notice.

We should add that various new families, besides many new genera and species, are described by Mr. Hampson for the first time. W. F. K.

OUR BOOK SHELF.

The Year-Book of Science (for 1892). Edited by Prof. T. G. Bonney, D.Sc., LL.D., F.R.S. (London: Cassell and Co., 1893.)

ALL interested in scientific progress will welcome the appearance of the second volume of this useful year-book. The staff of contributors includes such names as Dr. Ramsay, Prof. Seeley, Mr. Botting Hemsley, &c., and the accuracy of the summaries of the year's developments may therefore be thoroughly relied upon. The plan of the volume follows closely on the lines of its predecessor, but it has been extended so as to include geographical and anthropological matters, and zoology has received more complete treatment. If one may judge of the activity in different departments of science by the space required for the account of their progress, electricity and organic chemistry would appear to take the lead. As in the last volume, no attempt has been made to present a complete catalogue of papers. The object has been simply to select the memoirs of exceptional interest; and so far as we have been able to judge, the selections have been judicious. An excellent index of subjects, and one of authors, complete what will no doubt be found a very useful volume.

Treatise on Thermodynamics. By Peter Alexander, M.A. Pp. xii, 203. (Longmans, Green, and Co., 1892.)

THIS is in many respects a singular work. Whole pages, we may almost say whole sheets, are devoted to the multiplication of elaborate proofs of intrinsically simple theorems for which a few lines would be ample allowance, while some of the real difficulties of the subject are but lightly touched on. The other special characteristics, so far as we have seen, are three in number. First, and most prominent, the extraordinary proportion of formulæ to text, which gives the whole the look of a treatise on Partial Differential Coefficients rather than on a branch of Physics. Second, the fearful and wonderful collection of names for special cycles, *e.g. Isothermentropicycle*, *Isobarymegacycle*, *Isenergentropicycle*, &c. Finally, the expressions of doubt or hesitancy with which many steps, universally recognised as valid, are introduced. In the first and second of these characteristics the author far transcends the results of the licence willingly allowed to pioneers like Clausius and Rankine. But these have been (at least in great part) long since discarded, and can never be reintroduced. The third characteristic is, to say the least, not precisely one to be desiderated in a text-book, where we naturally expect to find some slight trace of "Sir Oracle."

Mediæval Lore: an Epitome of the Science, Geography, Animal and Plant Folk-Lore and Myth of the Middle Ages. Being Classified Gleanings from the Encyclopædia of Bartholomew Anglicus on the Properties of Things. Edited by Robert Steele. (London: Elliot Stock, 1893.)

THE original work of which parts are translated in the present volume, may be said to have a place of its own in the history of European literature. It was written in the thirteenth century, and the Latin text was soon widely appreciated, while in the course of the fourteenth century it was translated into French, Spanish, Dutch, and English. The book is full of interest, for it presents a summary of all that was known in the Middle Ages about man and the world. The change which has been gradually effected by the use of modern scientific methods is, of course, incalculable; but some readers will probably be surprised to find to how large an extent Bartholomew mingles the results of shrewd and accurate observation with quaint fancies and unverified judgments. The present volume consists of selections from the edition of Berthelet, 1535; and the good style of the translator adds greatly to the charm of the author's

philosophy and science. Mr. Steele has done his work with much tact and care, and an interesting preface is contributed by Mr. William Morris.

Astronomy for Every-day Readers. By B. J. Hopkins, F.R.A.S. (London : George Philip and Son, 1893.)

THIS is a little book which aims at explaining in "as accurate and interesting a manner as possible such of the phenomena of the heavens as should be known to every intelligent person." It consists of six chapters dealing respectively with day and night, the phases of the moon, the tides, the seasons, eclipses, meteors, shooting stars, and comets. Descriptive astronomy is not touched upon, but there is an introductory chapter giving a general survey of the solar system and its dimensions. The book has been very carefully written, and the scientific explanations are much relieved by interesting references to the history of the subject. The author has succeeded in giving very clear and concise accounts of the every-day phenomena with which the book specially deals, and it seems well adapted to awaken a desire for more in the class of readers to whom he more particularly appeals. A biography of the author—who is described as "the working-man scientist"—is also included.

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.*]

Blind Animals in Caves.

IN an article in the current number of the *Contemporary Review* Mr. Herbert Spencer discusses the "familiar instance" of blind animals in caves as bearing upon the hypothesis of the transmission of acquired characters. Mr. Spencer is not satisfied with the explanation of the blindness of these cave animals offered by Weismann, who endeavours to account for them by two conditions recognised as operating in regard to other cases by Darwin, viz. cessation of selection and parsimony of growth ("Origin of Species," sixth edition, p. 118), of which the former author has treated under the name Panmyxia. Mr. Spencer shows that the saving of ponderable material in the suppression of an eye is but a small economy: he loses sight of the fact, however, that possibly, or even probably, the saving to the organism in the reduction of an eye to a rudimentary state is not to be measured by mere bulk, but by the non-expenditure of special materials and special activities which are concerned in the production of an organ so peculiar and elaborate as is the vertebrate eye.

That, however, to which I wish here to draw the attention of Mr. Spencer and his readers is this :—Mr. Spencer appears to think that if he disposes of Weismann's explanation of the blindness of cave-animals according to "Panmyxia"—there remains only the explanation by "transmission of acquired characters" in the field. He appears not to be acquainted with the explanation which I have offered of the blindness of cave-animals. It is closely similar to that given by Darwin of the occurrence of wingless insects on oceanic islands. My explanation consists in an application to the case in hand of Darwin's principle of "natural selection." I published it some years ago in my article "Zoology" in the "Encycl. Britannica," reprinted in 1890 in a volume of essays, bearing the title "The Advancement of Science." My suggestion was (and is) as follows, and I should like to see what Mr. Spencer has to say to it :—"This instance (that of the blind cave-animals) can," I wrote in the article above-named, "be fully explained by natural selection acting on congenital fortuitous variations. Many animals are thus born with distorted or defective eyes whose parents have not had their eyes submitted to any peculiar conditions. Supposing a number of some species of Arthropod or Fish to be swept into a cavern or to be carried from less to greater depths in the sea, those individuals with perfect eyes would follow the glimmer of light and eventually escape to the outer air or the shallower depths, leaving behind those with imperfect eyes to breed in the dark place. A natural selection would thus be effected. In every succeeding generation (bred in the dark place) this would be the case, and even those with weak but still seeing eyes would in the course of time escape, until only a pure race of eyeless or blind animals would be left in the cavern or deep sea."

My own position in regard to the hypothesis of the transmission of acquired characters remains what it was ten years ago, viz. that in the absence of observed instances of this transmission and in the presence of repeated observation that particular acquired characters are *not* transmitted, I do not consider it legitimate to *assume* a transmission of acquired characters as the explanation of any given case, such, for instance, as that of the blind cave-animals. I am confirmed in this attitude by the fact that a little consideration has enabled me and others to explain satisfactorily, by reference to no hypothetical causes, but to the admitted and demonstrable facts of "congenital variation" and "natural selection," instances brought forward as "only to be explained on the assumption of the truth of Lamarck's hypothesis."

On the other hand, I have always considered that there is not sufficient ground for asserting that a transmission of acquired characters *can not* take place. The important question is still as it was five years ago, "*Does* it take place?"

Oxford, February 14. E. RAY LANKESTER.

Glacier Action.

I HAVE read with great interest and pleasure the short review in your paper of last week by Prof. Bonney, giving a summary of the results of a survey of the French freshwater lakes, and indicating as the most probable conclusion that they cannot be accounted for on the theory of the late Sir A. Ramsay, by the digging-out power of glaciers.

Living as I do in a highly glaciated country, and in a country also full of lakes, both fresh and salt, I have never believed in that theory. Lakes seem to me to be due to the same causes which have produced the glens and hollows in which they lie, and these causes cannot be identified with glacier action alone. The theory of Ramsay attributes to glacier action powers and effects which have never been proved to belong to them. Glaciers do not dig out. They rub down—abrade—and scoop, when they are moving down inclined planes at angles more or less steep. But when they reach level ground they do not dig ; they rest upon the level surfaces, and when pressed from behind they flow over it. But I have never seen any proof that they can act like a ploughshare, or rather like one of the new digging machines.

In so far as all existing glens may have been formerly occupied by glaciers, their depths must have been increased by glacier action, on the supposition that they were tilted, or upraised at some angle required for this form of true glacier action. On this supposition, indeed, lake basins may be said to be partly due to glaciers. But then this supposition involves and depends upon the assumption that earth movements have made the lake basins what they now are—hollows in a comparative level.

Like all other general theories in the history of geology, the "glacial theory" seems to me to have been ridden to the death, and I have been long waiting for some signs of that reaction or correction which is still much needed. I hold that in this country there is not only no evidence of "ice sheets" overriding all the hills, but the strongest evidence against such sheets. Our glens had true glaciers in abundance, no doubt, and they have left their tool-marks very distinctly. But those marks are quite inconsistent with one universal ice-cap or ice-sheet over all the land. ARGYLL.

Inveraray, February 16.

Dr. Joule's Thermometers.

EVERY one will, I am sure, be glad to know that Dr. Joule's thermometers are under investigation by Prof. Schuster.

It is unfortunate that Joule does not give the actual readings of the freezing point, but if the comparison quoted by Rowland was made in either 1879 or 1890 it may be that he referred to the reading of November, 1879, when the total rise of the zero point was 12·92 scale divisions. In that case the original reading in April, 1844, would be 9·70 ; at any rate this number cannot be very far from the truth.

The temporary changes of zero point alluded to by Prof. Schuster certainly complicate the matter, but from the numbers given it would appear that since 1879 or 1880 there has been a

further secular rise of from 0·38 to 0·89 of a scale division. Nothing is said in Joule's paper about the temperatures at which the thermometers had been kept before the readings of the freezing point were taken, but as the later observations—and most of the earlier ones—were made in the winter months, it may perhaps be assumed that the temperatures were nearer 7° than 30°, and that the actual reading on the scale last winter should be taken as nearer 23·51 than 23·00. If this is so the total rise of the zero point last winter would be nearer 13·81 than 13·30.

Prof. Schuster states that "with properly annealed thermometers the secular changes are much smaller than the temporary ones," and that is no doubt true for observations extending over a limited time and with such comparatively large variations of temperature as from 7° to 30°. It may be pointed out, however, that the secular rise since 1879 or 1880 is probably greater than the maximum temporary change recorded by Prof. Schuster, and of course the total secular rise is enormously greater.

It may be true that the secular changes of a thermometer gradually vanish, but it must, I think, be conceded, that in the case of Dr. Joule's thermometer it will be a long time before absolute constancy is attained. There can be no doubt that even now, nearly forty-nine years after the first reading was taken, the zero point is still rising, and it does not appear to me to be very improbable that during the next fifty years there may be a further rise of two scale divisions, the amount calculated from the purely empirical formula which I have suggested.

SYDNEY YOUNG.

University College, Bristol, February 20.

Foraminifer or Sponge?

UNDER the above heading in last week's NATURE Dr. Hanitsch briefly draws our attention to Mr. A. Goës' report on the deep sea organisms procured by Prof. Agassiz in the American tropical Pacific, which he describes as Arenaceous Foraminifera, with the name *Neusina Agassizi*.

As it was from me that Dr. Hanitsch received the specimens he describes, which I had after a personal conversation on the matter sent him, for his opinion as to their relation to true sponges, I venture to send some further observations on these interesting forms.

Dr. Hanitsch is, I believe, quite right in referring Mr. Goës' Neusina to Prof. Haeckel's *Stannophyllum zonarium*, as described in his report on the *Challenger* deep-sea Keratosa. But while admitting my admiration of Prof. Haeckel's wonderful production on the *Challenger* specimens, I do not agree with him as to their being true Keratose sponges.

My conclusion is based upon the examination of nearly the whole *Challenger* collection, and in not one species could I find the slightest trace of any of the flagellated chambers characteristic of sponges.

Prof. Haeckel accounts for the absence of this important feature through the bad preservation of the specimens. Yet he describes the most delicate parts of a commensal Hydroid in full, and was able to observe amœboidal cells, and the granulated sarcode bodies peculiar to all bottom living Foraminifera.

If, however, the forms described by Prof. Haeckel prove after all to be true Keratose sponges, the present state of our knowledge does not justify their separation from such recognised genera of Foraminifera, as Masonella, and Syringammina of the late Dr. G. Brady; Technitella, Haliphysema, and Marsipella of Canon Norman; or *Hyperammina palmiformis*, described by myself from the Faröe Channel, all which forms have the power of forming siliceous and chitinous skeletons.

Without going into further detail here it will be readily understood that I quite agree with Mr. Goës in placing these organisms among the Foraminifera, although it would have been better had he given us a clearer and more detailed description of his Neusina.

I had hoped to have published my personal observations on these most interesting organisms, but circumstances have prevented me doing so up to the present.

I for one would be glad if Dr. Hanitsch would give his opinion as to their supposed sponge structure, which he has not done in his previous letter.

F. G. PEARCEY,

Late of the *Challenger* Expedition and Commission.

Owens College Museum, Manchester.

Colonial Meteorology.

ON p. 363 of your last number your reviewer of the "Year-book of the Imperial Institute," after remarking that "climate certainly deserves better treatment," continues:—

"We do not think space would be wasted in giving the mean monthly temperatures and rainfall for the average year and for two extreme years, at a few representative stations in the larger colonies. This information cannot indeed be found in any existing books, but must be worked out from original records, which exist abundantly, and are rarely made available to practical workers."

I am afraid that the reviewer does not always read NATURE, for you, sir, have on several occasions noticed my efforts in this direction, efforts which have gone on uninterruptedly for twenty years. As, now that you have taken the matter up, it is not improbable that some of the funds lavished on the Imperial Institute may be devoted to the subject, and my small organisation be swamped or superseded, I hope that you will, in justice to the directors of the various Colonial observatories who have helped me for so many years, and as some consolation for the entire ignorement of our organisation by your reviewer, allow me to give its history in the fewest words possible.

In 1873 I determined to try to publish monthly a table giving the principal climatic data for each synchronous month at widely spread stations over the entire British Empire. The leading idea was identity, so as to ensure comparability. I therefore prepared some blank forms and sent them with a circular letter to about twenty of our leading Colonial meteorologists. Every one without exception promised to help, and it says much for colonial climate to add that during the subsequent twenty years not more than five or six of my original correspondents have passed away.

During the period occupied in the transit of my request and of the replies thereto, I wrote a series of short articles pointing out the leading features, and as far as practicable the mean values, for the various stations, so that when we began publishing the monthly values, the departures from the mean could be recognised. These articles and the tables themselves from 1874 to 1881 appeared in *The Colonies* (subsequently *The Colonies and India*). When in 1882 that paper passed into other hands, the proprietors declined to publish the tables, and I began to insert them in the *Meteorological Magazine*, where they have appeared regularly month by month for the subsequent thirteen years. At the close of each year an extra table is given with a summary of the results for the year, and NATURE has often done me the honour of quoting portions of these summaries.

I enclose copy of our last table, and though I know that to reproduce it would be to make a somewhat large demand upon your space, I feel that the work (wholly unpaid, be it remembered) of my Colonial friends during these past twenty years, claims some consideration and some recognition. You will see by the signatures that the authorities are the highest attainable.

G. J. SYMONS.

62, Camden Square, N.W., February 17.

Ozone.

WITH reference to a paragraph in NATURE, p. 373, on observations of ozone in the atmosphere, and the paucity of observers and records, I may be allowed to state that I have collected sets in the North Atlantic and Pacific Oceans and Mediterranean. These have been taken by officers of the Royal Navy and mercantile marine at sea, and some of the records have been tabulated, and may be communicated to some society in due course. Moffatt's papers, made by Negretti and Zambra, have been used throughout, so the observations are all uniform and comparable.

W. G. BLACK.

Edinburgh, February 19.

LION-TIGER AND TIGER-LION HYBRIDS.

THE Council of the Royal Zoological Society of Ireland entertain some hope that it will be possible to produce in their Gardens examples of hybrids or cross-breeds between the two largest species of cat, namely, the lion and tiger.

That such hybrids have been produced is a matter of historical record, and as the writer is particularly inter-

ested in the success of the experiment now in progress in the Dublin Gardens, where over one hundred lion cubs have been successfully reared, he thinks it desirable to record all the details which he has been able to collect on the subject.

So far as can be ascertained the only lion-tiger cubs, as they have been called, which were ever produced belonged to several distinct litters by different parents, perhaps, but in the same menagerie—that of F. Atkins, of Windsor.

