THURSDAY, MAY 16, 1895.

## HYGIENE AND METEOROLOGY.

*Hygienische Meteorologie. Für Ärzte und Naturforscher* Von Prof. Dr. W. J. van Bebber, Abtheilungs Vorstand der deutschen Seewarte in Hamburg. (Stuttgart: Ferd. Enke, 1895.)

NO long preface is needed to prove that meteorology and hygiene have a close and intimate connection, or that the study of both sciences may be mutually helpful. The exhibition of a small death-rate does not exhaust the whole of the problems with which hygiene busies itself. All that tends to ameliorate the condition of the human race, all that ministers to the comfort or promotes the well-being of the individual, is cared for by the student of hygiene. That climate and the phenomena, which we recognise under the comprehensive term "weather," have an intimate connection with the health and comfort of the race, will not be seriously denied, whatever different views may be held as to the precise manner, and to what degree, the condition of the atmosphere can operate on individual cases. Some knowledge of meteorology has hitherto been demanded from candidates for diplomas in sanitary science, public health, or State medicine; and, judging from the rules adopted by the Council, December 1, 1893, the conditions of the examination will in future demand a still closer acquaintance, since the applicant is required to show the possession of a "distinctively high proficiency, scientific and practical, in all the branches of study which concern the public health." To those who seek something more than a bare superficial knowledge of meteorology, this book will be very welcome, and not only to those who desire diplomas, but to the larger, though less specially instructed, class who desire the welfare of the human family.

Coming from one the direction of whose scientific studies is distinctly meteorological, it might be anticipated that the book would deal more with this subject than with hygiene; and to some extent this is the case, and possibly the interest in the book will on this account be diminished. We have a collection of facts, admirably arranged, though drawn, of course, mostly from German sources; and such a collection will be of the greatest value to some student of sanitary and social science, who, trained in physiological schools, will produce a work of greater interest, more closely connected with the spread and mitigation of disease as affected by climate or meteorological conditions of a more or less temporary character. In one important respect, however, the book deviates from the generality of meteorological treatises, and at the same time removes an objection which has frequently been urged by physicians, who assert that weather statistics are not given in the form which is most convenient or most instructive. To take a mean of his observations is too frequently the sole aim of the meteorological observer, and consequently mean results for temperature, for example, are given, where the range of variation is the more important element from the medical point of view. This fact is fully recognised by the author, and he deals not only with the mean values, but also with the amount of variation from the arithmetic mean and the frequency with which such variations occur.

The book is divided into eight sections. The two first treat of the physical properties and of the various ingredients of the air. Elementary physics characterises the first, chemistry the second. In this latter section are described somewhat fully the gases which enter into the atmosphere, not excepting those which are present in minute quantities. Accidental ingredients, such as dust and micro-organisms, are also considered. One does not meet with anything very new, but the facts are well and pleasantly arranged, and would give any student all the information necessary for fully comprehending the successive chapters. It might have been expected that the constituents of water would have been treated with the same degree of fulness. Free oxygen in water may not be of the same importance as in the air, but the aëration of water is not insignificant, whether regarded as an important withdrawal from the atmosphere itself, or the part it plays in the oxidation of organic material, be it in the form of ozone or hydrogen dioxide, or other efficient oxidiser.

The chapter on Temperature is admirable. From a vast collection of material with which intimate study has made the author closely familiar, he is able to systematise and arrange those facts which have the greatest and most obvious bearing on the subject. It is a graphic digest of all that affects the temperature of the world, and is amply illustrated by tables compiled from many sources. We wish we could pay him a compliment on his maps. In the map on page 110 it is only with great difficulty that Europe is recognised, and the one on page 174 is very little better. The tables are, however, so very well arranged, that this slight defect is of little consequence.

As an illustration of the minuteness into which the author enters, we may quote the measures of the temperature of different parts of clothing when worn. The figures have been reduced to Fahrenheit scale, in which form, if less scientific, they may be of use to some of the commercial firms who are interested in such matters.

| | Temp. 50° | Temp. 79° |
|---|---|---|
| Temp. on the coat ... ... | 71·2° | 82·4° |
| ,, between coat and vest ... | 73·6 | 83·8 |
| ,, ,, vest and linen shirt | 75·9 | 84·7 |
| ,, ,, linen shirt and woollen shirt ... | 77·4 | 85·3 |
| ,, ,, woollen shirt and skin ... ... | 90·9 | 89·8 |

The loss of temperature which the body experiences at a temperature of 59° is diminished by clothing in the following proportions:—

| | |
|---|---|
| Radiation from the bare skin ... ... ... | 100 |
| ,, when covered with wool ... ... | 73 |
| ,, when covered with wool and linen ... | 60 |
| ,, when covered with wool, linen, and vest ... ... ... ... ... | 46 |
| ,, when fully dressed ... ... ... | 33 |

It does not appear whether the velocity of the wind has been taken into account in deriving these figures. The importance of clothing comes, however, again to the fore as affected by moisture, where the author computes and illustrates the amount of heat abstracted from the body in order to convert into vapour the water which a saturated suit of clothes is capable of containing.

This latter remark has reference naturally to the chapter on Precipitation, which, with the following one on Thunder-storms, does not call for any special remark. Emphasis is laid on the purifying influences that rain and snow have on the atmosphere; but little is said, perhaps, because little is known with certainty, of cleansing influences on water. The question how far water once contaminated can be restored to its original organic impurity, without the processes of evaporation and reprecipitation, has exercised the minds of chemists and sanitarians in this country with some severity. Information is still necessary both as to the processes at work and the agents by which impurities are removed, as they admittedly are, by some self-cleansing method. The author is understood to recommend filtration as especially necessary to eliminate (*auszuscheiden*) bacteria, presumably bacteria of a pathogenic character. He does not seem to recognise the fact, if it be a fact, that a filter-bed covered with bacteria has still the power of arresting in a very considerable degree the bacteria in the water that filters through it. How this is accomplished is another matter, which may not concern meteorology, but the large questions of sedimentation and percolation of water in its passage through the ground comes naturally into the treatment by Dr. Bebber, more especially as he enters with some degree of detail into ground water, and the conditions which make it potable or otherwise.

Wind and the motion of cyclones are subjects that the author has made peculiarly his own, and are dealt with here at considerable length. Considering the important results that follow the transport of masses of air from place to place, and the mingling and purification of the atmosphere that is thus effected, it is not suggested that the subject receives an undue amount of attention. The connection between cyclonic paths (*Zugstrasse*) and hygiene, however, is not so immediately evident; but the subject is one that has long interested Dr. Bebber, and he naturally has much to say. It is meteorology pure and simple, and has this defect, that it is scarcely full enough for the student of that science, and in too great detail for the sanitarian.

Perhaps the most interesting chapter in the book is the last, on Climate, and in which is treated diseases under various climatic conditions. On page 275 is given a table showing the annual mortality per thousand in various parts of the world. This table is apparently thrown together haphazard, and does not exhibit that careful arrangement by which Dr. Bebber in other parts of his book has illuminated his work and instructed the student. But the bald facts, as written down, gain by that very absence of symmetry, and are both interesting and gratifying. It is true, as the author is careful to point out, that the facts have been gathered under very various circumstances, under various authorities and systems, and are not strictly comparable; but making every allowance for inexact compilation, they do exhibit a manifest improvement in the health of nations, and bear a gratifying testimony to the successful study and practical enforcement of sanitary laws. The few samples we can extract illustrate best the increased adaptibility of individuals to meet those conditions that are generally regarded as adverse to health and longevity. Take the case of British troops in India:

| | | | |
|---|---|---|---|
| From 1800-1830. | Annual death rate per thousand | ... | 84·6 |
| ,, 1830-1856. | ,, ,, | ... | 57·7 |
| ,, 1869-1878. | ,, ,, | ... | 19·3 |
| ,, 1879-1887. | ,, ,, | ... | 16·3 |