The father of the first litter of these cubs was a lion bred in Atkins's menagerie, the head-quarters of which were at Windsor. The mother was an imported tigress. From Griffith's account ("Animal Kingdom," vol. ii. p. 448, 1827) it would seem that the lion and tigress were about two years together, in the same cage, before any issue appeared. The first litter, consisting of three cubs, was born at Windsor on October 17, 1824—being the result of a particular intercourse which lasted for ten or twelve days in the beginning of the previous July. The cubs were shortly afterwards exhibited to his Majesty, who, according to the showman's own handbill—a copy of which has been lent to me by Dr. William Frazer—christened them lion-tigers. The lion died six weeks afterwards, and the cubs, as related by Griffith, were fostered by several bitches and a goat, and it was expected would attain to maturity; but although there is no clear intimation as to the exact date when this was written, the figures of the cubs accompanying the account are said to represent them at the age of only about three months. It is stated by one writer, however, that they did not attain to maturity ("English Cyclopædia Nat. Hist.," vol. ii. p. 763, art. "Felidæ," 1854).

The next litter was born at Edinburgh on December 31, 1827, according to Atkins's showbill and Sir William Jardine's works.[1] There were two cubs, and it would seem that they were exhibited together with, and therefore probably reared by, the mother, in the same den; but whether she were the same tigress as the mother of the previous litter is not clear.

They were seen by Sir William Jardine in September, 1828, and his figures may have been taken from them; but it has some resemblance in details, though not in general pose, to the figures published by Griffith of the 1824 litter. It would seem that Sir William was under the impression that it was these very cubs which were subsequently exhibited together with their parents in the same cage in the autumn of 1829. But there is a difficulty in accepting this conclusion, because the stuffed specimens of these two cubs still exist—one in the British Museum (Natural History) and the other in the Science and Art Museum, Edinburgh. I have recently had opportunities of examining both, and I should be inclined to think that the cubs were not *more* than about nine or ten months old when they died. So that either the cubs seen in 1829 were born subsequently to December 31, 1827, or the stuffed cubs just referred to must have been born previous to that date. That the cub in the British Museum was presented by J. Atkins, of Windsor, is attested by Dr. Gray's "Old List," page 40, which, through the courtesy of Dr. Günther, I have been able to consult.

That the specimen in Edinburgh was one of those born in 1827, and figured by Sir William Jardine, is, indeed, stated in the "English Cyclopædia," which adds that the cubs of that litter died young. Hence, it seems most probable that the cubs seen in the autumn of 1829 belonged to a subsequent litter, as has been suggested above. Further, Mr. J. G. Robertson, formerly of Kilkenny, has informed me that he saw a lion, tigress, and their three hybrid cubs in one cage in Kilkenny, where they were brought by a showman about the year 1832. They were the sole stock of the show.

[1] "The Menageries, Quadrupeds," Sir William Jardine (2nd edition), vol. i. pp. 191, 192. 1830.

Accordingly, it seems that besides the definitely attested births of the years 1824 and 1827, there were also, probably, some others. One of the accounts states that there is no great difficulty in promoting the union of the two species.

Besides the cub already referred to as having been presented to the British Museum by J. Atkins, I have also been shown by Dr. Günther unmounted skins of two reputed hybrid lion-tiger cubs, which are said in Dr. Gray's list to have been purchased from a dealer named Mathur, in 1842. They cannot, I think, have survived more than two or three days after birth, and their markings are too indistinct to justify any special description, particularly as their parentage is not more definitely attested. But it is of some importance to place on record here what is said as to the markings of the cubs first referred to. The specimens in the British and the Edinburgh Museums are both somewhat faded. In Gray's list the former is thus described: "Hybrid cub between lion and tigress; yellow; back slightly waved; limbs and tail banded with black."

Sir William Jardine merely says the general colour was not so bright as that of the tiger, and the transverse bands were more obscure.

Griffith describes the cubs he figured as follows:—

"Our mules, in common with ordinary lions, were born without any traces of a mane, or of a tuft at the end of the tail. Their fur in general was rather woolly; the external ear was pendant towards the extremity; the nails were constantly out, and not cased in the sheath, and in these particulars they agreed with the common cubs of lions. Their colour was dirty yellow or blanket colour: but from the nose over the head, along the back and upper side of the tail the colour was much darker, and on these parts the transverse stripes were stronger, and the forehead was covered with obscure spots, slighter indications of which also appeared on other parts of the body. The shape of the head, as appears by the figures, is assimilated to that of the father's (the lion); the superfineness of the body on the other hand is like that of the tigress" (p. 449).

Prof. R. H. Traquair, F.R.S., keeper of the natural history division of the Edinburgh Museum, has kindly had a photograph taken of the specimen above referred to prepared for me, and the transverse markings are distinctly visible in this picture.

I am tempted to conclude this record with an extract from Atkins's somewhat quaintly-expressed handbill, which does not bear any date, but probably belonged to the year 1828. The greater part of the bill consists of a long poetical description of the family with "a tigress their dam, and a lion their sire," and of the numerous distinguished persons who had paid them a visit. The following prose portion will probably be sufficient to extract from what is possibly one of few still existing copies of the handbill.

"ATKIN'S IMMENSE MENAGERIE.

"WONDERFUL PHENOMENON IN NATURE.

"*The singular, and hitherto deemed impossible, occurrence of Lion and Tigress in one den.*

"Cohabiting and producing young, again took place in this menagerie, on the 31st of December, 1827, at the City of Edinburgh, when the royal tigress brought forth two fine cubs!! And they are now to be seen in the same den with their sire and dam. The first litter of these extraordinary animals were presented to our most gracious Sovereign, when he was pleased to express considerable gratification, and to call them lion-tigers, than which a more appropriate name could not have been given. The great interest the lion and tigress have excited is unprecedented; they are a source of irresistible attraction, especially as it is the only instance of the kind

ever known of animals so directly opposite in their dispositions forming an attachment of such singular nature. Their beautiful and interesting progeny are most admirable productions of nature. The group is truly pleasing and astonishing, and must be witnessed to form an adequate idea of them. The remarkable instances of subdued temper and association of animals to permit the keeper to enter their den, and to introduce their performance to the spectators, is the greatest phenomenon in natural history."

V. BALL.

OBSERVATIONS OF ATMOSPHERIC ELECTRICITY IN AMERICA.[1]

THE meteorological official of the United States known as "The Chief Signal Officer" has sanctioned the publication of this voluminous report of 320 quarto pages, embodying the result of a widespread photographic record and direct reading of atmospheric electrometers carried out under the auspices of the United States Government during the years 1884 to 1888, with the immediately utilitarian object of ascertaining how far it was possible to use electrical indication in weather prediction. As Mr. Mendenhall says, "No studies or investigations which did not bear upon this question were [considered] proper or allowable."

Although thus limited in scope the actual observations made and here recorded can hardly fail to be of service to future investigators into this obscure subject.

The report begins with a historical introduction, in which it is admitted that electricity was first purposely drawn from the clouds in France by Buffon and D'Alibard about a month before Franklin tried his already projected experiment; and that de Saussure was one of the first to obtain fairly quantitative results and to detect a diurnal period.

Volta "hit upon the capital device of a burning match" to replace the previous feeble collecting devices such as a bullet and wire shot up into the air. But nothing really exact and continuous was done "until Sir W. Thomson attacked the problem." He introduced the quadrant electrometer and the water-dropper, which have been the universal recording instruments ever since.

In fact "the work of Palmieri on Mount Vesuvius constitutes perhaps the only extensive series of observations in which instruments founded on the original design of Sir W. Thomson have not been used."

In the States the first energetic and influential mover in the direction of a serious record appears to have been Prof. Cleveland Abbé, who got himself authorised in 1880 by the Chief Signal officer to consult with Prof. Rowland on the subject, and afterwards with Prof. Trowbridge, and to make arrangements for a series of effective observations. Under the auspices of these gentlemen a staff of observers were trained and suitable instruments obtained, tested, and improved. Various collectors were tested, and in 1883 a photographic registration apparatus of M. Mascart was put into operation. In 1884 Mr. Mendenhall "was appointed to assume the direction of the work as chief of the physical laboratory and instrument division of the office in Washington." Stations were established in Washington, Baltimore, Boston, New Haven, Ithaca, and Ohio.

Much work was done in connection with electrometers by McAdie and McRae, but this is incorporated in the article "Electrometer" of the "Ency. Britt."

The instrument ultimately adopted was a quadrant electrometer of the Mascart pattern with special improvements, and was constructed by the Société Génevoise. A picture of it is given.

[1] "Report of Studies of Atmospheric Electricity." By T. C. Mendenhall. Extract from Memoirs of the National Academy of Sciences, 1889. (Washington.)

The method of connecting the quadrants to the two equal halves of a water battery, so that they might always be at equal opposite potentials, and of attaching the needle to the collector, was after many trials adopted; partly because higher insulation was thus possible, partly in order to get a straight line law. Deviation from this, due to what is called the "electric directing couple," is not overlooked, but by a stiff suspension and small range it is minimised.

An interesting chapter is that on "collectors." The water-dropper was mostly used, but its freezing is apt to interrupt the record. "Sergeant Morrill experimented on a special flame collector," supplied with gas at constant pressure and arranged so that wind could not extinguish it, and "before the termination of the work obtained very satisfactory results." But in order to secure uniformity between different stations he also designed a mechanical collector—a clockwork machine with revolving arm and intermittent contacts, which is virtually a gigantic replenisher, utilising the atmospheric potential as an inductor, and thereby feeding the electrometer up to the same potential. It seems to be as quick in response as a water-dropper (an important point, as some of the fluctuations of potential are very rapid), but "as it was only completed towards the end of the period of observation nothing very definite can be said of its performance." An illustration of the ingenious device is given in detail.

Observations.

Preliminary records are given showing the curves got at a roof station and a balcony station, also at different observatories in the same town. Some also from the top of the Washington Monument, which naturally show far greater potential and changes than the instrument in the Signal Office.

There are plotted a number of zigzags obtained from the different stations about the States, and very complicated and entangled the record is. None of the stations show any agreement; and, particularly at Ithaca, the electrometers seem usually to have been in a wildly excited state.

But during an Aurora on May 20, 1888, they were singularly quiet, and the remark is made: "It will be observed that the indications of the electrometer were positive during the day and night, and that no unusual fluctuations occurred."

The atmospheric potential is usually positive, and it has been often thought that a change to negative signalised bad weather. Certainly this does frequently happen; sufficiently often to make it worth while specially to examine this point; and several curve charts are given to show that "negative electricity in clear weather was observed at most if not all of the Signal Service Stations on numerous occasions during the progress of the work. In many cases precipitation occurred at points 10 to 100 miles distant, but in others clear weather prevailed over almost the entire country. A number of instances of negative potential during clear weather occurred at Ithaca, where careful attention was given to the matter of special observation by Mr. Schultze."

Effect of Dust, Haze, Fog.

"The effect of dust, haze, smoke, &c., in producing negative potential has been noticed by more than one observer. [Query whether the negative potential can have ever produced or permitted the haze.—O. J. L.] Several instances of the action of clouds of dust were noted by Sergeant Morrill at Boston. On March 7, 1888, in the afternoon the potential was observed to fall rapidly from −90 to −270 upon the rising of an especially heavy cloud of dust, and similar phenomena were observed on April 7." "A fall of potential could be certainly predicted when a dust cloud was seen rising. On other days when high winds and dust clouds prevailed negative potential

was observed. A figure is given of an observation at Terre Haute, Ind., on a day when a fog formed after sunset, and the potential then rapidly fell from + 1000 to − 200 volts." "The same phenomenon was frequently observed during the autumn when the formation of a haze or fog just as the sun was setting was a common occurrence."

The observer at Terre Haute (Sergeant McRae) wisely made special observations as to the possible effect of locomotives on a railway a quarter of a mile distant; but, so far as the recods show, the passage of a train, when not happening to coincide with a fog formation, did not seem to disturb the curves.

Clouds and Wind.

"The direct action of a cloud or group of clouds in producing a fall of potential was often observed." For instance the following at Boston: — "In the morning of January 3, 1888, the potential had been steadily positive. At 11.30 it was + 32 volts, from which it fell steadily at the approach toward the zenith of a small cumulus cloud, reaching − 21 volts. As the cloud passed away the potential rose to + 6, again falling to − 31 as a large mass of cumulus clouds approached. Later the sky became overcast, and the potential became steadily negative.

"On June 7, at 5.30 p.m., the potential fell from + 43 to − 173, and then rose slowly to its former value. The rise and fall occupied fifteen minutes, and coincided with the appearance over the buildings to the west of a fleecy cirro-stratus cloud and its disappearance over the institute building in which the electrometer was located.

"Again, on June 9 the potential was positive all day up to 5 p.m. At that hour it fell from + 73 to − 113, then rising to + 52. The sky was nearly free from clouds, and the fluctuation coincided with the approach and departure of a cirro-stratus cloud, passing about 15° from the zenith. The inductive action of the cloud was plainly suggested in all of these cases."

High wind also usually causes a drop of potential.

Averages.

Some charts are then given of average monthly potentials, showing nearly always positive average values, highest in the winter, lowest in summer.

Some smoothed diurnal curves are also given, and "seem to indicate the existence of two principal maxima of potential in the day, and also in a general way that one of these occurs not many hours before noon and the other toward the latter part of the day."

Thunderstorms.

Special attention was paid to the observations before, during, and after the occurrence of thunderstorms, but the needle then dashes wildly to either side, and sparks often begin to pass. And the remark is made :—"Aside from the general characteristics (rapidity and range of fluctuation) these potential curves seem to have little in common. The examination of a few cases only might lead to interesting conclusions, which would almost certainly be overthrown by the study of a greater number. Sometimes the potential falls rather steadily until the violent movements begin, but sometimes it rises just as long and steadily. In many cases the fluctuations start from a high positive, while in many others the reverse is the case. The storm is usually accompanied by precipitation; sometimes this begins before the needle starts on its series of swings from side to side, and sometimes these movements precede precipitation. The steady rise of potential for some hours immediately following a thunderstorm may mean that clear and fair weather is to be expected, but Fig. 71 is good evidence that it may also be interpreted to mean that another thunderstorm is just at hand."

"Although these records are somewhat unsatisfactory as far as throwing any light upon the nature of thunderstorms, it must not be forgotten that with a single exception [two stations at Washington] none of these storms have influenced more than one station. The complete investigation of a storm would demand a large number of observing stations relatively near to each other, by means of which a full history of the potential changes about and in all parts of the storm could be obtained.

"Such an examination might result in bringing order and system out of what seems at present little less than confusion."

Then follow many specimens of the actual photographic record at Baltimore on days when lightning occurred, and finally a mass of tables embodying abstracts of results at the different stations, and also some taken at Kew and Greenwich in England; though at both of these institutions the scale used appears to be arbitrary.

General Conclusions.

Among the conclusions the following may be noted: "Instruments similar in every respect, separated by a distance of a hundred meters may give very dissimilar indications." (Not merely, it is explained, as regards *absolute* values only, which may be expected to disagree, but as regards fluctuations also.) "Observers were instructed to study the appearance of negative electricity before and after and during precipitations, and at one time the hope was indulged in by the writer, as well as by several of the observers, that this phenomenon might afford great assistance in the prediction of local storms, rains, snows, &c., which offer so much difficulty in forecasting by present methods.

"Further observation and investigation, however, did not justify this expectation, serving rather to increase the meteorological conditions under which negative potential might be looked for, and to diminish the definition of relationship between it and precipitation. That negative electricity is tolerably certain to be observed in connection with precipitation in a majority of cases is doubtless true, but it does not appear in such a way as to be of any value in forecasting."

Near the end of the historical introduction we learn with regret that the observations thus tabulated and discussed are now no longer going on.

"In August, 1888, all observations were discontinued. It was thought that a sufficient number had been accumulated to decide the question of their use in weather forecasting, and in fact their study up to that date gave little encouragement in that direction." "Many questions of great scientific interest . . . had to be set aside for those likely to be of immediate practical value."

The amount of material thus rapidly accumulated, centralised, and well discussed, is typical of what can be done under efficient Government authorisation and by the head of a National Laboratory. The carrying on of the research for immediate utilitarian ends, and stopping it as soon as it was seen that the results aimed at were not forthcoming, is perhaps also typical.

It is to be hoped that some day the question will be reopened, and a fresh series of results obtained. So far as I (who am by no means a meteorologist) can judge, I should surmise that a number of fairly concentrated stations over a large plain would be desirable; and also that the vertical gradient of potential should be attempted by a series of collectors at different attitudes on a tall mast, or possibly up a hill-side.

Further, the general aspect of the curves seems to me to suggest that the instruments were almost too sensitive and not sufficiently dead-beat. They should be quick in indication and at the same time thoroughly damped, so that the record shall contain as little as possible of any effect due to instrumental inertia. Some very light

quartz-fibre instrument might be devised, and perhaps it might contain its own recording apparatus in a compact form, so as to make registration a much easier and less cumbrous business than it has been hitherto.

When so much is unknown it is a mistake to begin by observing with too great intricacy of detail. The salient features should be first obtained, and then attention directed to the minutiæ; but one of the first things to do is to arrange that every swing in the curve shall mean a swing of atmospheric potential, and not a mere excursion of a heavy needle.

I hope that the energy, skill, and judgment of the various observers in the States, and of Mr. Mendenhall, the author of this valuable report, may be utilised through the resources of the U.S. Government by the inauguration of a fresh series of observations under somewhat different conditions, and without the hamper of any immediately specified practical object. OLIVER J. LODGE.

THE PRESERVATION OF THE NATIVE BIRDS OF NEW ZEALAND.

IN our issue of September 16 last year (vol. xlvi. p. 502) we printed an excellent memorandum drawn up by Lord Onslow, late Governor of New Zealand, relating to a proposal for the preservation of the native birds of that colony by setting apart two islands for this purpose, namely, Little Barrier or Hauturn Island in the north, and Resolution Island in the south. As regards the first of these islands, we have lately received a copy of the report by Mr. Henry Wright (addressed to the Hon. John Ballance, Premier of New Zealand) upon the subject. According to Mr. Wright, Hauturn Island, in the Gulf of Hauraki, which is almost circular in shape, and contains an area of from 9000 to 10,000 acres, rising in the middle to an elevation of about 2000 feet, is very well adapted for the purpose required. Writing with a thorough knowledge of all the north island, Mr. Wright is able to say that there is no other part of it where the native birds are to be found in anything like such profusion and variety. He gives a list of forty species to be met with within its limits, and mentions as particular varieties the stitch-bird or kotihe (*Pogonornis cincta*) and the large dark kiwi (*Apteryx bulleri*) as both found there. There are slight difficulties in the way of the project, such as the presence of about a dozen Maoris now living on the island, and of a claimant for the timber, which, in the shape of kauri pine (*Dammara australis*), is present in large quantities. There are no Weka Rails (*Ocydromus*) in the island to destroy the birds' eggs; and there are no bees, which, for some reasons, are considered to be highly inimical to the native birds in New Zealand. The wild pigs, formerly numerous, have been killed out; and the mutton-bird (*Œstrelata gouldi*), the young of which were formerly eaten by the pigs, will consequently be able to breed again undisturbed. Cats unfortunately are very numerous, but Mr. Wright proposes to offer at once a reward for their destruction, which is, of course, of great importance.

Mr. Wright's report seems quite convincing as to the suitability of Hauturn Island for the object in view, but we regret to hear that some difficulties have arisen in the Parliament of New Zealand as to the appropriation of the funds required for the purpose.

Lord Onslow, however, is not disposed to let the matter drop, and will, we are sure, be strongly supported by Lord Glasgow, the present Governor of New Zealand, in carrying the matter to a successful issue. The Council of the Zoological Society of London, whose attention has been called to the subject, have passed in its favour the following resolutions, which were communicated to a general meeting of that body on the 16th inst.

(1) The council of the Society have learnt with great satisfaction the steps that were proposed to be taken by the Earl of Onslow, when Governor of New Zealand, and by the Houses of General Assembly for the preservation of the native birds of New Zealand, by reserving certain small islands suitable for the purpose, and by affording the birds special protection on these islands.

(2) The council much regret to hear that difficulties have been encountered in carrying out this plan as regards one of these islands (Little Barrier Island), and trust that the Government of New Zealand may be induced to take the necessary steps to overcome these difficulties and to carry out this excellent scheme in its entirety.

(3) The council venture to suggest that besides the native birds to be protected in these reserves shelter should also be afforded to the remarkable Saurian, the Tuatera Lizard (*Sphenodon punctatus*), which is at present restricted to some small islands on the north coast of New Zealand, in the Bay of Plenty.

These resolutions have been communicated to the present Governor of New Zealand, and will, we trust, be of some assistance to him in inducing his Ministers to carry this excellent scheme into execution.

THE EARTHQUAKES IN ZANTE.

THE following is a list of the shocks of earthquake at Zante, compiled from telegrams published in the *Times* and *Standard*:—January 31, at daybreak, the most destructive earthquake, of which, however, some warning must have been given, if we may judge from the comparatively small loss of life. Other slighter shocks followed during the day. February 1, 2 a.m., another severe shock, felt also in Cephalonia. February 2, two more violent shocks, one of which caused some fresh damage. February 3, further shocks, but less frequent and violent. February 5, another violent shock. February 6, continued shocks of slight intensity, followed by three more severe ones in the afternoon and evening. February 7, another violent shock in the morning, resulting in but little additional damage. February 8, some slight shocks. February 10, some slight shocks in different districts. February 11, 1 a.m., a somewhat severe shock, followed by a succession of shocks between 8 and 9 p.m. February 12, further shocks in the early morning, soon after midnight, and again at intervals during the day. February 13 or 14, renewed slight shocks, accompanied by loud subterranean rumblings. The Athens correspondent of the *Times*, telegraphing on February 20, says: "The shocks of earthquake continue at Zante, with varying degrees of violence. No serious damage is reported, but those who are compelled to live in the half-ruined or insecure houses are exposed to frequent alarms." It is estimated that the total loss of property due to the shocks may exceed £600,000.

According to a telegram in the *Times* for February 6, the tide in Venice on the evening of February 1 "ebbed so low as to leave several of the canals without water. The gondola traffic was interrupted at different points, and many of those craft were stranded. This phenomenon corresponded with the earthquakes at Zante and Cephalonia." A simple calculation will show, however, that this can hardly have been due to the principal shock. The straight line joining Zante and Venice passes almost directly up the Adriatic, and its length is roughly 720 miles. Taking the time between daybreak on January 31 and the evening of Feb. 1 at 36 hours, this would give for the sea-wave an average velocity of 20 miles an hour, corresponding to an average depth of about 30 feet, which is considerably less than the actual amount, the mean depth of the Adriatic being 110 fathoms.

Earthquakes are frequent in Zante, and sometimes very severe. One of the most destructive shocks, which occurred on October 30, 1840, is described by Ansted in

his work on the Ionian Islands (pp. 415-419) chiefly from the report of the Lord High Commissioner, Sir Howard Douglas. The prison was in this case also unroofed, and hardly a house in the town of Zante escaped some injury. All of the villages on, or bordering on, the plain suffered more or less, especially Sculikado, which was reduced to a heap of ruins. The total amount of damage done was estimated at not less than £300,000. The great earthquake was followed by a large number of others, some very severe, ninety-five being counted up to November 4. Ansted notes (pp. 368, 369) the curious fact that each of the Ionian Islands seems for the most part to have its own earthquakes, independently of the others. About the year 1818, he says, all the sensible shocks in Cephalonia and Zante were tabulated, the record extending over two and a quarter years. "During this time thirty distinct and well-marked shocks were recorded in Cephalonia; but in no case did the shocks in Zante, although nearly contemporaneous, absolutely coincide with them. In most cases an interval of some days, and almost always more than twenty-four hours, seems to have elapsed between the times of the disturbances in the two, although they are so near that in these days [1863] of long range, a cannon-shot fired from the one might reach to the other."

NOTES.

THE French Academy of Sciences has opened a subscription in support of the movement for the publication of the writings of Jean Servais Stas and the erection of a monument in his memory.

A MEETING of delegates of the Academies of Science at Berlin, Göttingen, Leipzig, Munich, and Vienna was held on January 29, under the presidency of Prof. Ribbeck. The object of the meeting was to prepare the way for a sort of federal union of the various German scientific societies, so that they may be able to act together about important matters of common interest. A hope was expressed that a great international confederation of scientific societies might ultimately be formed.

ANNOUNCEMENT has been made of the death, on February 2, 1893, at Hendaye, in the Department of the Basses Pyrénées, in his sixty-eighth year, of M. Victor Aimé Léon Olphe-Galliard, author, among other works, of "Contributions à la Faune Ornithologique de l'Europe Occidentale," in forty livraisons (of which the last was published in 1892) giving an elaborate description of the birds not merely of Western but of almost the whole of Europe, to say nothing of allied species belonging to other countries. M. Olphe-Galliard (whose name few writers, even Frenchmen, spell correctly) was remarkable among his countrymen for his knowledge of other languages than his own, and his recognition of the works of foreign ornithologists stands out in great contrast with that accorded to them by most continental authors. He translated into French several valuable papers written in Swedish and other tongues as little known, thus bringing them before readers to whom they would have been otherwise inaccessible, while he still further showed his appreciation of foreign naturalists by introducing into his principal work portraits of Johann Friedrich Naumann and William Macgillivray as the representative ornithologists of Germany and Great Britain. The earliest performance by which M. Olphe-Galliard will be remembered was his description in the *Annales* of the National Society of Lyons for 1852 of the interesting Algerian bird which he called *Erithacus Moussieri*, after a French army-surgeon of that name who had recognised it as a new species in 1846. In the following year specimens of it were procured by the late Mr. Louis Fraser, and placed in the British Museum, but they met no kind reception there then, or even later, for the species finds itself in the *Catalogue of Birds* (vii. p. 20) far removed from what all naturalists who have observed it in life declare to be its nearest relations—the Stonechats or the Redstarts—and shot into the rubbish-hole placarded *Timeliidæ*, where no one would ever think of looking for it. M. Olphe-Galliard's latest publication consisted of letters addressed to him by the somewhat eccentric Christian Ludwig Brehm, which appeared in the *Ornithologisches Jahrbuch* for 1892.

A MEETING of conchologists is to be held at 67, Chancery Lane, on Monday, February 27, at 8 p.m., for the purpose of founding a "Malacological Society of London."

THE Geologists' Association has arranged for a visit of the members to the British Museum (Natural History), Cromwell Road, on March 18, when Mr. W. Carruthers will give a demonstration on "Gymnosperms from the Devonian to the present time." There will be an excursion to Norwich, Cromer, and Lowestoft at Easter.

SOME admirable suggestions for the guidance of teachers of evening classes in wood-working under the direction of County Councils have been prepared by the Examination Board and Committee of the City and Guilds of London Institute. The suggestions relate to drawing lessons, object lessons, and bench-work lessons.

THE type of weather during the past week has undergone but little change from that of the preceding week. Anticyclonic areas lay over Scandinavia and Spain, and low pressure systems continued to skirt our north and west coasts. The general conditions, however, were much quieter, although a deep depression reached the west of Ireland on Sunday, causing gales on our western coasts. On Tuesday a large and important disturbance arrived over the south-west of England from off the Atlantic, and the wind circulation around its central area was complete. The difference of barometric pressure was, however, by no means large in different parts of the kingdom, and consequently there was not much wind. The barometer fell as low as 28·7 inches over the centre of the cyclonic area, and later during the day the disturbance continued its passage across England, and was accompanied by heavy rain. Temperature continued high for the season, the daily maxima ranging generally from 45° to 55°, while on Sunday, the 19th inst., the thermometer rose to 60° in the inland parts of England. In London it reached 59°, which was a higher reading than had been recorded so early in the year since 1878. The sky was exceptionally brilliant in the east and south-east on that day, but on the whole the air has been very damp throughout the week, and rainfall has been of almost daily occurrence. For the week ended the 18th inst. the rainfall exceeded the mean in all districts, except in the east of England. In the west of Scotland and the south-west of England the excess was considerable. Bright sunshine only exceeded the normal amount in Ireland and the north and east of Scotland.

THE Pilot Chart of the North Atlantic Ocean for February, 1893, shows that the weather in the North Atlantic during January was not abnormally severe, and that the eastern part of the ocean was unusually free from storms. A map is given illustrating the great size and severity of the hurricane of December 22 last, which had moved rapidly from Hatteras in an east-north-east direction. At the time selected for illustration, when the centre lay in longitude 36° west, the storm area covered the entire Atlantic from Labrador and Nova Scotia to Madeira, Portugal, and Ireland. Some very low barometer readings were recorded, the lowest being 27·75 inches. There was a large amount of ice during January along the coast of

America, as far south as Hatteras; in Chesapeake Bay it was reported to be thicker than for twenty-five years.

THE official report of the International Meteorological Conference at Munich from August 26 to September 2, 1891, has now been issued. It contains protocols of the various meetings, with appendices and supplements.

THESSALY was supposed to have got rid of the plague of field mice, but it appears that the congratulations offered to her were somewhat premature. The Athens correspondent of the *Times* telegraphs that swarms of these troublesome creatures are beginning to reappear both in Thessaly and in the neighbouring district of Phthiotis. "It was hoped," he says, "that the severe cold and heavy rains of the last few months had exterminated them, but they seem to have taken refuge in the mountains, and are now returning in large numbers to the plains. The Prefect of Phthiotis has applied to the Government for instructions as to the best means of dealing with this destructive pest."

ACCORDING to a correspondent of the *Scotsman*, writing from Borthwickbrae, Selkirkshire, the mice pest in Scotland has greatly diminished, if it has not entirely disappeared, during the last two months. "The great abundance of owls," he says, "coupled with the very severe weather, has no doubt given them a check." During the severe storm of last month the owls, unfortunately, suffered also. The keeper at Alemoor Loch counted over thirty of the short-eared or heather owl, and eight kestrel hawks—some lying dead, others able to fly a few yards only, while several sat until lifted in the hands. The short-eared owls did not go to the woods to roost, which were close to the loch, but were in the willows and reeds along the edge of the loch.

SIR EDWARD BIRKBECK has accepted the presidency of the British Sea-Anglers' Society, which was founded recently at a meeting held in London. It is proposed that the Society shall have branches in all parts of the United Kingdom, and the members hope that they may be able not only to secure for themselves certain advantages in connection with their favourite sport, but to be of some public service. The chairman of the preliminary meeting, Mr. C. H. Cook, touched on the question of legislation for the protection of sea-fish. "I hope," he said, "that the anglers will take up the cause of immature sea-fish. Already a movement, to which we may give a strong impetus, is rolling forward in this direction, but it is checked by the trawlers' interests. The harm done by these men is almost incalculable. I have seen their nets within a stone's throw of the shore, in less than three fathoms of water, where they scoop up and destroy the infant fish by the million. It may be that the evidence tendered by trustworthy members of the Sea-Anglers' Society may be the means of putting an end to inshore trawling. I hope it will. It often happens that the information given to the Fishery Boards is wilfully misleading, owing to it being given by fishermen, who fear they will lose their living."

THE Council of the Cremation Society of England, in its Report for 1892, expresses much satisfaction with the progress made by the cause which the Society represents. It seems that within the year no fewer than 104 bodies were cremated, "including a large proportion of individuals well known in society by their connection with art, science, or literature, or by a distinguished position of some other kind, ten having been members of the medical profession."

MR. A. H. S. LUCAS, who has edited the *Victorian Naturalist* admirably since it was started nearly nine years ago, has tendered his resignation in consequence of his election to the head-mastership of Newington College, Sydney. The Field Naturalists' Club, of Victoria, to which the magazine belongs, has expressed its cordial thanks to Mr. Lucas for his services. Mr. F. G. A. Barnard, who has been both secretary and librarian of the club, will act for the present as Mr. Lucas's successor.

A MOST interesting and suggestive paper on "pottery glazes: their classification and decorative value in ceramic design" was read by Mr. W. P. Rix at the meeting of the Society of Arts on February 7. It is printed in the current number of the Society's Journal. Mr. Rix tries to show that the relative merit of various glazes is based upon certain optical principles, which have only been partially examined by men of science, and that these principles, underlying the pleasurable sensations to the eye, really govern that which we are pleased to call good taste and excellence, so far as glazes are concerned, and are not mere matters of opinion. The reading of the paper was followed by a lively discussion, in the course of which Mr. Binns quoted a saying attributed to Mr. Gladstone, that a fine piece of glaze "feels like the touch of a baby's hand." Mr. Binns had often been struck with the aptness of the illustration. There was a peculiar soft texture in a fine piece of glaze that only a connoisseur could appreciate.

THE *Times* of Tuesday gives an account of a process by which anthracite coal bricks are now being manufactured. The bricks are made of grains of anthracite dust, which are forced to cohere by means of a special cementing compound and by great pressure. The coal dust is mixed with the binding material in the proportion of 96 per cent. of the former to 4 per cent. of the latter. The compound is fed into a mixer, where it meets a jet of steam, a stiff paste being formed, which is delivered successively into a series of moulds under a pressure of 25 cwt. As the mould plate revolves, the charge in each mould is brought between two rams, which exert a pressure of two tons per square inch on each side of the charge, forming a very dense and homogeneous coal brick. The brick, still in the mould, passes on to the delivery ram, by which it is pushed out on to a table, and is removed for the market. These coal bricks are said to make an excellent fuel and to possess a very high efficiency for steam-raising purposes. The *Times* thinks that with such a fuel at the disposal of the public there is room to hope for a reduction in the pollution of the atmosphere of towns, as well as a reduction in the coal bills of steamship companies and of steam users generally. It adds that the invention is being worked by the Coal Brick Syndicate, of 2, Trafalgar-buildings, Northumberland Avenue, London.

IT seems that serious depredations have been committed among the recently-discovered Phœnician tombs at Gebel Imtarfa, in Malta. The *Mediterranean Naturalist* says that the manner in which not only these tombs, but many others, have been rifled of their contents by irresponsible curiosity hunters, and the state in which many of the ancient ruins of the islands now are constitute a disgrace to European archæological science. More has been done to obliterate and destroy vestiges of Malta's ancient history during the last two centuries than was effected in the preceding two thousand years. Orders have been issued from head-quarters, Valletta, to the effect that the District Commanding Royal Engineer is to report immediately any discoveries of ancient tombs, burial places, or pottery that may occur in course of excavations for works, or come to light in any way; and that such objects are to be carefully preserved until they have been inspected by an officer of the Civil Government, and left untouched *in situ* until this inspection has been made.