From the West Indies the evidence is of the same character:

| | | | | |
|---|---|---|---|---|
| From 1820-1836. | European Troops, | Jamaica, | Mortality | 121 |
| ,, 1817-1846. | ,, ,, | West Indies | ,, | 75 |
| ,, 1879-1887. | ,, ,, | Jamaica | ,, | 11·0 |
| ,, 1820-1836. | Negro Troops, | Jamaica | ,, | 30·0 |
| ,, 1879-1887. | ,, ,, | ,, | ,, | 11·6 |

On the Gold Coast, the figures are so remarkable that that they can only be explained by supposing some different method of computation to have been employed in the two circumstances:

| | | | |
|---|---|---|---|
| From 1829-1836. | European Troops, Gold Coast | ... | 483 ! ! |
| ,, 1879-1885. | ,, ,, ,, | ... | 68 |

Possibly a similar source of error will explain the only retrograde case to be met with, for which the insalubrious climate of Cayenne is responsible:

| | | | |
|---|---|---|---|
| From 1819-1849. | Troops, Mortality | ... ... ... | 27·2 |
| In 1855 | ,, ,, | .. .. ... ... | 90·8 |

Of course some of these beneficent results may be attributed to greater care in the selection of men to be sent to these regions; but it would be distinctly wrong to deny also that much is due to insistence on improved conditions of residence, of clothing, of food and drink, especially in the maintenance of uncontaminated sources of drinking water, in fact an insistence on those conditions which sanitary science has shown to be of the utmost importance to individuals and nations.

Possibly, enough has been said here to show that we have to do with a very interesting book, and one far reaching in its aims. If we have to make any complaint, it is only to express the regret that it is not more so. It is the omissions that are sometimes disappointing, the contents never are. We give, in conclusion, one last illustration. Remembering that the book is issued from Hamburg, and that this town suffered severely from the scourge of cholera in 1892, one cannot but feel that the Observatory is in possession of facts which could not but be of interest in discussing the vexed question of the spread of this disease. Beyond the slightest possible mention on p. 287, the author does not refer to it. Yet it is suggested that he could have told us authoritatively what meteorological conditions coincided with the greatest spread of the disease, that he could have given us details of the temperature of the ground and of the Elbe water (see p. 147) that presumably favoured the increase of the bacillus, if it did not come within his province to discuss any differences of morphology, of virulence, or reproductive faculty in the vibrio.

## MECHANICAL ENGINEERING.

*A Text-book of Mechanical Engineering.* By Wilfrid J. Lineham, Head of the Engineering Department at the Goldsmiths' Company's Institute, New Cross. (London: Chapman and Hall, Limited, 1894.)

MR. LINEHAM says that the desirability of writing his book was suggested to him by the initiative of the City and Guilds of London Institute in providing an examination in mechanical engineering. In preparing students for this examination he was led, he says, "to consider seriously (1) whether the whole theory and practice of mechanical engineering, or even a *précis* of it, could be compressed into one volume; and (2) whether it was desirable so to compress it." After examining Mr. Lineham's book, we must confess to feeling grave doubt whether the second question, at least, should not have been answered in the negative before he set about the execution of so very large a task. The ambition of the attempt is, perhaps, more conspicuous than its success; at the same time the book has good features, and students of engineering may learn from it much that will be valuable to them. It is a novel contribution to engineering literature; by no means wholly satisfactory, but still one that should take a useful place.

Mr. Lineham deprecates in advance the criticism which he expects will be made on the compression of a vast subject into a single volume, by citing "the examples of great and successful writers—to wit, Rankine, Ganot, Deschanel, and others." We do not know whether both adjectives are intended to apply to Ganot and Deschanel, who, in any case, did not write on a subject which has a practice as well as a theory. As to Rankine, who certainly did write great and successful treatises on engineering, the citation seems particularly unfortunate. To compress everything into one volume was exactly what Rankine did not do. He wrote four or five large books dealing with various branches of the subject, and did not hesitate to repeat certain portions in more than one book whenever that was necessary to make each intelligible apart from the rest. Rankine's method and the author's are as wide apart as the poles; and of the two we prefer Rankine's. Moreover, Rankine, in his great series of text-books, dealt almost wholly with the *rationale* of engineering; but here, in a single volume, more than half the space is occupied by a description of the processes of the workshop.

It is in the descriptive portions that Mr. Lineham is at his best. Probably no better general account of hand and machine tools, and of the way to use them, has been published. The pattern shop and foundry, the smithy, the machine shop, fitting and erecting shops, all come in for their due share of attention. The construction of a horizontal engine is selected as a typical case, and is described from start to finish with minuteness of detail and with the aid of many admirable drawings. The illustrations of the book are indeed excellent throughout, both in style and matter. They are illustrations that really illustrate. There are 732 of them, and all are engineers' drawings. They have been prepared with obvious care, and it would seem with unsparing labour on the author's own part. They are treated in a way which allows of their liberal introduction without much expenditure of space. In a word, they are everything that the illustrations in such a text-book ought to be. The descriptive section of the book concludes with a useful chapter on boiler-making and plate work, with a somewhat extended account of hydraulic rivetting processes, and with a short notice of electric welding. In setting forth so much descriptive matter as this first part includes, it is of course difficult to preserve in all parts a proportion to which exception may not be taken. We could wish to have seen more space given to the milling processes, which take so prominent a place in modern workshops. Nine or ten pages for hydraulic rivetting, and a mere page and a half for the universal milling machine, seems less happy a proportion than the author has generally maintained. This, however, is a small matter; and it may safely be said that any engineering pupil or apprentice will have his outlook widened, and his knowledge considerably increased, by reading the first part of Mr. Lineham's book.

To the study of the second part, however, he will do well to bring some independent criticism. The first chapter is on the strength of materials, and we had not penetrated far without finding the ground shaky. Dealing with the nature of shear stress, the author uses the symbols $f_t$, $f_c$ and $f_s$ to indicate intensities of tensile, compressive, and shearing stress respectively, and resolves shearing stress into normal stresses inclined at 45° to it by the equation

$$f_c^2 + f_t^2 = f_s^2$$

$$\therefore \ f_c \text{ or } f_t = \frac{f_s}{\sqrt{2}} = \frac{f_s}{1 \cdot 414}.$$

This is a bad start in a chapter which is to include references to such subjects as the strength of thick cylinders, the torsion of square shafts, and the effects of combined bending and twisting in crank-shafts.

Immediately after this error is the following paragraph:

"On account of the cup or wedge fracture exhibited when a specimen is broken by tearing or crushing, and for other reasons, Prof. Carus-Wilson argues that rupture takes place by shear stresses at 45°, either wholly or partially. Certain it is that the three stresses are intimately connected, and assist each other in destroying the cohesion of the particles."

We have not an intimate acquaintance with the contributions which Prof. Carus-Wilson has made to this subject; but there is no evident reason why his authority should be invoked in support of an idea which is surely as old as the testing of materials.

Turning to the paragraph headed "Strength of square shaft," we find a geometrical construction described at some length, which is apparently based on Coulomb's erroneous theory. The student who has taken the trouble to follow this will feel excusably confused or irritated when he goes on to read the subsequent lines:

"St. Venant showed, however, in 1856 that Coulomb's ring theory was not strictly applicable to any but circular sections, and gave the following:

$$\text{Moment of square section} = f_s (\cdot 208 s^3)$$

because the greatest stress does not occur at the corners. To illustrate St. Venant, Thomson and Tait have magined the shaft to be a box full of liquid, which, if rotated, would leave the latter behind somewhat, and the apices would cause two stresses—tangential and centripetal—to act on the particles, the former only being of momental value."

Now what is the student, whether at the New Cross Institute or elsewhere, to make of this without further explanation? To introduce St. Venant and say no more than this, is surely giving either too much or not enough. The same criticism might be repeated at many other places. Under the heading of "Pillars and Struts," we are told that Euler is pronounced Oiler (this, at least, is nothing if not practical), and his formula for the stability of long columns is quoted without explanation. Gordon's formula and constants are also quoted, and the subject is dismissed with the dictum:

"Claxton Fidler says a pillar-strength cannot be an absolute quantity, but may be anywhere between Euler and Gordon's results."