A DISCUSSION on Mr. E. G. Carey's paper—to which we lately referred—on the bridges of the Manchester Ship Canal is

reported in the new instalment of the Transactions of the Institution of Engineers and Shipbuilders in Scotland. Mr. Carey, in the course of his reply to the various speakers, alluded to the question as to the value of annealing steel. He said that, so far as his experience went, annealing steel certainly removed all stress. At the Forth Bridge they were very curious about this subject. They had a single strip of steel, which they strained up to some 30 times, to about 25 tons on the square inch. After every straining, it was annealed. That went on for days and weeks, and the steel seemed to be literally the same as when they started. The experiment grew wearisome, and ultimately, when the strain was run up inadvertently to about 30 tons per square inch, and the specimen finally broke, it was almost a relief, but it proved that the annealing of steel removed all strain, and that, although injured, if annealed, it seemed to recover its former properties.

A VALUABLE synonymic and bibliographical catalogue of the New Zealand land and freshwater Mollusca, by H. Suter, was communicated to the Linnean Society of New South Wales at its meeting on December 28. In 1880 Prof. Hutton, in his "Manual of the New Zealand Mollusca," enumerated 125 species of land, fresh, and brackish water molluscs. Since then zoology has made such rapid strides that this fauna is raised in Mr. Suter's catalogue to a total of 178 species, divided by him into 45 genera. The land mollusca embrace 142 species, of which 15 are operculate; the fluviatile shells are reckoned at 32, 12 being bivalves and 7 operculate univalves. This large addition of one-third to the list of twelve years ago is not the greatest advantage the present catalogue has over its predecessor; numerous species are now removed which, by the negligence of collectors or the errors of European authors, were formerly included among the shells of New Zealand. The attention bestowed during the last decade upon the anatomy of the New Zealand snails has furnished data for a more natural classification, while the increase of colonial libraries has facilitated the quotation of fuller references than were previously available.

MR. J. M. STAHL, Illinois, has much to say in the *American Agriculturist* about the virtues of wood ashes. Speaking of them as a medicine for farm animals, he says he has found them of great value. He has raised swine rather extensively for more than twenty years without cholera or swine plague, and has not lost one per cent. of his hogs from disease. He keeps wood ashes, and charcoal mixed with salt, constantly before his swine in a large covered box with holes two-by-six inches near the bottom. The hogs will work the mixture out through these holes as fast as they want it. He selects ashes rich in charcoal, and mixes three parts of ashes to one of salt. There is no danger of the swine eating too much of this mixture, or of pure salt, if it is kept constantly before them, and they are provided with water. The beneficial effects of the mixture are quite marked, especially when the hogs are fattened on fresh maize. A little wood ashes, given to horses, is also, he maintains, very beneficial. In thirty-seven years' experience upon the farm he has lost but one horse, and this was overheated in the horse-power of a threshing-machine during his absence, and the only "condition powder" he has ever used has been clean wood ashes. The ashes may be given by putting an even teaspoonful on the oats twice a week, but he prefers to keep the ashes and salt mixture constantly before the horses, and has made for it a little compartment in one corner of the feed box. His experience is that the best condition powder is a mixture of three parts wood ashes to one of salt; and that when it is given regularly, and reasonable care and intelligence are used in handling the horse, no other medicines are necessary. Mr. Stahl has also great faith in the efficacy of wood ashes as a fertiliser.

A VALUABLE paper on the industrial resources of the Caucasus, by an Austrian official, Herr G. Sedlaczek, is summarised in the Board of Trade Journal for February. Dealing with the silk industry, the author says that the Russian Government has spent more money for the furtherance of this department of trade than for any other industrial purpose in Caucasia, and that the results are in no way commensurate with the trouble and outlay. Although the country possesses innumerable mulberry trees, in some parts forming veritable forests, and excellently suited for feeding silkworms, although the climatic conditions are favourable, and the inhabitants have from time immemorial been familiar with the working up of the raw material, the most untiring efforts of the Government have proved little else than a struggle to preserve the mere existence of the silk culture and industry. The estimated production of silk in Transcaucasia at the present day is 36,000 pouds, although in 1855 it was 30,000 pouds. The average value of the produce is said to be about 6,000,000 roubles. Considerable advance has been made in reeling, spinning, and twisting; new foreign machinery is everywhere at work, and all that is wanting is a good raw material, the production of which is, however, being constantly prevented, on the one hand by disease in the worms, and on the other by the indolence of the producers. The Russian demand for silk is far from covered by native production, silk being annually imported to the value of about 12½ millions of roubles, while the exports amount only to about 3,000,000 roubles in value. In spite of protective duties the imports are increasing while the exports are decreasing.

MANY marine animals (radiolaria, ctenophora, &c.) rise and sink slowly in the water, having some means, apparently, of changing their specific gravity. This has been recently studied by Herr Verworn (*Pflüger's Archiv*), in the case of *Thalassicolla nucleata*, a radiolarian about the size of a pea. It has a central capsule with nucleus, a coarse endoplasm, a vacuole-layer, a gelatinous-layer, and ray-like processes. As a rule, these animals float at the surface. They sink on seizing food heavier than themselves, also when strongly stimulated by shaking, or by chemical agents. It was found that the central capsule and the gelatinous layer are both heavier than sea-water, while the vacuole-layer is lighter. On being stimulated, the pseudopodia (or processes) were drawn into the vacuole-layer, and the protoplasm also retired from this, the walls of the vacuoles flattening from without inwards, till at length very little of them was left. Then the animal began to sink. At the bottom the vacuoles were soon regenerated, and the animal rose again. Thus it appears that the vacuole-layer is the hydrostatic apparatus of these organisms, the vacuole-liquid being that part of the cell which is lighter than sea-water, and keeps the cell at the surface. The same probably holds good with other pelagic animals. That the vacuole-liquid is lighter than the sea-water from which it comes is no difficulty, since it is known that living protoplasm is impermeable for many salts.

A VOLUMETRIC method for determining the amount of chromium in a specimen of steel has become a great metallurgical desideratum since the good qualities conferred upon steel by its addition have become generally known. Such a method is described by G. Giorgis, of the University of Rome, in the *Atti* of the *Accademia dei Lincei*. It is founded upon the formation of potassium chromate and hydrated manganese sesquioxide on adding a solution of potassium permanganate to a solution of sesquioxide of chromium in potassium hydrate. Ten grammes of the steel are dissolved in a mixture of sulphuric and nitric acids (3 to 1), the solution is made up to 1 litre with distilled water, and 250 c.c. are made just alkaline with sodium hydrate, and treated with hot permanganate of potash till the solution assumes a red colour. After cooling the whole is

poured into a flask of 500 c.c. capacity, filling up with water. 400 c.c. are filtered through a dry filter, acidified with sulphuric acid, reduced by SO_2, and concentrated to 200 or 100 c.c., according to the quantity of chromium probably present. Donath's method may then be employed, consisting in the addition of the chromium salt prepared as above described, to a measured quantity of a standard permanganate solution, and watching for the golden yellow colour assumed by the mixture when the permanganate is all dissolved, *i.e.* when all the chromium exists in the form of a chromate, from which the amount of chromium is easily calculated. It is said that this process is extremely accurate, and requires only a small fraction of the time required by gravimetric methods.

THE subject of dew appears to be still involved in some controversy. An experimental contribution to it has been recently made by Herr Wollny (*Forschungen*, &c.), who used plants in glazed pots with earth of varying moisture, some of these being allowed to radiate freely on favourable nights, while others were screened. The following is a brief outline of Herr Wollny's views:—Dew depends partly on evaporation from the ground, partly on transpiration. It is at present doubtful whether precipitates from the air share in it or not. A cloudy sky weakens the cooling process without stopping it wholly. With copious radiation, the temperature minimum is at the surface of the plant-covering (of the ground), and here the aqueous vapour rising from the warm ground is partly precipitated. With increase of the ground-heat downward there is increase of the water brought up by the plants, which is given up as vapour and condensed. The more moisture there is in the ground, the more water is evaporated from the ground and the plants. Dew formation is usually favoured by the larger number of stomata on the under surface of leaves than on the upper. On a given surface of ground the dew is more plentiful the stronger the plant organs above ground, and the closer the plant growth. The temperature of still air increases from the surface to a certain limit (at about 5 feet over grass it was sometimes 4° or 5° C. warmer than on the ground). In experiments with blotting paper, cotton wool, feathers, and asbestos, the first was much moistened, while the others showed dew in drops. Bodies of organic origin attract more moisture than those of mineral (a case of hygroscopic absorption). For vegetation, the author considers the benefit of dew but trifling. Of the whole annual precipitation at Munich dew only gave 3·23 per cent.

WITH the present year the weekly *Botanische Zeitung* enters on the fifty-first year of its existence, and Graf zu Solms-Laubach gives with the first number of the year an interesting sketch of its history, uninterrupted for half a century, even during the stormy period of 1847–1849. The inception of the undertaking was due to the suggestion of a botanist still living, Dr. Carl Müller, of Halle. The first number of the *Botanische Zeitung* appeared on January 9, 1843, under the editorship of Von Mohl and Schlechtendal. The editorial chair has been occupied since then by some of the most distinguished German botanists, De Bary, Hallier, Kraus, Jost, and the present editors, Solms-Laubach and Wortmann.

DR. VINES, the Professor of Botany in the University of Oxford, has for some time past had in preparation a "Student's Text-book of Botany," which will be more comprehensive than his edition of Prantl's well-known "Elementary Text-book." It is to be fully illustrated, and is expected to be ready early in the autumn of this year. It will be published by Messrs. Swan Sonnenschein and Co.

MESSRS. GAUTHIER-VILLARS ET FILS, Paris, continue to issue the useful series of small volumes called "Encyclopédie Scientifique des Aide-Mémoire." The following volumes have lately been added: "Corderie," by M. Alheilig; "Formation des Gîtes Métallifères," by L. de Launay; "Le Grisou," by M. Le Chatelier; "Moteurs à Vapeur," by M. Dudebout; "Détente Variable de la Vapeur," by A. Madamet; "Canons, Torpilles, et Cuirasses," by A. Croneau; "Textiles Végétaux," by H. Lecomte; "Essais d'Or et d'Argent," by H. Gautier; "État Actuel de la Marine de Guerre," by L. E. Bertin; "Industrie des Cuirs et des Peaux," by Ferdinand Jean.

THE "Annuaire," for 1893, of the Royal Observatory of Belgium, by F. Folie, has been published. This is the sixtieth year of issue.

THE Department of Science and Art has issued the volume for 1893 containing its calendar, history, and general summary of regulations.

IN the course of an elaborate investigation recently published in the *Zeitschrift für Hygiene*, December 9, 1892 ("Die Aetiologie des infectiösen fieberhaften Icterus" (Weil'sche Krankheit), Jaeger draws attention to the dangers which may arise from bathing in polluted water. Already in 1888 Pfuhl (*Deutsche militär-ärztl. Zeitschrift*, 1888, Heft 9 and 10) attributed an outbreak of typhoid fever, accompanied by jaundice, which occurred amongst the garrison stationed at Altona to bathing in the Elbe, which at the time was described as more than usually polluted. Hüeber and Globig came to similar conclusions with regard to outbreaks of the above "Weil'sche Krankheit," which appeared at Ulm on the Danube and Lehe respectively. Jaeger has made a special study of the cases which arose amongst the soldiers at Ulm, and has endeavoured to trace, if possible, the infection to its source. It was found that the military bathing-place was situated below the point where the Danube is joined by the highly-polluted river Blau. This stream is described as being practically an open sewer, and even before it reaches Ulm is stated to be grossly contaminated in its flow through the small village of Söflingen. It was further ascertained that in this village for many years a mysterious disease had been rife amongst the ducks and geese, whilst fowls were also occasionally attacked, and that moreover it was a common custom to throw the dead carcases of these animals into the Blau as the readiest means of getting rid of them. A careful examination of some of the birds which had succumbed to this disease revealed the constant presence of a micro-organism, which Jaeger asserts was identical with that found repeatedly and isolated in the cases of icterus investigated by him at Ulm. It is further stated that by mixing some of the highly-polluted Blau water at Söflingen with sterile broth, and inoculating it into white mice, they were killed in sixteen hours, and that the organism, which was found abundantly present in various organs of the body, was in every respect identical with that previously isolated in the cases of icterus at Ulm, and from the carcases of the birds at Söflingen. Taking these various results into consideration Jaeger is of opinion that they afford very strong evidence of the virus of this disease having been introduced into the highly contaminated stream at Söflingen, and conveyed thence to the military bathing-place, which, as already mentioned, is situated below the junction of the Blau with the Danube. In consequence of the appearances in cultivations to which this organism gives rise, the author has suggested for its name *Bacillus proteus fluorescens*, and claims in it to have discovered the exciting cause of the so-called "Weil'sche Krankheit," the etiology of which is attracting much attention on the continent.

NOTES from the Marine Biological Station, Plymouth:—Heavy gales have prevailed for many weeks, confining operations to the inshore waters. The week's captures include numbers of the Archiannelid *Dinophilus tæniatus*, of the Polychæta *Marphysa*

sanguinea and *Sigalion boa*, and of the Nudibranch *Ancula cristata*. In addition to the forms mentioned last week, the townettings have contained the Siphonophore *Muggiæa atlantica*, the Anthomedusa *Margellium* (*Lizzia*) *octopunctatum*, and several ephyræ of *Aurelia*, together with numbers of Teleostean ova, Prosobranch and Opisthobranch veligers, larval Lamellibranchs and *Cyphonautes*-larvæ. The Polychæte *Cirratulus cirratus* and Gastropod *Littorina littoralis* are also breeding.

THE additions to the Zoological Society's Gardens during the past week include a Vervet Monkey (*Cercopithecus lalandii*) from South Africa, presented by Mr. Walter Neall; two Red and Yellow Macaws (*Ara chloroptera*) from South America, presented by Mr. Henry Goschen; a Herring Gull (*Larus argentatus*) European, presented by Mr. W. R. Galbraith; a Bar-breasted Finch (*Munia nisoria*) from Java, presented by Mr. Sydney D. Birch; two Whooper Swans (*Cygnus musicus*) European, purchased; a Vulpine Phalanger (*Phalangista vulpina*), three Barbary Mice (*Mus barbarus*) born in the Gardens.

OUR ASTRONOMICAL COLUMN.

COMET BROOKS (NOVEMBER 19, 1892).—The following ephemeris for Comet Brooks is taken from *Astronomische Nachrichten*, No. 3142:—

1893.	R.A. (app.) h. m. s.	Decl. (app.) ° ′
Feb. 23 ...	0 31 49 ...	+24 18·2
24 ...	33 0 ...	23 59·8
25 ...	34 9 ...	23 42·1
26 ...	35 17 ...	23 25·0
27 ...	36 24 ...	23 8·5
28 ...	37 30 ...	22 52·4
March 1 ...	0 38 34 ...	22 36·8

COMET HOLMES (1892 III.).—Several communications with respect to the late appearances of this comet are inserted in the Comet Notes of *Astronomy and Astrophysics* for February, among which will be found one by Prof. E. Barnard. Observing with a 12-inch on the night of January 16, at 8h. 10m., he found that an estimation of the comet's diameter gave 30″, while a setting of the wires indicated 29″·4. While under observation "*the comet seemed to be perceptibly brightening*," and further measurements at 9h. 45m. gave a diameter of 32″·4. At this time he says: "The nucleus had developed clearly, and was very noticeable as a small, ill-defined star." With the 36-inch, which he was able to use later, he made the following measures, which we reproduce here, as they are quite unique in showing the increase in diameter of a comet due evidently to some external impact:—

Standard Pacific time. h. m.	Diameter. ″
10 29	43·4
10 30	44·9
10 31	43·6
10 42	47·8
10 43	47·9
10 45	46·0
11 13	47·3
11 15	46·1

In concluding his remarks he says: "This is certainly the most remarkable comet I have ever seen, taking everything into consideration."

The following is the ephemeris for this week:—

Greenwich, Midnight.

1893.	R.A. (app) h. m. s.	Decl. (app.) ° ′ ″
Feb. 23 ...	2 19 4·4 ...	+34 31 7
24 ...	20 44·6 ...	33 36
25 ...	22 25·5 ...	36 9
26 ...	24 6·4 ...	38 42
27 ...	25 48·0 ...	41 18
28 ...	27 29·6 ...	43 54
March 1 ...	29 11·9 ...	46 34
2 ...	2 30 54·3 ...	34 49 13

SOLAR OBSERVATIONS AT ROME.—In the *Memorie Degli Spettroscopisti Italiani* for January, Prof. Tacchini communicates the observations made at the Royal College with respect to the various phenomena observed at the solar surface during the third trimestre of 1892. Dealing first with the prominences the total number for each of the months are respectively for north latitudes, 182, 129, 120, total 431; and for south latitudes 141, 167, 185, the total number here amounting to 493. The balance here is in favour of the southern hemisphere for greater frequency, but a curious fact may here be remarked, and that is that the maxima for the north and south latitudes occur in the months of July and September respectively, each exceeding considerably the number of prominences recorded for the same month in the opposite hemisphere.

The greatest frequencies occurred in latitudes (+60°+70°) and (−50°−60°). The groups of spots seem to have predominated slightly in the southern latitudes, the record showing 49 against 41; at the equator as many as 13 for zone (0°+10°) were seen, the zone (0°−10°) showing only 4; the relative frequency occurred here in the same zones in both hemispheres (±10°±20°).

With reference to eruptions, the month of July contains the only records, six for the northern, and three for the southern hemisphere, four of these taking place in zone (+10°+20°).

Prof. Tacchini also has a note on the great prominence of November 16 last, in which he describes in detail the numerous observations which he was fortunate to procure. Although one can gather a good idea of the rapidity of the ascent from the table, the figures which accompany it show in a striking manner the great changes of shape that was such a conspicuous feature in its ascent. At 9h. 0m. on the 16th the height was only 131″·8, but at 1h. it had reached 319″·2, and at 1h. 35m., 534″·3, this being its maximum height. It is interesting to notice the numbers showing the increase of altitude in *one* minute of time.

For instance, at 11h. 55m. the increase of altitude per minute was 0″·56, at 1h. 4m. it was 6″·75, decreasing from this value to 4″·34 at 1h. 27m. At 1h. 32m. the velocity of ascent was increased, the value amounting to 9″·72, but at 1h. 34m. the increase of altitude reached its maximum, 20″·80, showing the ascent per minute.

THE STAR CATALOGUE OF THE "ASTRONOMISCHE GESELLSCHAFT."—The Harvard College Observatory has now completed the task of cataloguing the zone of stars undertaken in connection with the great catalogue of the *Astronomische Gesellschaft*. The stars included number 8627, and lie between 49° 50′ and 55° 10′ north declination, and the positions are reduced to the epoch 1875. Most of the observations were made by Prof. Rogers during the years 1870–1884, and the reductions have throughout been in his charge. The publication appears simultaneously as vol. xv. part ii. of the *Annals of the Harvard Observatory*, and as one of the volumes of the *Gesselschaft*. All concerned are to be congratulated on the completion of the zone, which involved over twenty-six thousand observations and an immense amount of calculation.

NOVA AURIGÆ.—Mr. Fowler draws attention to the fact that the nova is still as bright as ninth magnitude, and therefore easily visible in comparatively small telescopes. Its spectrum seems to consist of the two bright nebula lines near wave-lengths 5006 and 4956. The latter is only slightly fainter than that at 5006.

PARALLAX OF β CYGNI.—Mr. Harold Jacoby, whose work on the reduction of the Rutherford photographic measures of the stars about β Cygni we have previously referred to, suggests in *Astronomical Journal*, No. 287, that the discrepancies in the results can be explained on the hypothesis of a parallax of β Cygni amounting nearly to a whole second of arc. To investigate this he has chosen five pairs of comparison stars, from which he has computed the parallax from each pair separately by "using the difference of the distances of the two comparison stars from β as the quantity from whose variation the parallax should appear;" in this way he has obtained the weighted mean for the parallax to be + 0″·97, a value which, if endorsed by further observations will show us that of all stars β Cygni is one of our nearest neighbours.

GEOGRAPHICAL NOTES.

MR. G. B. GRUNDY, of Brasenose College, the student in geography appointed jointly by the University of Oxford and the Royal Geographical Society, has made a careful survey of the battlefield and site of the town of Platæa and of Leuctra,

in Greece. He is now engaged in preparing a comprehensive memoir on the subject which may be expected to throw new light on some questions of historical geography.

MR. MACKINDER, in his fifth lecture for the Royal Geographical Society's education scheme, spoke of the chief lines of communication between Asia and Europe and the ways by which successive bands or hordes of Asiatic invaders forced a passage into the heart of Europe. The routes across Asia Minor from the Gate of Cilicia to the northern waters, and the thoroughfare through the Balkan peninsula now traversed by the international railway, were shown to have guided the movements of peoples and the formation or dissolution of nations from the dawn of European history on to the present day.

THE United States appears to have entered the field as an aggrandising power, taking up territory beyond the limits of the continent of North America. The annexation of Hawaii seems likely to be effected without remonstrance, and a footing has also been obtained in San Domingo, the eastern part of the island of Haiti.

MR. A. VAUGHAN WILLIAMS has been exploring the region round the mouth of the Sabi River in south-east Africa. He has ascended the stream for thirty miles to the limit of tidal influence.

THE orthography of African place names is a perpetual source of confusion. It appears that in place of Zimbabwe or Zimbabye we ought, in order to render the sound of the word used by the people surrounding the ruins, to write "Zimbabghi." The familiar name Mashonaland is in itself a corruption of the native name, but is always pronounced Mashunaland, a pronunciation to which the spelling ought to conform.

RAILWAYS seem likely at last to become established in China. The line from Teintsin to Taku has now been extended to the River Lan, a total distance of 130 miles, and is being rapidly pushed northward, a considerable section being already opened for passenger traffic.

CAPTAIN BOWER'S JOURNEY IN TIBET.

AT an extra meeting of the Royal Geographical Society, on Monday night, Captain H. Bower described his recent journey with Dr. Thorold across Tibet from west to east. They set out from Leh on June 14, 1891, and were fortunate enough to get well into Tibet before meeting any natives. Travelling due east they crossed a pass of 18,400 feet, on the other side of which lay the Horpa Cho, the highest lake yet met with in Tibet, and probably the highest in the world, its altitude being 17,930 feet. Along the route eastward many other lakes were passed, all salt and without outlet, the want of fresh water being sometimes severely felt; a kettleful of hailstones was a welcome catch on one occasion. The travellers used ponies and donkeys for carrying their loads, as yaks do not eat grain, and grass was often not met with for many days' journey. At length, after travelling east and south-east for about 700 miles, they were stopped within 200 miles of Lhasa by the Tibetans, who paid no attention to Chinese passports, and after much parleying insisted on a complete change of route. The party had to retrace their steps for several days' march, turn northward, and then make their way east at a safer distance from the capital. It was now the month of October and the crossing of passes over 18,000 feet, with temperatures of 15° or more below zero, in strong wind was extremely trying. About the end of November, for the first time for four months, the tents were pitched at a less altitude than 15,000 feet, and soon afterwards Chiamdo was reached. Here great difficulty was experienced with the lamas, who insisted that no European should enter the town; but by the intervention of the Chinese Amban, whose power was really but slight, the party was allowed to proceed, passing round the outside of the town. From Chiamdo to Batang the way was easy, and no difficulties were experienced thereafter. At Ta-Chen-Lu they entered China and reached Shanghai on March 29, 1892. Throughout Central Tibet the authorities disclaimed the sovereignty of China, maintaining that only the grand lama had jurisdiction in that region. Many of the lamas met with were educated and intelligent men, but not inclined to give information. Much difficulty was experienced in getting the names of lakes and mountains, no two Tibetans giving the same answer. The fanaticism and distrust of the people created constant difficulties, but Captain Bower, under the pretext of being a Buddhist with a peculiar ritual, succeeded in making observations for position openly as part of a religious service, previous attempts to do so by stealth having failed.

THE CHEMISTRY OF OSMIUM.

AN important addition to our knowledge of the chemical nature of this interesting element is contributed by Prof. Moraht and Dr. Wischin, of Munich, to the current number of the *Zeitschrift für Anorganische Chemie*. Two years have scarcely elapsed since the position of osmium in the periodic system was finally decided by the painstaking re-determination of its atomic weight by Prof. Seubert. Previous determinations of the atomic weight of osmium had been made with material which Seubert subsequently showed to be impure, and in consequence the erroneous value, 198·6, had been ascribed to it. Indeed previous to the year 1878 the order of precedence as regards atomic weight of the four metals of the platinum group —gold 196·2, iridium 196·7, platinum 196·7, and osmium 198·6 —was entirely at variance with the order demanded by their chemical and physical properties, and a standing contradiction of the periodic law of Newlands and Mendeleef. In that year, however, Seubert attacked the case of iridium, and as the result of a series of determinations, made with the laborious care which has characterised all his work, the atomic weight of this metal, when obtained in a pure state, was shown to be 192·5, a number very different to that previously assigned to it, and which was afterwards remarkably confirmed, even to the decimal place, by an independent investigation by Joly. Three years later Seubert made his celebrated re-determination of the atomic weight of platinum, which resulted in the number 194·3 being finally derived for the true atomic weight of the perfectly pure metal. This value was likewise subsequently confirmed by Halberstadt. In the year 1887 the position of gold was decided by simultaneous independent re-determinations of its atomic weight by Thorpe and Laurie in this country and Krüss in Germany, the two values being practically identical, 196·7. Lastly, in 1891, Seubert completed his work by re-determining the atomic weight of osmium with a specimen of the metal of practically perfect purity, with the result that the old number, 198·6, was found to be entirely erroneous, due to considerable quantities of impurities being present in the samples previously employed, and that the real value of this constant was 190·3, thus removing osmium from its former situation at the end of the series and placing it in its proper position at the head of it.

The order of precedence of the metals of the platinum group is therefore as follows :—Osmium 190·3, iridium 192·5, platinum 194·3, and gold 196·7. This order is in full accordance with the relative chemical and physical properties of these metals, and the last outstanding exception to the periodic generalisation has disappeared.

Although the properties of pure metallic osmium, and particularly its atomic weight, are now known with certainty, the nature of its compounds is yet very little understood. Moreover, it is evident from the result of the investigation of Prof. Seubert that previous workers have been dealing with an impure metal of atomic weight, 198·6. It was therefore desirable that not only should the chemistry of this element be extended to compounds hitherto uninvestigated, but that the composition and properties of the compounds already known should be subjected to a re-examination.

Prof. Moraht and Dr. Wischin have therefore taken up the study of the compounds of osmium with oxygen, sulphur, and the halogens, employing material of a very high degree of purity, and the results of their investigation are both novel and interesting.

Work with osmium compounds is endowed with peculiar personal danger to the chemist, owing to the great facility exhibited under the most various conditions for the formation of the tetroxide OsO_4, a substance which boils at 100° C., and is very volatile at the ordinary temperature, and which attacks the skin, the lungs, and particularly the eyes with most serious consequences.

The material started with was a comparatively pure sample of the best known salt containing osmium, potassium osmate, $K_2OsO_4.2H_2O$. This salt was further purified by distillation

with nitric acid or aqua regia and absorption of the liberated tetroxide vapours in a solution of caustic potash. The dark brown solution of potassium perosmate thus formed was largely diluted with water, and reduced to osmate by the addition of alcohol. After the expiration of about twenty-four hours almost the whole of the osmium had separated in the form of beautiful little crimson octahedrons of the salt $K_2OsO_4.2H_2O$, which, after washing with dilute alcohol, proved to be quite free from impurity, showing no trace of iridium.

Previous observers have noticed that an aqueous solution of *potassium osmate*, K_2OsO_4, is most remarkably affected by sunlight, a rapid decomposition being brought about with deposition of a black precipitate to which the composition $OsO_2.2H_2O$ has been ascribed. The specimens experimented with, however, undoubtedly contained iridium, and it was therefore of interest to investigate the action of sunlight upon solutions of the pure salt just described. When the crimson octahedrons of pure $K_2OsO_4.2H_2O$ were dissolved in cold water, and the clear reddish violet-coloured solution was exposed to direct sunshine, no evidence of change was apparent for several days, but the moment the vessel containing the solution was immersed in a bath of boiling water, while in bright sunshine, decomposition commenced, and a black precipitate rapidly accumulated, until after the expiration of two or three hours the whole of the osmium present was deposited. As there is a marked tendency for the production of the noxious fumes of osmium tetroxide during this decomposition of the hot osmate solution by the waves of light it is best to take the precaution of reducing their amount to a minimum by the addition of a little alcohol, which acts as a strong reducing agent under these circumstances, and by passing a stream of hydrogen through the solution during the whole operation. The precipitate is usually so finely divided that considerable difficulty is experienced in separating it from the solution. The filtration succeeds best when the filter is previously moistened with dilute acetic acid, when a clear colourless filtrate is usually at once obtained. The precipitate cannot be dried in a warm air bath, as it is largely converted thereby into the volatile osmium tetroxide. It may safely, however, be dried over phosphoric anhydride in the vacuum of an air-pump.

The accurate analysis of an insoluble substance of the nature of this precipitate, and containing a metal such as osmium, which so readily oxidises to the volatile tetroxide, is a task of exceptional difficulty. The usual method of reduction to metal in a stream of hydrogen is insufficient, for more or less of the tetroxide is always formed during the process, necessitating the use of an absorption apparatus containing a solution of caustic potash, placed in front of the tube containing calcium chloride to absorb the water formed. The difficulty is, then, how to estimate the small quantity of osmium thus dissolved in the large excess of alkali. It was eventually found that the weak electric current from three Daniell's cells precipitates the whole of the osmium from such a solution, contained in a nickel dish which forms the negative electrode, in the form of pure *osmium dioxide*, OsO_2, which may conveniently be dried *in vacuo* over phosphoric anhydride and weighed as such.

By this mode of analysis the interesting fact was eventually elicited, that the black insoluble substance formed by the action of light upon a hot solution of potassium osmate is not, as was previously supposed, a hydrate of osmium dioxide of the composition $OsO_2.2H_2O$, but is no other than free *osmic acid* itself, the hydrate of osmium trioxide, $OsO_3.H_2O$ or H_2OsO_4. Osmic acid is thus formed by the direct action of water, under the influence of sunlight and slight rise of temperature, upon the potassium salt. This remarkable change is expressed by the simple equation:

$$K_2OsO_4 + 2H_2O = H_2OsO_4 + 2KOH.$$

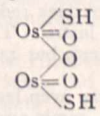
The liquid, as soon as the change commences, is observed to exhibit a strong alkaline reaction, becoming, as indicated in the equation, a solution of caustic potash. It is singular that the presence of alcohol and the passage of a current of hydrogen during the reaction do not cause any reduction, serving only to hinder the further oxidation to the state of tetroxide. Indeed, if the crimson octahedral crystals of potassium osmate are covered in sunshine with warm alcohol and a current of hydrogen is allowed to bubble through the liquid, no trace of blackening is observed upon the faces of the crystals. The moment water is added, however, decomposition is immediately brought about.

Osmic acid, H_2OsO_4, is a soot-black powder, which fumes strongly in moist air, owing to its rapid conversion into the volatile osmium tetroxide, OsO_4, but which is quite permanent at the ordinary temperature when preserved under water containing alcohol. It dissolves readily in nitric acid with formation of the hydrate of osmium tetroxide, the so-called per-osmic acid. Cold hydrochloric acid attacks it but very slightly. Upon warming, however, it is entirely soluble, forming an olive-green liquid, which will be subsequently considered, with liberation of a small quantity of chlorine. Sulphuric acid does not attack it. Osmic acid reacts in a most energetic and interesting manner with sulphuretted hydrogen gas. Even in the dry state at the ordinary temperature the reaction proceeds with considerable violence. If the experiment is conducted in a piece of combustion tubing, upon which a bulb has been blown for the reception of the osmic acid, the moment that the gas enters the tube the whole of the black powder immediately becomes incandescent, and drops of water and a large quantity of free sulphur are deposited in the portion of the tube not heated by the reacting substances. The residual product of the reaction is a brown powder, which has been found to be a hydrated oxysulphide of osmium of the composition $2OsSO.H_2O$.

The reaction occurs in accordance with the equation—

$$2H_2OsO_4 + 4H_2S = 2OsSO.H_2O + 5H_2O + 2S.$$

This *oxysulphide of osmium* is soluble in acids with decomposition, even sulphuric acid decomposing it with evolution of sulphuretted hydrogen. It possesses acid properties, for it liberates carbon dioxide from carbonate of soda and sulphuretted hydrogen when fused with sulphide of potassium. It would, moreover, appear to contain SH groups, for it yields mercaptan upon treatment with soda and ethyl iodide, the osmium being reduced to the dioxide OsO_2. Its probable constitution is therefore represented by the graphic formula:—



When this oxysulphide is warmed in dry sulphuretted hydrogen another violent reaction occurs, the whole mass again becomes incandescent, and the whole of the oxygen is eliminated in the form of water. The product of this second reaction with sulphuretted hydrogen is pure *osmium disulphide* OsS_2.

$$Os_2O_3(SH)_2 + 2H_2S = 2OsS_2 + 3H_2O.$$

Of the *halogen* compounds of osmium only the chlorides have been at all investigated, chiefly by Claus, whose observations may be summarised in a few words.