The theory of heat engines is treated in an equally scrappy and inconclusive fashion. The student will not find it easy to reconcile what he is told on p. 609 as to the efficiency of the engine not depending on the working substance, with the statement, on p. 613, that "in practice it is difficult to find a sufficiently perfect substance"—which is given as a reason why the efficiency of a real engine is less than the efficiency in Carnot's cycle. He will find himself also at a loss to understand the statement that "in adiabatic expansion external work is done at the expense of internal heat, and is therefore negative"; or to see why the dryness fraction of steam is necessarily "a whole number" (p. 594). Again, to take a matter of first-rate importance in regard to the action of steam in the cylinder, initial condensation is spoken of as if it affected the efficiency merely by the trifling alteration it produces in the form of the expansion curve, and we do not find a hint as to the real reason for its highly prejudicial effect.

It would be unfair to conclude that all the theoretical portions of the book are equally unsatisfactory. But at the best, their brevity, and the narrow limits of mathematical knowledge which the author assumes on the part of his readers, make this part of the work more like an engineering pocket-book than a treatise, the purpose of which ought to be to educate the student to reason about the application of mechanical principles to engineering. If the book, in this aspect, is representative of the teaching which the new Polytechnics are giving, it suggests the inquiry whether what Lord Armstrong once called "the vague cry for technical education" has met with the best possible response. We have no sympathy with those who would exclude either engineer apprentices or any other workmen from the highest education they are capable of. But the question may fairly be asked whether a good deal of what is apparently taught, and taught for the express purpose of enabling pupils to pass a specified examination, is in any just sense education at all. The mental discipline which would be obtained by making a real study of problems such as are touched on in this book, would be of the highest value as an education to the engineer. But there is no royal road to the comprehension of elasticity and thermodynamics. If the young apprentices and working lads, who, much to their credit, flock to the new Polytechnics, will take the trouble to truly master any of these things, they will gain an intellectual possession which will make them better men, if not directly better workmen. We would be the last to set a bound to their aspiration, or to discourage the study of Euler and St. Venant. But as a preparation for any such task, they must first, let us say, learn what is the meaning of a differential coefficient. To offer them scraps of conclusions which have to be taken on trust, and "reasons" which can carry conviction to no one except perhaps a jaded examiner, is giving stones to children who presumably cry for bread. If this represents the "theoretical" side of technical education as the new technical schools understand it, or as examiners accept it, we are still some way from a satisfactory solution of the much-vexed problem. For a great deal of this does not usefully instruct, and does not effectually educate: it is, as we have said, either too much or not enough.

## *THE LAKE OF GENEVA.*

*Le Léman Monographie Limmologique.* By F. A. Forel. Tome second. (Lausanne: F. Rouge, 1895.)

THE first volume of Prof. Forel's work on the Lake of Geneva appeared in 1892, and was reviewed in these pages (vol. xlvii. p. 5). It dealt chiefly with the physical history of the lake-basin, while the present one, containing parts 6–10 of the whole work, begins with "Hydraulics," or the currents, waves, *seiches*, and other deviations of the surface from the normal form of a fluid at rest. It passes on to thermal questions, such as the temperature at different depths, freezing of the surface, &c.; next to optical questions, such as the colour, occasional iridescence and other peculiarities of the water, and the phenomenon of the *Fata Morgana;* then to acoustics (briefly); and lastly, to the chemistry of the water.

As it is impossible, in the limits of a comparatively short notice, to deal with the numerous subjects included in the present volume, we shall restrict ourselves to those which, perhaps, may be more widely interesting than the rest. The first one concerns those curious oscillations of the level of the lake, which locally are called *seiches.* This phenomenon, as defined by Prof. Forel, consists in an alternate rise and fall of the surface of the water; the movement being roughly comparable with that of a balanced plank, when set swinging by a slight disturbance. These oscillations are more or less rapid; their amplitude varying much. Commonly it is only a very few inches; but it may amount, though rarely, to about six feet—the disturbance sometimes lasting for twenty or twenty-five minutes. The whole question is discussed by Prof. Forel in its various aspects, and a history given of the different explanations which have been advanced. He attributes it neither to the effect of storms, nor to that of wind, nor to that of varying atmospheric pressure, but to a disturbance of the whole mass of water by earth-tremors, and compares it to the effect which may be produced on a fluid contained in a flat dish by tapping the bottom. In this hypothesis, however, he frankly admits the existence of a difficulty; namely, that earthquakes and *seiches* are not always associated, for in some cases the former have not been accompanied by the latter. The difficulty is undoubtedly a serious one, and it is thus met by Prof. Forel. In an earthquake the undulatory movement is variable in character. In some cases it affects a pendulum seismograph, in others it does not; much depending on the rate at which the shock travels. If this be quick, it will not produce a perceptible undulation to a mass of water; if it be slow, it will set up a very sensible movement. Thus an earthquake of the latter type will produce a *seiche*, but not one of the former. There is much to be said in favour of this hypothesis; but further seismographic observations are required to show that there is a real coincidence between the nature of the earthquakes and the occurrence of the *seiches*.

More than one point of interest is discussed in the section dealing with optical questions. The Swiss lakes, as is well known, vary in colour, some having a distinctly green tint, but others, and especially the Lake of Geneva, being noted for the exquisite blue of the water. To facilitate comparative observation, Prof. Forel has constructed a scale of colours, beginning with sulphate of copper, as the pure blue, and representing the effects of chromate of potash added in proportions commencing with 2 and ending with 65 per cent. After a careful study of the whole question, he comes to the conculsion that the colour of the water depends not merely on the quantity of minute mineral matter present in a state of suspension, but also on the amount present in solution.

The third point, the chemistry of the water, is also very interesting. The author has collected together a large number of analyses already published, has added some others, and discusses the whole. These exhibit differences more considerable than we might have expected; for instance, the residue after evaporation varies from 160 to 218 mgs. per litre. These differences, allowing for possible errors, are probably due primarily to the affluents of the lake, the waters of which are long in becoming completely mixed with the main mass. The principal constituents of this residue are carbonate of lime, sulphate of lime, and carbonate of magnesia, the amounts being variable. Evidently they depend partly upon the time of the year, for in two samples, drawn from the same locality in January and in May, the numbers in the one case were as 3·3 : 2·6 : 1, in the other 3·7 : 1·4 : 1.

The volume, in short, is full of valuable matter, and worthy of its predecessor. As we said of that, it is a little too diffuse for a scientific treatise, but it was necessary, as the author then explained, to write it so as to attract a larger circle of purchasers.

T. G. BONNEY.

## OUR BOOK SHELF.

*A Catalogue of the Books and Pamphlets in the Library of the Manchester Museum.* By W. E. Hoyle, M.A., F.R.S.E., Keeper of the Museum. (Manchester: J. E. Cornish, 1895.)

THIS catalogue, of 292 pp., owes its appearance in print to private enterprise, and is noteworthy as being classified according to the "Dewey Decimal System," under which each digit composing the registration number of a book marks a distinct narrowing in its significance, and for the arrangement under each class by Cutter's "Decimal Author Table," whereby each book receives a number which is virtually an abbreviation of its author's name. Thus, that "597·0941 Ya 21" denote the second, and "597·0941 Ya 2" the original edition of Yarrell's "History of British Fishes," may appear perplexing; but it is claimed by the advocates of the Dewey-Cutter systems that however much the library may grow, these numerical combinations will remain, and that they allow for maximum extension with minimum disturbance.

The classified catalogue upon which we have commented covers 230 pp., and is followed by a supplementary "author catalogue." The author modestly remarks in his preface, that the volume is "the work of one who is not a professional librarian." The labour of compilation has been great; and this catalogue, like all else that its author has put before the world, bears strongly the stamp of thoroughness and accuracy. We cordially recommend it to our university and public librarians, not, however, without a fear that they may adjudge it dangerous in its over-elaboration.

An index of subjects is appended, and Russian names have been transliterated according to the system advocated in our pages (NATURE, vol. xli. p. 396), and adopted in many of the principal scientific libraries.

*A Course of Elementary Practical Bacteriology, including Bacteriological Analysis and Chemistry.* By A. A. Kanthack, M.D., and J. H. Drysdale, M.B. (London: Macmillan, 1895.)

A LITTLE volume of 127 pages, primarily intended to carry candidates for diplomas in Public Health through a three months' course in bacteriology, and not pretending to be more than a laboratory guide. The instructions are extremely brief, and for the most part unaccompanied by any theoretical explanation. This entire divorce of theory and practice is, in our opinion, not unattended with danger, often leading the student to unintelligently cram the details of methods without having any proper understanding of the principles involved. It is frequently forgotten that the chief object of laboratory work should be to gain a living knowledge of a science, rather than the acquisition of mere dexterity in its practical technique. The exercises are, as we should anticipate from the experience and standing of the authors, well chosen, thoroughly representative, and cover a large amount of ground. On the other hand, some statements made without qualification may easily give rise to mistakes if accepted without reserve. Thus we are told that it is often possible to give a definite opinion in from eighteen to forty-eight hours, as to the presence or absence of cholera vibrios. Recent researches, however, go more and more to show that it is by no means so easy as was supposed to give a correct "definite opinion" as to the identity of this or any other particular micro-organism. We doubt whether bacteriology is sufficiently advanced to admit of treatment in quite such a final and hard and fast manner as it receives in this text-book; but we are told that these pages are not to supplant the demonstrator, and we would add that they should be carefully supplemented by the teacher. If thus employed, this work should prove a very valuable addition to the bacteriological literature of our country. Especially welcome is the inclusion of the principal methods for the detection of some of the chemical products of bacterial life.

*Primer of Navigation.* By A. T. Flagg. (London: Macmillan, 1894.)

MR. FLAGG'S little primer can be strongly recommended to all beginners; it is the A B C of the art of navigation. Every step is explained in the most simple and accurate manner; and for students depending upon self-instruction, a better or more clearly written primer would be difficult to imagine.

## LETTERS TO THE EDITOR.

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

### The Origin of the Cultivated Cineraria.

AFTER reading the recent letters on the origin of the cultivated Cineraria, I have consulted the principal authorities cited by Mr. Bateson in NATURE of April 25; I now wish to point out that Mr. Bateson has omitted from his account of these records some passages which materially weaken his case.

Mr. Bateson, as I understand him, considers his letter to prove (1) that modern Cinerarias arose as hybrids from several distinct species; and (2) that the main features of existing varieties were established between about 1830 and about 1846, as a result of the appearance of considerable "sports" among these hybrids or their offspring. I will first discuss the latter half of the letter, in which authorities are quoted to prove two special acts of hybridisation, performed at known dates by known persons, and to show that certain named varieties arose as "sports."

First, as to hybridism. Drummond, of Cork, writing in 1827, is quoted as recommending the cultivation of *C. cruenta* for the production of "fine double and single varieties of different colours." At this date, therefore, *C. cruenta* was apparently variable, and yielded forms worth cultivation without hybridisation.

An article by Mrs. Loudon, written in 1842, is next quoted as evidence that "in or about 1827" Drummond obtained "some handsome hybrids" between *C. cruenta* and *C. lanata*. In this article a list of other hybrids, said to have been produced by unnamed persons between 1827 and 1842, is also given. It is not stated that these hybrids were grown by florists for exhibition, or that they had received definite names. The list is followed by a paragraph, omitted by Mr. Bateson, which is so important that I copy it at length:

"Some of the most beautiful Cinerarias now in our greenhouses have been raised by Messrs. Henderson, Pine-Apple Place; particularly *C. Hendersonii* and the King, both raised from seeds of *C. cruenta*. *C. waterhousiana* was raised by Mr. Tate, gardener to John Waterhouse, Esq., of Well Head, near Halifax, from seed of *C. Tussilaginis*, fertilised by the pollen of *C. cruenta*. Two new ones have lately been raised, of remarkably clear and brilliant colours, apparently from *C. cruenta*, named Queen Victoria and Prince Albert, by Mr. Pierce, nurseryman, of Yeovil, Somersetshire." (*Ladies' Magazine of Gardening*, 1842, p. 112.)

This passage clearly shows that in the writer's belief the hybrids produced by Drummond and others had not given rise to two, at least, of the named varieties of her time: certainly two, and probably two more, were descended from *C. cruenta* alone.

Mr. Bateson refers to this account of *C. waterhousiana*, and also to an earlier one, said to be communicated by Tate himself, the originator of the plant, to a writer in *Paxton's Magazine of Botany*, for 1838. In this account the parents are called *C. cruenta* and *C. tussilagofolia*; and in this, the earliest account, there is no statement as to which species furnished seed and which pollen. I do not know whether *Tussilagofolia* was ever recognised as a synonym of *C. Tussilaginis* or not; since the name does not occur in the *Index Kewensis*, where I find, as the only entry bearing on the subject, "*Waterhousiana = Senecio tussilaginis?*" Mr. Bateson has assumed that *Tussilagofolia* is identical with *Tussilaginis*: for while repeating only the statement given by Mrs. Loudon, he cites both her article and that in *Paxton's Magazine* as authorities. Is he sure that there did not exist in 1838 a florist's variety named *Tussilagofolia?*

Again, the writer in *Paxton's Magazine* goes on to express an opinion, not referred to by Mr. Bateson, that several of the florist's varieties known to him are descended from *C. cruenta* alone. He recommends the cultivation of various "species and varieties" (*not* hybrids) of Cineraria, and says "one species especially merits cultivation, namely *C. cruenta*. This may be regarded as the parent of many of those beautiful varieties which are so successfully cultivated by Messrs. Henderson." (*Paxton's Mag. Bot.* iv. p. 220, *not* p. 43.)

Against these specific statements, the only contemporary assertion that all named varieties are hydrids, which is quoted by Mr. Bateson, occurs in the *Journal d'Horticulture*, &c. (Ghent, 1846). This journal contains a general statement that florists' Cinerarias have been produced by crossing and recrossing several species, which are named; but although a list of florists' varieties is given, the exact history and parentage of each variety is not attempted.

Finally Burbidge, who wrote in 1877, is quoted as believing that existing varieties are due to hybridism between three species. It is not mentioned that Burbidge, before giving the systematic list of hybrid plants, in which the passage relied upon occurs, is careful to point out the uncertain nature of much of his evidence, and even writes, by way of caution to his readers, that "the parentage of many of the hybrids enumerated in this book is open to question" (p. 118).

I have only examined one of Mr. Bateson's cases of alleged "sports," namely *C. webberiana*. This plant, as Mr. Bateson says, is described and figured as having flowers of a deep blue, the rays being short and wide as compared with *C. waterhousiana*, for example. I fail to see why Mr. Bateson calls this a "sport." There is no evidence cited by him to show that it is descended from *C. waterhousiana*: and if it is not, then there is nothing remarkable in the shortness of its rays. The colour gives no evidence, without detailed knowledge of its descent; for I find in *Paxton's Magazine*, between 1838 and 1841, varieties recorded which are "lilac tipped with purple," "approaching to a blue," "bright blue," "blue or bluish," and in 1842 comes this "deep blue" variety *webberiana* to complete the gradual series.

Judging only from the documents referred to, it seems clear (1) that *C. cruenta* was cultivated, in what was believed to be a pure state, in 1827, and that it yielded valuable varieties, single and double, at that date; (2) that according to contemporary opinion, many of the varieties cultivated between 1838 and 1842 were directly descended from *C. cruenta*, and were not hybrids; and (3) that in 1842 some florists, at least, were believed to produce new varieties by the continued cultivation of *C. cruenta* alone.

So far as Mr. Bateson's history goes, therefore, it establishes the existence in 1842 of sufficient named varieties, believed to be pure-bred *C. cruenta*, to serve as parents for the flowers of to-day.

As to the actual pedigree of the modern varieties, I am not qualified to express an opinion. All I wish to show is that the documents relied upon by Mr. Bateson do not demonstrate the correctness of his views; and that his emphatic statements are simply evidence of want of care in consulting and quoting the authorities referred to. W. F. R. WELDON.