When finely-powdered metallic osmium is heated in a stream of dry chlorine sublimates are formed. The first chlorine compound formed is chromous-green in colour, but is only produced to a very slight extent. There is next deposited a dense black sublimate, and finally a smaller quantity of a sublimate of the colour of red lead. None of these three chlorine compounds are crystalline. Claus subsequently stated that the lowest chloride $OsCl$, is a bluish-black solid when isolated, and forms a dark bluish-violet solution; the sesquichloride Os_2Cl_3 is reddish-brown in the solid state, and gives with water a rose-red coloured solution, and the dichloride $OsCl_2$ is the compound which exhibits the colour of red-lead, and yields a lemon-yellow solution

These observations of Claus are completely confirmed by the experiments of Prof. Moraht and Dr. Wischin, who, however, have extended them, and have been able to isolate other and higher chlorides of osmium.

They commenced by warming a large quantity of the free osmic acid above described for two days upon a water-bath with concentrated hydrochloric acid, the flask in which the reaction was conducted being connected with an upright condenser. A little alcohol was added in order to prevent the formation of osmium tetroxide. The osmic acid eventually entirely dissolved with formation of the dark olive-green coloured solution previously incidentally mentioned, a little chlorine being evolved at the commencement of the operation. It was found impossible to evaporate the solution upon the water-bath without decomposition, but evaporation *in vacuo* over sulphuric acid and solid caustic potash, the latter to absorb the hydrochloric acid, succeeded admirably. The solid left after complete evaporation consisted of well-formed crystals which assumed the habit of six-sided pyramids. These crystals were dark olive-green in colour when moist, but when the last traces of superfluous water were removed, exhibited a bright vermilion colour. They were readily

soluble in water and alcohol, the solutions being coloured dark green, and the salt may be recrystallised from these solvents. Upon analysis they were found to consist of the chloride Os_2Cl_7 crystallised with seven molecules of water.

This chloride of osmium, $Os_2Cl_7.7H_2O$, would appear to be a molecular compound of the *trichloride*, $OsCl_3$, and the *tetrachloride*, $OsCl_4$. For when potassium chloride solution is added to the solution of the crystals in alcohol, a precipitate of brilliant red octahedrons and cubes of potassium osmichloride, K_2OsCl_6, is obtained, showing the presence of *osmium tetrachloride*, $OsCl_4$. Moreover, when the precipitate is separated by filtration, and the filtrate concentrated by evaporation *in vacuo*, dark green crystals of the *trichloride*, $OsCl_3$, are deposited containing three molecules of water of crystallisation.

During the reduction of these crystals of the trichloride in a current of hydrogen for the purposes of analysis, a small quantity of a white sublimate was obtained, which probably consisted of the *octo-chloride*, $OsCl_8$, corresponding to the tetroxide OsO_4.

Bromine does not react with osmium with anything like the energy of chlorine. The free elements do not appear to combine at all, even at moderately high temperatures. Only a small quantity of a sublimate of a dark brown colour is obtained by passing bromine vapour over osmic acid. This sublimate dissolves to a brown solution in water, which, however, rapidly decomposes with deposition of a black precipitate.

When osmic acid, H_2OsO_4, is treated with hydrobromic acid in the manner just described in the case of hydrochloric acid a similar reaction occurs with formation of a clear reddish-brown solution which yields, upon evaporation *in vacuo* over sulphuric acid and solid caustic potash, small crystals of a molecular compound of the *tribromide*, $OsBr_3$, and the *hexabromide*, $OsBr_6$, together with six molecules of water of crystallisation. These crystals of $Os_2Br_9.6H_2O$ are dark reddish-brown in colour and exhibit a beautiful metallic lustre. They are quite stable when preserved in a dry atmosphere, but rapidly deliquesce in moist air.

Iodine appears to possess even less affinity for osmium than bromine. When, however, osmic acid is treated with hydriodic acid a deep greenish-brown solution is obtained which deposits *in vacuo* dark violet rhombohedrons, exhibiting a brilliant metallic lustre, consisting of the anhydrous *tetra-iodide of osmium*, OsI_4. This iodide, the only one containing osmium yet prepared, is permanent in a dry atmosphere at the ordinary temperature, but rapidly deliquesces like the bromide when exposed to moist air.

In relative stability the chloride bromide and iodide of osmium above described exhibit a gradation such as would be expected from the relations between the halogen elements themselves. The iodide is readily dissociated by slightly raising the temperature, and upon the addition of water is decomposed with the deposition of a black precipitate containing the metal. A similar decomposition occurs, although much more slowly, in case of the bromide. The chloride, however, is well-nigh permanent under these conditions, only exhibiting traces of decomposition after the lapse of a considerable time. A. E. TUTTON.

REDUCTION OF TIDAL OBSERVATIONS.[1]

THE tidal oscillation of the ocean may be represented as the sum of a number of simple harmonic waves which go through their periods approximately once, twice, thrice, four times in a mean solar day. But these simple harmonic waves may be regarded as being rigorously diurnal, semi-diurnal, terdiurnal, and so forth, if the length of the day referred to be adapted to suit the particular wave under consideration. The idea of a series of special scales of time is thus introduced, each time-scale being appropriate to a special tide. For example, the mean interval between successive culminations of the moon is 24h. 50m., and this interval may be described as the mean lunar day. Now there is a series of tides, bearing the initials M_1, M_2, M_3, M_4, &c., which go through their periods rigorously once, twice, thrice, four times, &c., in a mean lunar day. The solar tides, S, proceed according to mean solar time, but, besides mean lunar and mean solar times, there are other special time scales appropriate to the other tides.

The process of reduction consists of the determination of the mean height of the water at each of twenty-four special hours, and subsequent harmonic analysis. The means are taken over such periods of time that the influence of all the tides governed by other special times is eliminated.

The process by which the special hourly heights have hitherto been obtained is the entry of the heights observed at the mean solar hours in a schedule so arranged that each entry falls into a column appropriate to the nearest special hour. Schedules of this kind were prepared by Mr. Roberts for the Indian Government.[1] The successive rearrangements for each sort of special time were made by recopying the whole of the observations time after time into a series of appropriate schedules. The mere clerical labour of this work is enormous, and great care is required to avoid mistakes.

All this copying might be avoided if the observed heights were written on movable pieces. But a year of observation gives 8760 hourly heights, and the orderly sorting and resorting of nearly 9000 pieces of paper or tablets might prove more laborious and more treacherous than recopying the figures.

The marshalling of movable pieces might, however, be reduced to manageable limits if all the twenty-four observations pertaining to a single mean solar day were moved together, for the movable pieces would be at once reduced to 365, and each piece might be of a size convenient to handle.

The realization of this plan affords the subject of this paper, and it appears that not only is all desirable accuracy attainable, but that the other requisite of such a scheme is satisfied, namely, that the whole computing apparatus shall serve any number of times and for any number of places.

The first idea which naturally occurred was to have narrow sliding tablets which should be thrown into their places by a number of templates. It is unnecessary to recount all the trials and failures, but it will suffice to say that the slides and templates would require the precision of a mathematical instrument if they are to work satisfactorily, and that the manufacture would be so expensive as to make the price of the instrument prohibitive.

The idea of making the tablets or strips to slide into their places was accordingly abandoned, and the strips are made with short pins on their under sides, so that they can be stuck on to a drawing board in any desired position. The templates, which were also troublesome to make, are replaced by large sheets of paper with numbered marks on them to show how the strips are to be set. The guide sheet is laid on a drawing board, and the pins on the strips pierce the paper and fix them in their proper positions.

The strip belonging to each mean solar day is divided by black lines into 24 equal spaces, intended for the entry of the hourly heights of water. The strip is nine inches long by $\frac{1}{8}$ inch wide, and the divisions ($\frac{3}{8}$ by $\frac{1}{8}$) are of convenient size for the entries. There was much difficulty in discovering a good material, but after various trials artificial ivory, or xylonite, was found to serve the purpose. Xylonite is white, will take writing with Indian ink or pencil, and can easily be cleaned with a damp cloth. It is just as easy to write with liquid Indian ink as with ordinary ink, which must not be used, because it stains the surface.

The observations are to be treated in groups of two and a half lunations or 74 days. A set of strips, therefore, consists of 74, numbered from 0 to 73 in small figures on their flat ends.

If a set be pinned horizontally on a drawing board in vertical column, we have a form consisting of rows for each mean solar day, and columns for each hour. The observed heights of the water are then written on the strips.

When the twenty-four columns are summed and divided by the number of entries we obtain the mean solar hourly mean heights. The harmonic analysis of these means gives the mean solar tides. But for evaluating the other tides the strips must be rearranged, and to this point we turn our attention.

Let us consider a special case, that of mean lunar time. A mean lunar hour is about 1h. 2m. m.s. time; hence the 12h. of each m.s. day must lie within 31m. m.s. time of a mean lunar

[1] "On an Apparatus for facilitating the Reduction of Tidal Observations." By G. H. Darwin, F.R.S., Plumian Professor and Fellow of Trinity College, Cambridge. A paper read before the Royal Society on December 15, 1892.

[1] An edition of these computation forms was reprinted by aid of a grant from the Royal Society, and is sold by the Cambridge Scientific Instrument Company, but only about a dozen copies now remain.

hour. The following sample gives the incidence to the nearest lunar hour of the first few days in a year:—

Mean solar time. d.	h.		Mean lunar time. d.	h.
0	12	=	0	12
1	12	=	1	11
2	12	=	2	10
3	12	=	3	9
4	12	=	4	8
5	12	=	5	8
6	12	=	6	7
7	12	=	7	6
&c.			&c.	

The successive 12h. of m.s. time will march retrogressively through all the twenty-four hours of m. lunar time.

Now, if starting from strip 0, we push strip 1 one division to the left, strip 2 two divisions to the left, and so on, the entries on the strips will be arranged in columns of approximately lunar time.

The rule for this arrangement is given by marks on a sheet of paper 18 in. broad; these marks consist of parallel numbered steps or zigzags showing where the ends of each strip are to be placed so as to bring the hourly values into their proper places.

At the end of a lunation mean solar time has gained a whole day over mean lunar time, and the 12h. solar again agrees with the 12h. lunar. On the guide sheet the zigzag which takes its origin at the left end of strip 0 has descended diagonally from right to left until it has reached the left margin of the paper, and a new zigzag has begun on the right margin.

When the strips are pinned out following the zigzags on the sheet marked M, the entries are arranged in 48 columns, but the number of entries in each column is different. The 48 incomplete columns may be regarded as 24 complete ones, appertaining to the 24 hours.

Harmonic analysis of the 24 means of the complete columns gives the required tidal constants. It must be remarked, however, that as the incidence of the entries is not exact in lunar time, investigation is made in the paper of the corrections arising out of this inexactness.

The explanation of the guide sheet for lunar time will serve, *mutatis mutandis*, for all the others.

The zigzags have to be placed so as to bring the columns into exact alignment, and printers' types provide all the accuracy requisite.

To guard against the risk of the computer accidentally using the wrong sheet, the sheets are printed on coloured paper, the sequence of colours being that of the rainbow. The sheets for days 0 to 73 are all red; those for days 74 to 74 + 73, or 147, are all yellow; those for days 148 to 148 + 73, or 221, are green; those for days 222 to 222 + 73, or 295, are blue; and those for days 296 to 296 + 73, or 369, are violet.

Thus, when the observations for the first 74 days of the year are written on the strips all the sheets will be red; the strips will then be cleaned, and the observations for the second 74 days written in, when all the guide sheets will be yellow, and so on.

The paper also gives another considerable abridgement of the process of harmonic analysis, which is independent of the method of arrangement just sketched.

In the Indian computation forms the mean solar hourly heights have been found for the whole year, and the observations have been rearranged for the evaluation of certain other tides governed by a time scale which differs but little from the mean solar scale. It is now proposed to break the mean solar heights into sets of 30 days, and to analyse them, and next to harmonically analyse the 12 sets of harmonic constituents for annual and semi-annual inequalities. By this plan the harmonic constants for 11 different tides are obtained by one set of additions. In fact, we now get the annual, semi annual, and solar elliptic tides, which formerly demanded much troublesome extra computation. A great saving is secured by this alone, and the results are in close agreement with those derived from the old method.

An abridged method of evaluating the tides of long period MSf, Mf, Mm, is also given. The method is less accurate than that followed hitherto, but it appears to give fairly good results, and reduces the work to very small dimensions.

The advantages of the method proposed in the present paper may be best realized by a comparison of the amount of work entailed in the reduction of a year's tides as it has hitherto been carried out by the Indian Survey at Poona, and what it will be under the new method.

It has been usual in the Indian reductions to use three digits in expressing the height of water, and there have been fifteen series, or even more. It follows from a simple multiplication that the computer has had to write 394,000 figures in reducing a year of observation. This does not include the evaluation of the annual and semi-annual tides, so that we may say that there have been about 400,000 figures to write.

It is now proposed to express the heights by two digits, and they only have to be written once, and the number of figures to write is 17,500; accordingly the writing of 382,000 figures is saved.

In the old method the computer had to add together all the digits written, say, 394,000 additions of digit to digit.

It is now proposed to use twenty-four hourly values in three series, viz. S, M, and MS, and twelve two-hourly values in eight others, and the number of additions comes to 123,000. Thus 270,000 additions are saved.

We may say that formerly there were about 800,000 operations (writing and addition), and that in the present method there will be about 140,000. This estimate does not include a saving of several thousands of operations in obtaining the tides of long period. It may therefore be claimed that the work formerly bestowed on one year of observation will now reduce at least five years, and that the results are equally trustworthy.

The manufacture of the computing strips of xylonite is rather expensive, but as it formerly cost in England rather more than £20 to reduce a year of observation, the cost of the apparatus will be covered by the saving in the reduction of a single year, and it will serve for any length of time.

The apparatus, together with computation forms, will be on sale with the Cambridge Scientific Instrument Company at a price of about £8.

It is proper to mention that Dr. Börgen has devised and used a method for attaining the same end as that aimed at in this paper. He has prepared sheets of tracing paper with diagonal lines on them, so arranged that when any sheet is laid on the copy of the observations written in daily rows and hourly columns, the numbers to be summed are found written between a pair of lines. This plan is inexpensive and has considerable advantages, but the chance of error is no doubt increased by the fact that the lines of addition are diagonal, and because figures seen through tracing-paper are comparatively faint.

THE HARVARD COLLEGE OBSERVATORY.

THE forty-seventh annual report of the director of the astronomical observatory of Harvard College, for the year ending October 31, 1892, by Prof. E. C. Pickering, has been issued. We reprint the following passages:—

The number of photographs taken with the eight-inch Draper telescope is 2777. The number taken in Peru with the Bache telescope is nearly two thousand, of which 601 have been received in Cambridge. The examination of these plates has as usual led to the discovery of a large number of interesting objects. Ten variable stars, U Delphini, S Pegasi, T Aquarii, R Crateris, R Carinæ, S Canis Minoris, S Car næ, R Ophiuchi, X Ophiuchi, and Espin's variable star in Auriga in addition to the thirty-seven previously announced have the hydrogen lines bright in their spectra. Seven new variable stars have been discovered this year by means of this property. The number of stars of the fifth type has been increased by eight, making the total number now known of these objects forty-five. The hydrogen line F was shown to be bright in the spectra of six stars in addition to those already known. Photographs have been obtained of the spectra of eight planetary nebulæ showing bright lines. The spectrum of the nebula surrounding thirty Doradus is unlike that of other gaseous nebulæ. The star A. G. C. 20,937 has a somewhat similar spectrum. Five stars have been shown to have spectra of the fourth type. All of these peculiarities have been detected by Mrs. Fleming except in the cases of one of the known variables, one of the planetary nebulæ, and two of the stars of the fourth type, which were found by Mr. A. E. Douglass, in Peru, before the plates were sent to Cambridge.

The amount of valuable material accumulated with these instruments is continually increasing, and has proved useful in many cases in studying the history of newly-discovered objects.

The brightness for several years past of stars suspected of variability has been furnished to various astronomers. Plates have been sent to the Lick and Amherst Observatories and to the Smithsonian Institution for special investigations. From one of them a new variable star in Aries was discovered by Prof. Schaeberle. It is hoped that this use of our plates may increase in the future. A large number of photographs were taken of the new star in Auriga. An examination of the older photographs showed that the region containing it had been photographed eighteen times from November 3, 1885, to November 2, 1891, and that it was then apparently fainter than the thirteenth magnitude. It appeared upon five plates taken between December 16, 1891, and January 31, 1892. After its discovery it was photographed on sixty-five chart plates and thirty-six spectrum plates, until April 6, when it became too faint to be visible in the encroaching twilight. All of these plates have been carefully studied and measured. Twenty-one charts and fifteen spectrum plates of this object have been taken since its reappearance in September, 1892. On these last plates, the spectrum is shown to resemble that of a planetary nebula.

Many photographs of the lunar eclipse of November 15, 1891, were taken both at Cambridge and at the Boyden observing station near Arequipa, Peru. The examination of these photographs for the detection of a possible lunar satellite led only to a negative result.