University College, London, May 13.

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I HAVE read with some interest the communications on this subject which have appeared in NATURE, and I may add that I have examined living plants of the species in question with Mr. Thiselton-Dyer. My memory also serves me sufficiently far back to remember a great variety of different "strains" of *Cineraria*, in which they had not got so far away from the parent *C. cruenta* as they now are. I say the parent *C. cruenta*, because I believe that we have to deal with races or strains, obtained by selection according to the taste of the several selectors, and not with the descendants of hybrids between different species. I think Mr. Bateson has relied too implicity on the literature of the subject. Many of the records of hybrid productions in the vegetable kingdom are based upon groundless assumptions; mere seminal variations having been mistaken for crosses. It requires some skill and care to raise hybrids in the Compositæ; and when you have raised your hybrid, even assuming a fertile one, you can only propagate it vegetatively. All stability is gone. But it is not so with selected seminal variations of a given species. They will intercross most freely, and give birth to new varieties without end; yet each one of those varieties may be reproduced from seed, by careful isolation, without a single "bastard" appearing. There are several instances among our cultivated plants of this great plasticity combined with stability, but I will give only one—the China Aster. I select this because there can be no question of hybridity; and there is as great, or even a greater, variety than in the herbaceous Cinerarias. But with regard to the latter, I think our experience and the trustworthy literature go to prove that it is an analogous case. Careful selection, year after year, has resulted in the various fixed races or strains offered by florists. I am aware that the letters on this subject by no means exhaust it; but I think it may be safely asserted that selection has yielded much more than sports.

W. BOTTING HEMSLEY.

### Prof. Milne's Observation of the Argentine Earthquake, October 27, 1894.

A FEW days ago I received from Prof. Milne a letter, dated March 15, 1895, in which he sends me a list of earthquake disturbances, compiled from the records he was fortunate enough to rescue from the fire which destroyed his house on February 17. In this list I find no less than three observations of the great Argentine earthquake of October 27, 1894, which was recorded by three different horizontal pendulums. The times given for the beginning of the earthquake—viz. 18h. 10m., 18h. 5m., 17h. 41m.[1]—are not very trustworthy, because they were determined by measuring the linear distance from a break in the curve which was caused regularly every day about noon by taking away the lamp. The exact times of these breaks were noted in a book, which, unfortunately, was destroyed by the fire. Prof. Milne, however, tells me that in the instrument, to which corresponds the first of the above-mentioned times, the lamp was always removed within half a minute or one minute from noon (Japan time). Consequently, the error cannot exceed a few minutes. The duration of the disturbance was between two and three hours in all the three instruments.

If we consider that the error of the first observation is not likely to exceed ten minutes, then we find, by comparing Prof. Milne's observations with those made in Europe, that although the spherical distance between the epicentre of the earthquake and Tokio is *no less than* 17,400 *kilometres*, the earth-motion reached Japan at about the same time, or perhaps even a little earlier, than it arrived in Europe. It is unnecessary to point out the interest which is attached to systematic observations of this kind. Prof. Milne's observation is probably the first in which an earthquake was noticed by seismic instruments at a place so near the antipodes of the earthquake centre. A straight line between the two points is only very little shorter than the earth's diameter; the time required for the motion to pass through the globe was probably less than twenty minutes.

Merseburg, May 1. E. VON REBEUR-PASCHWITZ.

### Guanine in Fishes' Skins.

IN a joint paper by Mr. J. T. Cunningham and myself (*Phil. Trans.* vol. clxxxiv., 1893, B, pp. 765–812), we have ventured to question the accuracy of the statement made in many text-books of physiological chemistry, that guanine occurs in combination with calcium in the skin of fishes. We found that the guanine occurs in the free state. In the last number of Hoppe-Seyler's *Zeitschrift für Physiologische Chemie* there is a paper by Herr Albrecht Berthe, dealing with this subject, in which he shows that the calcium so frequently found with the guanine is due to the presence of impurities derived from the tissues and the scales. Its amount depends upon that of the impurities present, and is very variable. Instead of finding 11·76 per cent. required by the formula of "*Guaninkalk*," Berthe finds less than one-third of that percentage present, and even this also varies within wide limits. In the paper referred to above, we found one source of the calcium was due to the presence of comparatively large crystals of calcium phosphate, which are figured on p. 788; but there is no doubt that the bulk of it is derived from the scales.

CHAS. A. MACMUNN.

Oakleigh, Wolverhampton, May 4.

### The Oldest Vertebrate Fossil.

NOTICING in your issue of April 11 a reference to the discovery of specimens of *Cyathaspis* in the Silurian of Gotland in strata equivalent to the English Wenlock, and with it the statement that these fossils are "for the present the oldest known vertebrates," I am led to call your attention to the species described by myself from Silurian strata in Pennsylvania in 1885 (p. 48), and again in 1892 (p. 542), in the *Quarterly Journal* of the Geological Society. I forward with this a copy of the paper, from which it will be seen that the Salina (Ononduga) beds that yielded *Palæaspis* are older than the Ludlow (or Lower Helderberg), and that the Clinton are older than the Wenlock (or *Niagara*). Consequently *Onchus Clintoni* of the latter group is thus far the oldest vertebrate. E. W. CLAYPOLE.

Akron, Ohio.

[1] These hours are Japan time, *i.e.* 9h. east of Greenwich, and are reckoned from noon.

## TERRESTRIAL HELIUM.

SINCE our last reference to this subject three communications have been laid before the Royal Society. They are as follows:—

### HELIUM, A GASEOUS CONSTITUENT OF CERTAIN MINERALS.[1]

An account is given of the extraction of a mixture of hydrogen and helium from a felspathic rock containing the mineral clèveite. It is shown that in all probability the gas described in the preliminary note of March 26 was contaminated with atmospheric argon. The gas now obtained consists of hydrogen, probably derived from some free metal in the felspar, some nitrogen and helium. The density of helium, nearly free from nitrogen, was found to be 3·89. From the wave-length of sound in the gas, from which the theoretical ratio of specific heats 1·66 is approximately obtained, the conclusion may be drawn that helium, like argon, is monatomic. Evidence is produced that the gas evolved from clèveite is not a hydride, and a comparison is made of the spectra of argon and helium. There are four specially characteristic lines in the helium spectrum which are absent from that of argon: they are a brilliant red, the $D_3$ line of a very brilliant yellow, a peacock-green line, and a brilliant violet line. One curious fact is that the gas from clèveite, freed from all impurities removable by sparking with oxygen in presence of caustic potash, besides other fainter lines, exhibits one, and only one, of the characteristic bright red pair of argon lines. This, and other evidence of the same kind, appears to suggest that atmospheric argon and helium have some common constituent.

Attention is drawn to the fact that on subtracting 16 (the common difference between the atomic weights of elements of the first and second series) from 20, the approximate density of argon, the remainder is 4, a number closely approximating to the density of helium; or, if 32 be subtracted from 40, the atomic weight of argon if it be a monatomic gas, the remainder is 8, or twice the density of helium, and its atomic weight if it too is a monatomic gas.

### ON THE NEW GAS OBTAINED FROM URANINITE.[2]

Since my communication on the gas obtained from Uraninite (Bröggerite) was sent in to the Society on the 25th ult., I have been employing the method I there referred to in several directions, among them to determine whether the spectrum of the gas indicates a simple or a complex origin.

I was led to make this special inquiry on account of the difference in the frequency of the appearance of $D_3$ and the other lines to which I referred in the solar chromosphere. For instance, if we take the lines $D_3$, 4471, and 4302, the frequencies are as follows, according to Young[3]:—

| | | |
|---|---|---|
| $D_3$ ... ... ... ... ... | 100 | (maximum) |
| 4471 ... ... ... ... ... | 100 | ,, |
| 4302 ... ... ... ... ... | 3 | |

Hence, we might be justified in supposing that $D_3$ and 4471 are produced by the same gas, and that 4302 owes its origin to a different one.