The number of photographs taken with the 11-inch Draper telescope is 996. They include 372 spectra of β Aurigæ to determine the law of periodic doubling of the lines. 244 of these images show the lines double so that the separation can be measured. In like manner 208 spectra of ζ Ursæ Majoris have been photographed, and in 49 of them the lines are separated widely enough to be measured. A similar study has been made of the new star in Auriga, of β Lyræ, of 11 Monocerotis, and of some other stars having peculiar spectra. Photographic charts have also been obtained of numerous variable stars, stars having large proper motion, clusters and stars having peculiar spectra to determine their parallax if it is perceptible.

Boyden Department.

In establishing the fund that bears his name, Mr. Boyden desired to secure an astronomical station where the effects due to the atmosphere would be greatly diminished. This has now been successfully accomplished in the Harvard Station at Arequipa, Peru, where the effect of the air is no longer as heretofore the principal obstacle to progress in astronomy. Instead of this the limit is now the size and excellence of our instruments. A great advance would probably be made in our knowledge of the planets, and perhaps of the fixed stars, if a telescope of the largest size could be mounted under such favourable conditions.

This station has continued in charge of Prof. W. H. Pickering. The instruments chiefly employed have been the 13-inch telescope, the 8-inch Bache telescope, and a photographic camera having an aperture of 2½ inches. The first of these instruments has been largely devoted to visual work, for which unusual advantages are afforded by the transparency and steadiness of the air at this station. Many interesting results have been derived from the observations made of the moon and various planets. The observations of the moon relate to Plato and other regions, which have been carefully examined, and also to the systems of bright streaks visible at full moon. The markings of Mercury have been studied, and this investigation appears to confirm Schiaparelli's view that the rotation of Mercury on its axis occupies the same time as its revolution in its orbit. Although this planet appears to have no atmosphere, the markings upon it are very faint compared with those upon the moon. Venus was micrometrically studied near its inferior conjunction with regard to its diameter, polar compression, and the refractive effect of its atmosphere. No permanent markings could be detected. An extensive series of observations was made upon Mars. The relative positions of 92 points upon its surface were determined by the micrometer. More than forty minute black points were discovered, provisionally designated as lakes. The polar compression of the planet was measured, and appeared to be greater than that indicated by theory, which may be due to an excess of cloud in the equatorial regions. The presence of the dark and narrow streaks called canals by Schiaparelli has been confirmed and various measurements of them have been made. The clouds projecting beyond the limb, and terminator, discovered at the Lick Observatory, have been studied, and their height has been found to be at least twenty miles. The relative colours of different portions of the planet have been minutely observed. Two large dark blue areas have been detected, and other portions have been noticed to be subject to gradual changes of colour.

Many new double stars were found in a survey of the heavens south of 30°, between 12h. and 18h. The August occultation of Jupiter was observed both visually and photographically, as was also the new star in Auriga and Swift's comet, the photographs of which showed detail not noticeable in the visual observations.

With the camera, having the aperture 2½ inches, very satisfactory photographs have been obtained of the Magellanic clouds, showing their composition to be partly of stars and partly of nebulous matter; also the spiral structure of the larger of the two clouds.

Meteorological observations are regularly carried on. Stations have been established at Mollendo, 100 feet above sea level, at La Joya, the elevation of which is 4,150 feet, at the observing station, 8,060 feet high, at the Chachani Ravine 16,650 feet high, where numerous miscellaneous observations have been made. Notwithstanding the great height of the last-named station, it can be reached by a mule path, and a hut has been erected where the observers can pass the night. A survey of the Arequipa valley and neighbouring mountains has been made, depending on two separate base lines. The heights of the mountains have been measured, and in some cases the result has been checked by a mercurial barometer.

The Bruce Photographic Telescope.

This instrument, which if successful will be in many respects the most powerful in the world, is now rapidly approaching completion. The eight surfaces of its objective have been ground and polished so that it could be tested on a star. The results were satisfactory, although, of course, no definite opinion can be formed until the final corrections are applied. The focal length proved to be that desired within half of one per cent. Plans have been made and the foundations laid for a one-story brick building with a sliding roof, in which it will be erected during its trial in Cambridge. After this it is proposed to send it to the Arequipa station in Peru.

Photographs have been taken with the transit photometer on 192 evenings, and when clear, throughout the entire night. With this instrument images are obtained of all stars brighter than the sixth magnitude which cross the meridian during the night. The value of this work was illustrated when the new star in Auriga was discovered in February, 1892. It then appeared that this object had been photographed on twelve nights since December 10, 1891, while no trace of it was visible on thirteen plates covering this region and taken before December 2, 1891. The only knowledge that exists of its changes of light during the six weeks in which it remained undiscovered is furnished by these photographs and those taken with the 8-inch telescopes. It was also photographed with the transit photometer on twelve nights after its discovery. Of the forty thousand standard stars of the tenth magnitude about eight thousand have been selected by Miss E. F. Leland during the past year, making eleven thousand in all.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Oxford.—In the Chemical Department Prof. Odling is lecturing on the glucoses, Mr. Fisher on inorganic chemistry, Dr. Watts on organic chemistry, and Mr. Veley on physical chemistry. There are about sixty students working in the laboratories, and a few of the senior men are engaged in research.

Among the apparatus belonging to the late Duke of Marlborough, presented by the Duchess, are three large spectroscopes by Hilger, one having five prisms, another being a direct vision spectroscope 5 feet 6 inches in length, two balances by Deleuil; a mercury pump by Alvergniat, Dumas' vapour density apparatus, Thomson's electrometer gramme machine, large Rhumkorf coil and a quantity of valuable glass apparatus. There are besides a number of specimens of compounds of rare earths.

The Regius Professor of Medicine has placed his pathological

laboratory under the direction of the lecturer in Pharmacology. Dr. Ritchie of Edinburgh is carrying out in it some researches in Bacteriology. The Chemical Club started last term by some of the senior men continues to hold meetings weekly for the discussion of recent chemical investigations. Mr. Ingham of Merton is secretary. The meetings are well attended and useful.

Mr. R. T. Günther, B.A., Demy of Magdalen College, has been elected to the Naples Biological Scholarship for the ensuing year.

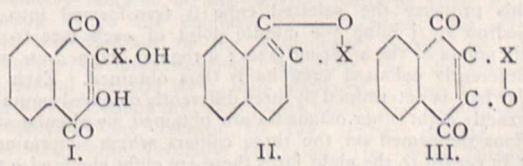
CAMBRIDGE.—Mr. H. Bury, Fellow of Trinity College, has been appointed by the Board for Biology and Geology to the use of a table at the Naples Zoological Station for March and April, 1893.

The Boards for Biology and Geology, and for Physics and Chemistry, have reported in favour of extending to Part I. of the Natural Sciences Tripos the plan already adopted for Part II., namely, the substitution of distinct papers in each scientific subject, instead of papers each of which contains questions in all the subjects. They propose that the change come into operation in 1894.

SOCIETIES AND ACADEMIES.

LONDON.

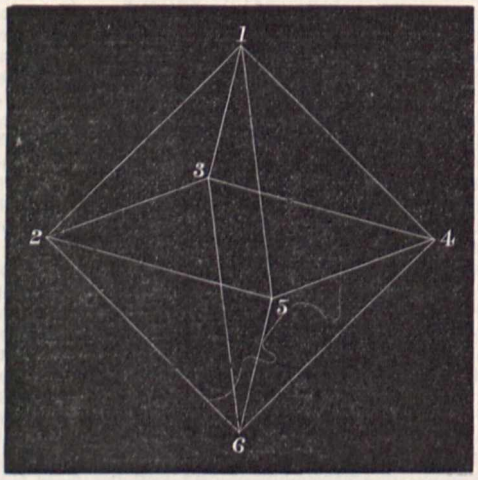
Chemical Society, January 19.—Prof. A. Crum-Brown, President, in the chair.—The following papers were read:—Glucinum, Part I. The preparation of glucina from beryl, by J. Gibson. The methods at present in use for preparing pure glucina from beryl are tedious and difficult to apply on the large scale, as the mineral, which contains but a small quantity of glucinum, has to be reduced to a very fine powder before being treated by the reagents usually employed for the decomposition of refractory silicates. The author has worked out a process which greatly facilitates the preparation of glucina. If the coarsely-ground beryl is heated in an iron vessel with six parts of ammonium hydrogen fluoride, complete decomposition occurs below a red heat. The product contains the aluminium and most of the iron as insoluble fluoride and oxide respectively, together with glucinum fluoride, which dissolves on extraction with water. In order to remove the last traces of iron from crude glucina, advantage is taken of the fact that the precipitation of a lead or mercuric salt by ammonium sulphide effects by mass action the complete separation of small quantities of iron which may be present in the solution.—The determination of the thermal expansion of liquids, by T. E. Thorpe. The author describes various improvements in the ordinary dilatometrical method of determining the thermal expansion of liquids. Amongst these the most important is the application of a device frequently employed in the construction of standard thermometers, and consisting in enlarging the bore of the dilatometer stem at some point. On such an instrument the positions of the 0° and 100° points may be determined irrespectively of its range, and the thermometer, and the column of liquid in the dilatometer stem may be totally immersed in a bath of moderate size, thus doing away with corrections for the emergent columns of the two instruments. The methods of constructing, calibrating, and using the dilatometers are described, together with the baths employed in heating them.—The determination of the thermal expansion and specific volume of certain paraffins and paraffin derivatives, by T. E. Thorpe and L. M. Jones. The authors give the data relating to a number of hydrocarbons, alcohols, ketones, and other derivatives of the paraffins. The results show a fairly satisfactory agreement, in most cases, with the values calculated by Lossen's formula, but all the observed specific volumes, with the exception of that of propionic anhydride, differ considerably from those calculated by means of Kopp's values.—The hydrocarbons derived from dipentene dihydrochloride, by W. A. Tilden and S. Williamson. The dihydrochloride, $C_{10}H_{16}2HCl$ melting at 50°, prepared by the action of moist hydrogen chloride on optically active turpentine, is known to be identical with that obtained from the active citrenes (limonenes) or from inactive "dipentene." On heating it with aniline, an oil is obtained which has hitherto been supposed to consist essentially of dipentene; on oxidising it, however, a certain proportion of aromatic acids is obtained. These acids are not formed on oxidising the active limonenes or pure dipentene with nitric acid; their formation in the previous case is, however, satisfactorily explained by the authors, who find that the dipentene obtained from the dihydrochloride contains large proportions of cymene, terpinene, terpinolene, and a small quantity of a saturated paraffinoid hydrocarbon boiling at about 155°.—Sulphonic derivatives of camphor, by F. S. Kipping and W. J. Pope. The authors have succeeded in preparing camphorsulphonic acid, $C_{10}H_{15}O.SO_3H$, a compound hitherto unknown, by the direct action of anhydrosulphuric acid or chlorosulphonic acid on camphor. The acid is purified by the conversion of its sodium salt into camphorsulphonic chloride, $C_{10}H_{15}O.SO_2Cl$; the latter substance is apparently obtained in optically different modifications which are separated only with considerable difficulty. The sulphonic chloride is readily hydrolysed on boiling with water, yielding the sulphonic acid from which a series of well-defined salts has been obtained. The action of anhydrosulphuric acid on bromocamphor results in the formation of bromocamphorsulphonic acid; this on suitable treatment yields a sulphonic chloride, $C_{10}H_{14}BrO.SO_2Cl$, which crystallises in magnificent colourless octahedra, melting at 136–137°. A bromocamphorsulphonic chloride of similar composition has been previously described by Marsh and Cousins as a "black, semi-crystalline tar;" a repetition of their work shows this to be merely an impure form of the substance now described. The corresponding chlorocamphorsulphonic chloride described by Marsh and Cousins as a "microcrystalline, black solid," crystallises in massive colourless octahedra when pure; it melts at 123–124°, and has a specific rotatory power $[\alpha]_D = +110°$. The authors describe a number of salts and derivatives of these sulphonic acids.—The preparation of dinitro-α-naphthylamine $[NH_2 : NO_2 : NO_2 = 1 : 2 : 4]$ from its acetyl and valeryl derivatives, by R. Meldola and M. O. Forster. Meldola's process of preparing dinitro-α-naphthylamine from α-acetnaphthalide having been questioned, the authors have re-investigated the method and confirm it in all respects; they give full working details of the process, and show that the same product is obtained by the nitration and subsequent hydrolysis of valeronaphthalide.—Thionyl bromide, by J. Hartog and W. E. Sims. Thionyl bromide is obtained as a heavy, crimson liquid by the action of sodium bromide on thionyl chloride; its colour is possibly due to impurity. At 150° the bromide decomposes, yielding bromine and sulphur bromides.—Desulphurisation of the substituted thioureas, by A. E. Dixon. The monosubstituted thioureas are all desulphurised on boiling with an alkaline solution of a lead salt; the same is true of disubstituted thioureas containing benzenoid groups, but not if such groups be absent. The tri- and probably also the tetra-substituted thioureas are not desulphurised under similar conditions. A number of new thioureas are described.—Salts of active and inactive glyceric acid: the influence of metals on the specific rotatory power of active acids, by P. F. Frankland and J. R. Appleyard. The authors have prepared and analysed a number of salts both of inactive and dextro-glyceric acid; the solubilities and specific rotatory powers are also given. Certain remarkable numerical relations apparently exist between the rotations of many of the salts; these should have considerable bearing on the vexed question of multiple rotation, and will be discussed after they have been submitted to a more detailed investigation.—Dibromo-β-lapachone, by S. C. Hooker and A. D. Gray. Monobromo-β-lapachone cannot be converted into dibromo-β-lapachone by the action of bromine alone; the formation of the latter derivative in the preparation of monobromo-β-lapachone from lapachol, is due to the production and subsequent decomposition of an additive compound of monobromo-derivative and hydrogen bromide.—The conversion of para- into ortho-quinone derivatives, by S. C. Hooker. Both in the lapachol and other groups, compounds derived from α-naphthaquinone, of the type represented by formula I., are far more readily converted, by the action of acids, into anhydrides derived from β-naphthaquinone (II.) than into anhydrides of the α-quinone type (III.).



—The nitro-derivatives of phenolphthalein, by J. A. Hall The author has prepared dinitro- and tetranitro-phenolphthalein,

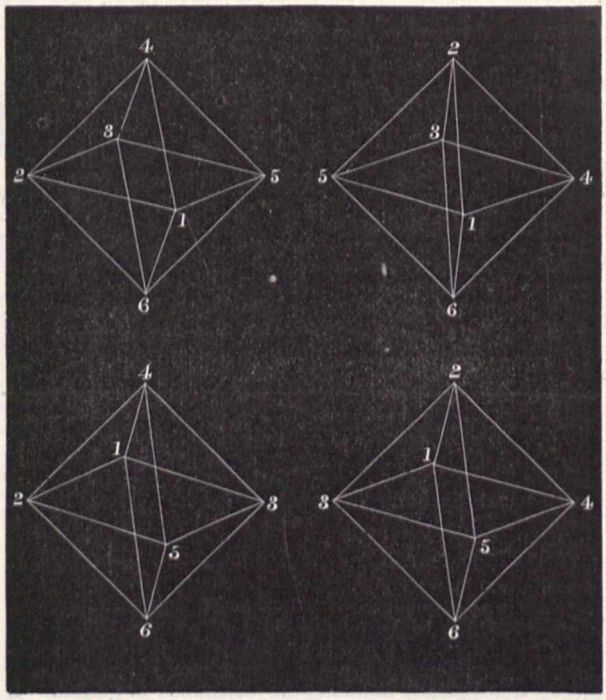
and describes their properties.—A method for the preparation of acetylene, by M. W. Travers. Calcium carbide may be prepared by heating a mixture of sodium, gas carbon, and calcium chloride for half an hour at bright redness in an iron bottle. The carbide thus obtained yields acetylene on treatment with water. 240 c.c., half the theoretical quantity, of acetylene is obtained for every gram of sodium used in the preparation of the carbide.