But further experiment has given me one case in which $D_3$ shows bright, while 4471 is entirely absent. I may now add that an equally important line to 4471, one at 4026·5, appears, with the dispersion employed, in the spectrum of Bröggerite, and both these lines are wide and fluffy, like the lines of hydrogen, and are apparently reversed.

The line 4026·5 has not been recorded by Young, though, as I have stated, the frequency of appearances of 4471 represents the maximum; still, while this is so, the intensity of both these lines in the spectra of the hottest stars is not surpassed, even by those of hydrogen. Hence, opinion as to their representing the same gas must be suspended. Further, I have photographed a line at 4388 apparently coincident with another important line in the same stars. Whether, coming from one source or two, in these three lines seen along with $D_3$ in the gas obtained by me from Bröggerite, we have, it would seem, run home the most important lines in the spectra of stars of Group III., in which stars alone we find $D_3$ reversed. Should these results be confirmed, the importance of the gas or gases they represent at a

[1] By Prof. W. Ramsay, F.R.S. (abstract).
[2] Second note. By J. Norman Lockyer, C.B., F.R.S.
[3] See "Solar Physics," Lockyer, p. 612.

certain stage of the evolution of suns and planets can be gathered from an examination of a photograph of the spectrum of Bellatrix.

Another case is afforded by a line at λ 667. This is associated with $D_3$ in Bröggerite and Cleveite, but the yellow line has been seen in Monazite *without* λ 667. It is almost certain, then, that these two lines represent two gases. Certainty cannot be arrived at till a larger quantity of gas has been obtained.

Again, the red line at λ 6575, close to C, referred to in my previous communication, is seen both in Gummite and Bröggerite; but in one case (Gummite) it is seen without $D_3$, and in the other with it, in one case (Bröggerite) without λ 614, and in the other with it. The above conclusions hold here also.

This line λ 614, possibly coincident with a chromospheric line, has been recorded in Gummite and Bröggerite. It has been seen *with* $D_3$ (in Bröggerite) and *without* it (in Gummite).

I have said enough to indicate that the preliminary reconnaissance suggests that the gas obtained from Bröggerite by my method is one of complex origin.

I now proceed to show that the same conclusion holds good for the gases obtained by Profs. Ramsay and Cleve from Cleveite.

For this purpose, as the final measures of the lines of the gas as obtained from Cleveite by Profs. Ramsay and Cleve have not yet been published, I take those given by Crookes,[1] and Cleve,[2] as observed by Thalén.

These are as follows, omitting the yellow line:—

| Crookes. | Thalén. |
|---|---|
| | 6677 |
| 568.05 | |
| 566·41 | |
| 516·12 | |
| | 5048 |
| | 5016 |
| 500·81 | |
| | 4922 |
| 480·63 | |
| | 4713·5 |

The most definite and striking result so far obtained is that, in the spectra of the minerals giving the yellow line, I have so far examined, I have never once seen the lines recorded by Crookes and Thalén in the blue. This demonstrates that the gas obtained from certain specimens of Cleveite by chemical methods is vastly different from that obtained by my method from certain specimens of Bröggerite; and since, from the point of view of the blue lines, the spectrum of the gas obtained from Cleveite is more complex than that of Bröggerite, the gas itself cannot be more simple.

Even the blue lines themselves, instead of appearing *en bloc*, vary enormously in the sun, the appearances being—

4922 (4921·3) = 30 times
4713 (4712·5) = twice.

These are not the only facts which can be adduced to suggest that the gas from Cleveite is as complex as that from Bröggerite. But while, on the one hand, the simple nature of the gases obtained by Profs. Ramsay and Cleve and by myself must be given up, reasoning on spectroscopic lines; the observations I have already made on several minerals indicate that the gases composing the mixtures are by no means the only ones we may hope to obtain.

This part of the inquiry will be more specially considered in a subsequent communication.

I may remark in conclusion that in this preliminary inquiry no attempt has been made to separate the possibly new gases from the known ones which come over with them; hence, the lines are in some cases very dim, and the application of high dispersion is impossible. The wave-lengths, therefore, especially in the visible spectrum, are approximations only; but the view that we are really dealing with gases operative in the solar atmosphere, like the helium which produces $D_3$, is strengthened by the fact that of the 60 lines so far recorded as new in the various minerals examined, about half occur near the wave-lengths assigned to chromospheric lines in Young's table. I am aware that most of the chromospheric lines have been recently referred to as due to iron, but I believe this result does not depend upon direct comparisons, and it is entirely opposed to the conclusions to be drawn from the work of the Italian observers, as well as from my own.

[1] NATURE, vol. li. p. 544.
[2] *Comptes rendus*, April 16, p. 835.

## ON THE NEW GAS OBTAINED FROM URANINITE.[1]

In my preliminary note communicated to the Royal Society on the 25th ult. I gave the wave-lengths of the lines which had been observed both at reduced and at atmospheric pressure in the gas (or gases) produced by the method to which I then referred of heating the mineral Uraninite (Bröggerite) in vacuo.

As a short title, in future I shall term this the distillation method.

Since then the various photographs obtained have been reduced and the wave-lengths of the lines in the structure spectra of hydrogen observed beyond the region mapped by Hasselberg.

I have further observed the spectra of other minerals besides Uraninite for the purpose of determining whether any of them gave lines indicating the presence of the gas in Uraninite or of other gases.

I now give a table of the lines so far measured in the spectra of 18 minerals between λλ 3889 and 4580 R, the region in which, with the plates employed, the photographic action is most intense.

*Lines Photographed in the Spectra of Gases obtained from various Minerals experimented upon up to May 6.*

| Wave-length. | | Chromo-spheric lines (Ångström's scale.) | Eclipse lines (1893), Rowland's scale (1893). | Orion star lines (Rowland's scale). | Remarks. |
|---|---|---|---|---|---|
| Rowland. | Ångström. | | | | |
| 3889 | 3888·5 | 3888·73 H. | 3889·1 | * | U |
| 3947 | 3946·5 | 3945·2 H. | 3946·0 | | U |
| 3982 | 3981·5 | | 3982·0 | | |
| 4026·5 | 4025·9 | | 4026·5 | 4026·5 | U |
| 4142 | 4141·3 | | | | |
| 4145 | 4144·3 | | 4144·0 | 4144·0 | |
| 4177 | 4176·3 | 4178·8 | 4177·8 | 4178·0 | |
| 4182 | 4181·3 | | | | |
| 4338 | 4337·3 | 4338 | * | 4338·0 | |
| 4347 | 4346·3 | | | 4346·0 | |
| 4390 | 4389·3 | 4388·5 | 4390 | 4389·0 | |
| 4398 | 4397·3 | 4398·5 | 4398·7 | | |
| 4453 | 4452·3 | | 4454 | | |
| 4471 | 4470·3 | 4471·2 | 4471·8 | 4471·8 | U |
| 4515 | 4514·3 | 4514·0 | 4514·5 | | |
| 4522 | 4521·3 | 4522·0 | 4522·9 | | |
| 4580 | 4579·3 | | | | |

* Broad hydrogen lines extend over these positions.
U = lines noted frequently in the spectra of Bröggerite.
H = photographed by Hale.

On this table I may remark that, of the lines given in my paper of April 25, the final discussion has shown that the following lines are hydrogen structure lines in the region beyond that mapped by Hasselberg:—

λλ 4479, 4196, 4156, and 4152·5.

The line 4368 is also omitted from this list, as it has not been finally determined whether it coincides with a line of O.

In the table, besides the λλ on Ångström's and Rowland's scale, I give lines which have been observed in the sun's chromosphere and chronicled by Young; those photographed during the eclipse of 1893 with a 6-inch prismatic camera, by Mr. Fowler, and those photographed with the same instrument at Kensington in some stars of Group III. of my classification in the constellation of Orion.

This table carries the matter of the relation of the new gases to star and stellar phenomena much further than I ventured to suggest in my second note.

We appear to be in presence of the *vera causa*, not of two or three, but of many of the lines which, so far, have been classed as "unknown" by students both of solar and stellar chemistry; and if this be confirmed, we are evidently in the presence of a new order of gases of the highest importance to celestial chemistry, though perhaps they may be of small practical value to chemists, because their compounds and associated elements are, for the most part, hidden deep in the earth's interior.