Mathematical Society, February 9.—Mr. A. B. Kempe, F.R.S., President, in the chair.—The following communications were made:—The Harmonics of a Ring, by Mr. W. D. Niven, F.R.S. This paper treats of the potential functions of an anchor ring, and explains how problems to which those functions are applicable may be solved for two coaxal rings. The proposition on which the method depends establishes that the ring harmonics of any degree may be derived from their predecessors of lower degree by simple differentiations with regard to the radius of the dipolar circle of the ring and the distance of a fixed point from the plane of this circle. Ultimately the harmonics depend upon the potential at any point due to a distribution on the circle either uniform or varying as a circular function of the arc. Now the potential due to such distribution on a circle B may readily be expressed in terms of the harmonics pertaining to a coaxal circle A, and hence any harmonic pertaining to B, and therefore any series of such harmonics, may be expressed in a series pertaining to A. In the latter form they are suitable for the application of surface conditions at any ring whose dipolar circle is A. The application worked out in the paper is the problem of the influence of two electrically charged coaxal rings upon one another. It is also shown how the same problem may be solved for a ring and sphere, symmetrically situated as regards the axis.—The group of thirty cubes composed by six differently coloured squares, by Major MacMahon, R.A., F.R.S. Selecting any one of the thirty cubes at pleasure it is possible to select eight of the remaining twenty-nine which in reference to the cube selected have a very peculiar and interesting

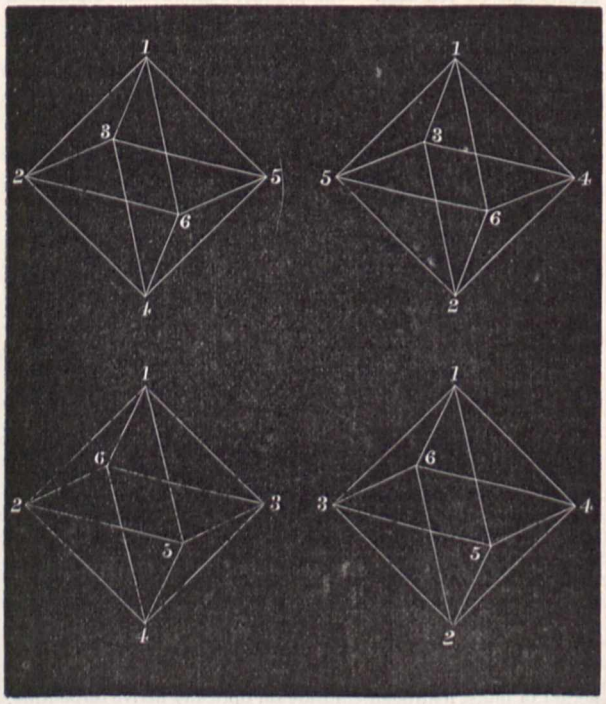


Selected Cube (transformed) diagonal 16 vertica

property. It is possible to form the eight cubes into a single cube in such wise that contiguous faces of the cubes are similarly coloured, and also so that the resulting cube has the appearance of the *selected* cube in regard to the colouring of its faces. To each cube of the thirty belong in this way eight other cubes, the selection of the eight cubes being unique. For the examination of this property the selected cube is transformed into an octahedron by joining the middle point of each face to the middle points of the adjacent faces; a regular octahedron with six differently coloured summits is thus obtained. Each triangular face is determined by three differently coloured summits, and exactly eight other octahedra are obtained by circular substitutions performed on the three colours which determine a face; in regard to the eight faces there are eight clock-wise and eight counter clock-wise substitutions, but only eight different octahedra can be obtained. These give the eight cubes associated with the selected cube. The eight cubes having been determined, the problem of forming them admits of just two solutions. One solution is—



Lower Four Cubes.



Upper Four Cubes.

The other solution is obtained by interchanging clock-wise and counter clock-wise rotations of octahedral faces. Other interesting properties of these cubes are examined in the paper.

Geological Society, January 25.—W. H. Hudleston, F.R.S., President, in the chair.—The following communications were read: On inclusions of tertiary granite in the Gabbro of the Cuilin Hills, Skye; and on the products resulting from the partial fusion of the acid by the basic rock, by Prof. J. W. Judd, F.R.S.—Anthracite and bituminous coal-beds; an attempt to throw some light upon the manner in which anthracite was formed; or contributions towards the controversy regarding the formation of anthracite, by W. S. Gresley.

February 8.—W. H. Hudleston, F.R.S., President, in the chair.—The following communnications were read: Notes on some coast-sections at the Lizard. By Howard Fox and J. J. H. Teall, F.R.S. In the first part of the paper the authors describe a small portion of the west coast near Ogo Dour, where hornblende-schist and serpentine are exposed. As a result of the detailed mapping of the sloping face of the cliff, coupled with a microscopic examination of the rocks, they have arrived at the conclusion that the serpentine is part and parcel of the foliated series to which the hornblende-schists belong, and that the apparent evidences of intrusion of serpentine into schist in that district are consequences of the folding and faulting to which the rocks have been subjected since the banding was produced. The interlamination of serpentine and schist is described, and also the effects of folding and faulting. Basic dykes, cutting both serpentine and schists, are clearly represented in the portion of the coast which has been mapped, and these locally pass into hornblende-schists, which can, however, be clearly distinguished from the schists of the country. The origin of the foliation in the dykes is discussed. The second part of the paper deals with a small portion of the coast east of the Lion Rock, Kynance. Here a small portion of the "granulitic series" is seen in juxtaposition with serpentine. The phenomena appear to indicate that the granulitic complex was intruded into the serpentine; but they may possibly be due to the fact that the two sets of rocks have been folded together while the granulitic complex was in a plastic condition, or to the intrusion of the serpentine into the complex while the latter was plastic.—On a radiolarian chert from Mullion Island, by Howard Fox and J. J. H. Teall. The main mass of Mullion Island is composed of a fine-grained "greenstone," which shows a peculiar globular or ellipsoidal structure, due to the presence of numerous curvilinear joints. Flat surfaces of this rock, such as are exposed in many places at the base of the cliff, remind one somewhat of the appearance of a lava of the "pahoehoe" type. The stratified rocks, which form only a very small portion of the island, consist of cherts, shales, and limestone. They occur as thin strips or sheets, and sometimes as detached lenticles within the igneous mass. The chert occurs in bands varying from a quarter of an inch to several inches in thickness, and is of radiolarian origin. The radiolaria are often clearly recognisable on the weathered surfaces of some of the beads, and the reticulated nature of the test may be observed by simply placing a portion of the weathered surface under the microscope. The authors describe the relations between the sedimentary and igneous rocks, and suggest that the peculiar phenomena may be due either to the injection of igneous material between the layers of the stratified series near the surface of the sea-bed while deposition was going on, or possibly to the flow of a submarine lava. The form of the radiolaria observed in the deposit, and also their mode of preservation, are described in an appendix by Dr. G. J. Hinde.—The reading of these papers was followed by a discussion, in which the President, Rev. Edwin Hill, Prof. Bonney, Dr. Hicks, Dr. Hind, and the authors took part.—Note on a radiolarian rock from Fanny Bay, Port Darwin, Australia, by G. J. Hinde. A specimen brought from Fanny Bay by Captain Moore, of H.M.S. *Penguin*, is of a dull white or yellowish tint, in places stained red. It has an earthy aspect, and is somewhat harder than chalk, but gives no action with hydrochloric acid. Microscopic sections show a fairly transparent groundmass, apparently amorphous silica, containing granules and subangular fragments up to '075 millim. in diameter, some of which appear to be quartz. Besides this, the rock contains numerous radiolaria, and it is really a radiolarian earth intermediate in character between the Barbados earth and such cherts as those of the Ordovician strata of Southern Scotland. The details of the extent of the deposit and its relationship to other rocks of the area are not yet obtainable, though it is possible that a considerable thickness of rock mentioned by Mr. Tenison Woods as occurring in this area may also be of radiolarian origin. The author describes a species of *Cenellipsis*, two of *Astrophacus*, one of *Lithocyclia* (new), one of *Amphibrachium*, three of *Spongodiscus* (one new), four of *Spongolena* (all new), two of *Dictyomitra* (both new), one of *Lithocampe* (new), and two of *Stichocapsa* (both new). From these it is not practicable at present to determine the geological horizon of the rock; with one exception, all the genera represented occur from Palæozoic times to the present.—Notes on the geology of the district west of Caermarthen. Compiled from the notes of the late T. Roberts (communicated by Prof. T. McKenny Hughes, F.R.S.). To the east of the district around Haverfordwest, formerly described by the author and another, an anticlinal is found extending towards Caermarthen, The lowest beds discovered in this anticline are the *Tetragraptus*-beds of Arenig age, which have not hitherto been detected south of the St. David's area. They have yielded eight forms of graptolite, which have been determined by Prof. Lapworth. The higher beds correspond with those previously noticed in the district to the west; they are, in ascending order: (1) Beds with "tuning-fork" *Didymograpti*, (2) Llandeilo limestone, (3) *Dicranograptus*-shales, (4) Robeston Wathen and Sholeshook limestones. Details of the geographical distribution of these and of their lithological and palæontological characters are given in the paper. After the reading of this paper Dr. Hicks said he felt sure he was expressing the feelings of the Fellows in referring to the serious loss which the Society had suffered by the death of Mr. T. Roberts, who certainly was one of the most promising palæontologists in this country. The important researches which he carried on, in conjunction with Mr. Marr, had made is now comparatively easy to understand some intricate and extensive districts in Pembrokeshire and Caermarthenshire, which previously were little more than blanks on the geological map.

February 17.—Anniversary Meeting.—The medals and funds were awarded as follows:—The Wollaston medal to Prof. N. S. Maskelyne, F.R.S.; Murchison medal to the Rev. O. Fisher; Lyell medal to Mr. E. T. Newton; and the Bigsby medal to Prof. W. J. Sollas, F.R.S.; the balance of the proceeds of the Wollaston fund to Mr. J. G. Goodchild; that of the Murchison fund to Mr. G. J. Williams; and that of the Lyell fund to Miss C. A. Raisin and Mr. A. N. Leeds. The following is the list of officers and council elected at the meeting:—President: W. H. Hudleston, F.R.S. Vice-Presidents: Sir A. Geikie, F.R.S., G. J. Hinde, Prof. J. W. Judd, F.R.S., H. Woodward, F.R.S. Secretaries: J. E. Marr, F.R.S., J. J. H. Teall, F.R.S. Foreign Secretary: J. W. Hulke, F.R.S. Treasurer: Prof. T. Wiltshire. Prof. J. F. Blake, Prof. T. G. Bonney, F.R.S., R. Etheridge, F.R.S., Sir A. Geikie, F.R.S., Prof. A. H. Green, F.R.S., Alfred Harker, H. Hicks, F.R.S., G. J. Hinde, T. V. Holmes, W. H. Hudleston, F.R.S., J. W. Hulke, F.R.S., Prof. J. W. Judd, F.R.S., R. Lydekker, Lieut.-General C. A. McMahon, J. E. Marr, F.R.S., H. W. Monckton, Clement Reid, F. Rutley, J. J. H. Teall, F.R.S., Prof. T. Wiltshire, Rev. H. H. Winwood, H. Woodward, F.R.S., H. B. Woodward. The presidential address dealt with some recent work of the Geological Society, the subjects ranging over a period of six or seven years. These embraced Pleistocene geology, theories in connection with Glaciation, Tertiary, Cretaceous, Jurassic, and Permo-Triassic geology. It further mentions that the number of papers on Pleistocene geology has been very considerable, and many of them relate to the south-east and the south of England; those relating to Central England and South Wales were fewer in number, whilst the north had furnished but few papers. The great memoir on the Westleton Beds had provided much material for consideration; that portion relating to the Southern Drift being especially interesting. Reference was made to a paper on Pleistocene succession in the Trent basin as forming a fitting introduction to the fascinating problems connected with the North Wales border on the one side and with Flamborough Head on the other. From Scotland notice was taken of some supplementary remarks on the paralled roads of Glen Roy. Speculation as to the evidence of a palæozoic ice age, the date and duration of the Pleistocene glacial period, and a notice on misconceptions regarding the evidence of former glacial periods were also discussed. The Tertiary Geology of the London and Hampshire basins was considered, more especially in relation to the Upper Eocene, or Bartons, and their probable equivalents in West Surrey. Under this heading, also, comes the Geology of Barbados, since the oceanic deposits in that island were held to be of late Tertiary age. These interesting discoveries were reviewed

at some length, and the results compared with tables in the recently issued "*Challenger* Reports." In Upper Cretaceous Geology the phosphatic deposits at Ciply and Taplow were noticed, and also the important correlations of the basement-beds in Norfolk, Lincolnshire, and East Yorkshire. The Lower Cretaceous beds at Speeton next passed under review, more especially in connection with their somewhat difficult palæontology and possible equivalents in Eastern Europe. It then went on to state that our knowledge of the Upper Jurassics of the East of England had of late years received considerable additions and important correlations between our Upper Jurassics generally, and their equivalent on the Jura had been effected, that the inferior Oolite and the Lias boundary had come in for their share of attention, whilst a determined attempt had been made to refer a portion of the red rocks of South Devon to the Permian.

PARIS.

Academy of Sciences, February 13.—M. de Lacaze-Duthiers in the chair.—On an invariant number in the theory of algebraic surfaces, by M. Émile Picard.—Study of the Cañon Diablo meteorite, by M. Henri Moissan. The composition of the meteorite is very variable from point to point. In the fragments examined the percentage of iron varied from 91·09 to 95·06, and that of nickel from 1·08 to 7·05. Diamonds were also found, both transparent and black, and a brown form of carbon of feeble density. The largest diamond measured 0·7 mm. by 0·3 mm. It had a yellow tint and a rough surface, and was transparent to light.—On the meteoric iron of Cañon Diablo, by M. C. Friedel. A small quantity of a silver-white fragile compound occurring in the meteorite in the form of plates disseminated through the nickeliferous iron and accompanied by schreibersite, was isolated, and its composition found to correspond to the probable formula Fe_5S. The mixtures of ordinary carbon, graphite, and diamond were found chiefly associated with nodules of yellow troilite.—On the presence of graphite, carbonado, and microscopic diamonds in the blue earth of the Cape, by M. Henri Moissan. After repeated and lengthy treatment with boiling sulphuric and hydrofluoric acids, 250 gr. of blue earth left a residue weighing only 0·094 mgr. In this residue brilliant hexagonal crystals of graphite were found, giving rise, when treated with potassium chlorate, to a graphitic oxide of a colour passing from green to yellow. Another species of graphite was also isolated which, when treated with H_2SO_4 at 200° C., swelled up considerably and dissolved. Its artificial preparation will be described in a subsequent paper. The portions of the residue unaffected by potassium chlorate and heavier than methylene iodide (density 3·4) comprised an amber-coloured mass, black diamonds, microscopic true diamonds, and small transparent crystals in form of elongated prisms, which did not burn in oxygen and were not fluorescent in violet light. The first, which contains a large proportion of iron, and the last, which contains silica, can be destroyed by treatment with fused potassium bisulphate and then with hydrofluoric and sulphuric acids. The blue earth, which was taken from the Old de Beers Mine, thus contained all the carbon compounds found in the iron matrix employed for their artificial production.—The clasmatocytes, the fixed cellules of the connective tissue, and the pus globules, by M. L. Ranvier. In an inflamed tissue the clasmatocytes and leucocytes are the only ones which give rise to purulent globules, the latter being, in fact, mortified lymphatic cellules.—Glycosic expenditure attendant upon nutritive movement in hyperglycemia and hypoglycemia brought about experimentally; consequences bearing upon the immediate cause of diabetes and other deviations of glycemic function, by MM. A. Chauveau and Kaufmann.—Observations of Holmes's comet made with the *equatorial coudé* (0·32 m.) of the Lyon Observatory, by M. G. Le Cadet.—On an explicit form of the addition formulæ of the most general hyperelliptic functions, by M. F. de Salvert.—On the laws of reciprocity and the sub-groups of the arithmetical group, by M. X. Stouff.—Experiments on overflowed weirs, by M. H. Bazin.—On the fringes of caustics, by M. J. Macé de Lépinay.—On a phenomenon of apparent reflection at the surface of the clouds, by M. C. Maltézos.—On the electric figures produced at the surface of crystallised bodies, by M. Paul Jannetaz. If the face of a crystal be covered with matter consisting of light and small grains, such as lycopodium seed or talc powder, and an electric discharge passed into the face through a point outside it, certain figures are formed, many of which were investigated by Wiedemann and Senarmont. Very regular ellipses were obtained by M. Jannetaz by passing a series of discharges from an electrostatic machine or an induction coil. The orientation of the major axes of the ellipses was observed for a large number of minerals. In most cases this axis was perpendicular to the direction of maximum conductivity for heat. In the case of a well-defined single cleavage, such as that of mica, talc, a block of wood, the cut edge of a book, or a schistose rock, the major axis was perpendicular to the plane of cleavage. The point need not touch the plate. Figures were obtained on a plate of gypsum strewn with lycopodium powder, and charged from beneath. Positive and negative sparks show the same effect.—Action of temperature on the rotatory power of liquids, by M. Albert Colson.—Density of nitrogen dioxide, by M. A. Leduc.—Considerations on the genesis of the diamond, by M. J. Werth.—On the chlorine derivatives of the propylamines, the benzylamines, aniline and paratoluidine, by M. A. Berg.—On dipropylcyanamide and dipropylcarbodiimide, by M. F. Chancel.—Survival after section of the two vagi nerves, by M. C. Vanlair.—On the internal pericycle, by M. Léon Flot.—On a modification to be applied to the construction of bottles designed to collect specimens of deep waters, by M. J. Thoulet. The compressibility of water is such that one litre, collected at a depth of 8000 m. below sea-level, would expand by 35 cc. when the bottle was opened at the surface. Such bottles may therefore be constructed of thin sheet copper or other metal allowing an expansion of thirty-five parts in 10,000.—Lines of structure in the Winnebago County meteorite and some others, by Mr. H. A. Newton.—On a meteorite observed at Newhaven (Connecticut), by Mr. H. A. Newton.

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