The facts that all the old terrestrial gases, with the exception

[1] Third Note. By J. Norman Lockyer, C.B., F.R.S.

of hydrogen, are spectroscopically invisible in the sun and stars—though they doubtless exist there—and that these new gases scarcely yet glimpsed, have already, in all probability, supplied us with many points of contact between our own planet and the hottest part of our central luminary that we can get at, and stars like Bellatrix, are full of hope for the future, not only in relation to the possibility of more closely correlating celestial and terrestrial phenomena, but in indicating that a terrestrial chemistry founded on low density surface products in which non-solar gases largely enter, is capable of almost infinite expansion when the actions and reactions of the new order of gases, almost, it may be said, of paramount importance in certain stages of stellar evolution, shall have been completely studied.

With regard to the differences indicated between the results of the chromospheric and eclipse observations in the above table, it may be useful to remark that Prof. Young's "frequencies," invaluable though they are, must necessarily be of less importance, from the present point of view, than the eclipse observations obtained, it may almost be said, at the same instant of time. There may be, and doubtless are, two perfectly distinct causes for the appearance of the so-called chromospheric lines. First, the tranquil condition of the lower strata of the sun's atmosphere which gives us the pure spectrum produced at a constant—and the highest that we know of in the sun—temperature. Secondly, the disturbed condition which fills the spectrum with lines of a so-called prominence. Formerly it was universally imagined that the prominences were shot up from below; and in that case the lines added would indicate a temperature *higher* than the normal. But I have sent many papers in to the Society indicating the many arguments against this view,[1] and to me, at the present time, this view is almost unthinkable. If these disturbance-lines are produced from above, they may represent the effects of many stages of *lower* temperature. Hence a list of chromospheric lines loses most of its value unless the conditions of each observation are stated, and the phenomena appearing at the same place at the same instant of time are recorded.

Now, this same place and same time condition is perfectly met by eclipse photographs, and hence I attac ι a great value to them. But the comparison between such eclipse observations and the spectra of certain stars indicates that the latter in all probability afford the best criteria of all.

[1] They are set out at length in the "Chemistry of the Sun," which I published in 1887.

## THE MARQUIS OF SAPORTA.

IN the study of palæobotany we may concern ourselves with the various problems of distribution, the geologic sequence of plant types, the value of fossil plants in comparative stratigraphy, and as tests of climatic conditions; or our attention may be concentrated on the important facts revealed by a microscopic study of petrified plant tissues. The latter field of research, in which Prof. Williamson has laboured with remarkable success during the last twenty-five years, is gradually being recognised by botanists as a branch of their science which they cannot afford to neglect in dealing with the wider problems of plant life. Fascinated by the almost incredible perfection in which Palæozoic, and more rarely Mesozoic, species have been preserved, the student of vegetable morphology is apt to take too little heed of the wealth of material which can only be studied in the form of structureless casts or impressions. In the majority of fossil floras the geologist or botanist must perforce confine himself to an examination of the few isolated and imperfect fragments that have escaped destruction in the process of denudation and rock-building, and have been preserved by fossilisation as meagre representatives of a past vegetation. As a specialist in this latter branch of palæobotany, there has been no more ardent worker since the days of Adolphe Brongniart, whom we may regard as the founder of palæobotanical science, than the Marquis of Saporta. Saporta's recent death, at his home in Aix-en-Provence, at the age of seventy-two, has deprived botanical and geological science of anunusually able and vigorous worker.

A perusal of Saporta's numerous contributions to scientific literature affords abundant evidence of critical and detailed investigation during a long period of years; nearly the whole of his published work has been in the domain of fossil botany. The Tertiary vegetation of France forms the subject of several of his contributions to science. From an early stage of his career the Cainozoic plant-bearing strata of Provence have occupied a prominent position in his palæobotanical studies; the Eocene flora of Aix, a valuable monograph on the remnants of an Eocene flora preserved in the tuffs of Sézanne, and various other writings on Tertiary plants, bear eloquent testimony not only to a remarkable power of detailed systematic work, but to a striking aptitude for a broad and philosophic manner of treatment. Students of Mesozoic botany soon learn to appreciate Saporta's memoirs on Cretaceous and Jurassic plants, and especially the splendid series of monographs on the Jurassic flora of France, published as separate volumes of the "Paléontologie Française" from 1873–91; in this profusely illustrated work, dealing primarily with French vegetation, we have to a large extent a general handbook of Oolitic botany. One feature which sets a high value on Saporta's palæobotanical work, is his wide and thorough acquaintance with the facts of distribution and taxonomy of living plants. Palæontological records are often in themselves of no special interest to zoologists and botanists, but if interpreted as indices of plant distribution in past ages, and applied to the wider problems of the evolution and dissemination of plant types, they assume considerable importance. Saporta's knowledge of recent floras, and his keen enthusiasm as an evolutionist, led him to regard fossil plants not simply as convenient aids to the stratigraphical geologist, but as affording indispensable data to the student of plant phylogeny. In "Le Monde des plantes avant l'apparition de l'homme" (Paris, 1879), we have a series of articles originally published in the *Revue des Deux Mondes* and *La Nature*, in which Saporta's encyclopædic information and finished literary style combine to render attractive to the layman and the specialist a retrospect of plant life during the geologic ages. Unfortunately the elaborate frontispiece to this volume, described as the "oldest known land plant," and named *Eopteris Morierei*, is merely a representation of an iron pyrites infiltration on the surface of a Silurian slate, and cannot be retained as a plant impression. In a more recent and smaller volume, "Origine paléontologique des arbres cultivés ou utilisés par l'homme" (Paris, 1888), we have an interesting sketch of the geological history of existing forest trees; and in another and more ambitious work,[1] in collaboration with Prof. Marion, an attempt is made to follow the lines of descent of the several subdivisions of the vegetable kingdom. The palæobotanist who is bold enough to venture on the task of tracing out the ancestry of plant forms, and of attacking the problems of development, is exposed to the very serious danger of allowing unsound links to form part of his chains of life. Saporta's constant desire to treat fossil plants from the point of view of a sanguine evolutionist, who wishes to press into his service all possible pieces of evidence towards the better understanding of the process of plant evolution, has in certain instances been led beyond the limits of accurate scientific reasoning. The majority of the so-called fossil algæ, to which he has devoted considerable attention, have been put out of court by Nathorst and others, as having no claim to consideration as records of thallophytic life; and it is generally agreed that the value of his work in this direction is seriously discounted, by the more than doubtful specimens which are described as vestiges of the lower and more primitive forms of plants. A few months before his death, Saporta completed an exhaustive monograph on

[1] Saporta and Marion: "L'évolution du règne végétal." 3 vols. 1881-1885.

the Mesozoic flora of Portugal;[1] this work marks an important advance in our knowledge of Lower Cretaceous and Upper Jurassic vegetation; and of special interest are the various forms of "archetypal angiosperms" closely resembling similar fossils from the Potomac beds of North America. This last monograph, full of elaborate botanical and stratigraphical work, affords a striking proof of the energy and youthful enthusiasm of the veteran student. Saporta's name will ever be held in respect by succeeding generations as that of a pioneer of palæobotanical science; and by those who were privileged to know him personally, or as a correspondent ever ready to render assistance to younger workers, the death of the Marquis of Saporta must be felt not merely as the termination of the labours of one of the foremost palæobotanists, but as the removal of a generous friend and colleague, whose wide knowledge and untiring devotion to science will stimulate younger investigators to more vigorous efforts in the rich field of palæobotanical study. A. C. SEWARD.

## SIR GEORGE BUCHANAN.

THE death of Sir George Buchanan removes from our midst a leader in that branch of medical science which concerns itself with the prevention of disease. His death came very unexpectedly, for the circumstances of his ill-health were known only to a circle of intimate friends; and his great desire to go on working as long as work was practicable, made him sufficiently cheerful to disguise the suffering which he at times experienced. It is some three years since he resigned the post of medical officer to the Local Government Board, this step having been taken by him on account of failing health. But he still found plenty of pleasurable occupation in connection with the various learned and scientific bodies with which he was associated, and he also served on the Royal Commission on Tuberculosis, of which he became chairman on Lord Basing's death. He was a pupil of University College, of which body he became a Fellow; he graduated B.A. and M.D. at the University of London, and at his second M.B. he distinguished himself by carrying off several gold medals and scholarships. Later on he became medical officer of health to the district of St. Giles, where he laboured hard for years to improve the conditions of public health and to amend the then terribly faulty circumstances under which the people lived. It was here that he attracted the attention of Sir John Simon, then medical officer of the Privy Council, and under him he served both as a temporary and, later on, as a permanent medical inspector. During this period, and subsequently when he himself directed the public health department of the State, the investigations which he carried out, and the reports which he presented to Parliament, embodied the results of work of which England may feel proud. As a type of the class of work we refer to, we may instance his prolonged investigations into the influence on health of large public works, of water-supply and sewerage, and his discovery of the lessening of mortality from pulmonary consumption wherever the construction of sewers had led to a lowering of the sub-soil water. Some of his papers on the subject of vaccination in relation to small-pox are also of the greatest value; they were the result of most careful labour, as well as of an earnest desire to eliminate all possible sources of error, and to arrive at the truth alone; and the more he studied the subject, the more convinced he became of the value of vaccination as a measure of public health. He sought to secure for all the work he did or supervised a truly scientific basis; and he always attached the greatest importance to the auxiliary scientific work for which a special, but only a small, grant is annually made to the medical department of the Local Government Board. He had a marked literary talent, and a conspicuous power of setting out the salient points of the work done by his inspectorial staff; with the result that his annual reports have gradually come into great demand by sanitarians and public health authorities in almost every part of the world. The result of all his labours is by no means accomplished, in some places work on the lines he has indicated has hardly commenced, and it must almost necessarily be that much that he has taught, will, in the lapse of time, fail to be associated with his name. But those who know the nature of his work, and who appreciate the thoroughness which always characterised it, will readily understand how far-reaching and beneficial the results must in the end be. In 1882 he was elected to the Senate of the University of London, and in the same year he was made a Fellow of the Royal Society; but otherwise distinctions came to him mainly at the close of his official career. This was doubtless largely due to all absence of self-seeking in his character. As head of a department he was always trying to promote the welfare of those under him, and it was only when he retired on a comparatively small pension that he asked for some consideration in view of the long services he had rendered to the State before he gave his whole time to his official duties. But the Treasury gave their usual answer, and he said no more. At this date he was made a Knight Bachelor, and in 1893 he received the honorary degree of LL.D. of the University of Edinburgh. He was a past President of the Epidemiological Society, a Censor of the Royal College of Physicians of London, and he acted as adviser in scientific and other matters to several other bodies. If such a characteristic can be deemed a fault, Sir George Buchanan's most prominent failing was an inability to conceal his sense of those who, as he thought, sacrificed principles and, at times, the truth itself in matters relating to the advancement of public health, for purposes of notoriety or of policy. But, on the other hand, no chief of a public department ever won the affection as well as the esteem of his staff better than Sir George Buchanan did; and he made it no secret that in regard to this he was always desirous to recall the example of his own former chief, who, happily, still lives, and to whom he was devotedly attached.

## NOTES.

OUR readers will be glad to know that Prof. Huxley continues to improve in health. A telegram received from Eastbourne as we go to press states that he is progressing favourably, and is able to get up daily, but is hardly strong enough yet to leave his room.

THE Bill, which was introduced into the House of Lords on Thursday last by Lord Playfair, on behalf of the Government, may be fairly said to bring the reconstruction of the University of London on the lines of the Gresham Commissioners' Report within the sphere of practical politics. The exact terms of the Bill have not yet transpired, but it is understood that the four Commissioners appointed to administer the Act are, in the first place, empowered to make modifications in the scheme if deemed expedient after consultation with the Senate and Convocation of the University of London, and other bodies affected; and in the second, enjoined to adequately safeguard the interests of the external or non-collegiate students. The Government having at last taken action on this question, it is the more satisfactory to note that the attempt made in Convocation on Tuesday last to rescind the resolutions passed at the January meeting (vol. li. p. 298), has completely failed, a resolution to the effect that "if a local Teaching University for London be desirable, it ought to be constituted apart from the existing University of London," being rejected by 238 against 117, or by a majority of 121 votes.

[1] "Flore fossile du Portugal (Direction des travaux géologiques du Portugal)." Lisbon, 1894.

THE unveiling of a memorial tablet to the late Prof. J. C. Adams at Westminster Abbey, on Thursday last, was an event in which all men of science are interested. It might have been made a great occasion, for Adams' name is esteemed throughout the scientific world, instead of which the meeting seems chiefly to have represented the University of Cambridge. The tablet has been placed in the north aisle, close to the graves of Newton, Herschel, and Darwin. It is the work of Mr. Bruce Joy, and bears the following inscription:—"Johannes Couch Adams, Planetam Neptunum Calculo Monstravit. MDCCCXLV."

A BILL incorporating the New York Zoological Society, and providing for the establishment of a zoological garden in New York, has just been approved by Governor Morton. The Act provides that the corporation shall have power to establish and maintain in New York City a zoological garden for the purpose of encouraging and advancing the study of zoology, original researches in the same, and kindred subjects, and of furnishing instruction and recreation to the people.

ON April 26, the Linnean Society of Bordeaux held a meeting devoted to the question of bibliographical reform. The prospectus of the new Bibliographical Bureau for Zoology was approved by all the members present, and the wish was expressed that a similar organisation be at once attempted for the other branches of natural science. In accordance with this wish, it was decided to elaborate a project for the establishment of a Central Bureau for Botany. This project will be presented to the Association Française at its next meeting, by the President of the Botanical Section. M. Mourlan, the Director of the Académie des Sciences of Belgium, proposes similar action for geology. It is hoped that, by the establishment of several federated bureaus, the plan of the Royal Society may be fully realised and without great difficulty. Meantime, the organisation of the Zoological Bureau has made considerable progress, the circular of the French Commission has already appeared, and has been widely distributed by the French Zoological Society; the American Commission has completed its preliminary study, and will soon send its circular to press. In other countries, notably in Russia, similar progress is reported.

THE programme of arrangements for the Ipswich meeting of the British Association has just been issued. The first general meeting will be held on Wednesday, September 11, when the Marquis of Salisbury will resign the chair, and Sir Douglas Galton, President elect, will assume the presidency, and deliver an address; on Thursday evening, September 12, a soirée will be held; on the following evening a discourse will be delivered by Prof. Silvanus P. Thompson on magnetism in rotation; on Monday evening, September 16, there will be a discourse by Prof. Percy F. Frankland on the work of Pasteur and its various developments; a second soirée will take place on Tuesday evening, September 17, and the concluding general meeting will be held on Wednesday, September 18. The Sections and their Presidents are as follows:—(*a*) Mathematical and Physical Science—President, Prof. W. M. Hicks, F.R.S. (*b*) Chemistry—President, Prof. R. Meldola, F.R.S. (*c*) Geology—President, W. Whitaker, F.R.S. (*d*) Zoology (including Animal Physiology)—President, Prof. W. A. Herdman, F.R.S. (*e*) Geography—President, H. J. Mackinder. (*f*) Economic Science and Statistics—President, L. L. Price. (*g*) Mechanical Science—President, Prof. L. F. Vernon Harcourt. (*h*) Anthropology—President, Prof. W. M. Flinders Petrie. (*k*) Botany—President, W. T. Thiselton-Dyer, C.M.G., F.R.S. Section I (Physiology) will not meet at Ipswich, but papers on animal physiology will be read in Section D. The delegates of corresponding Societies will meet on Thursday, September 12, and Tuesday, September 17, under the presidency of Mr. G. J. Symons, F.R.S. The acceptance of papers is, as far as possible, determined by organising committees for the several Sections, before the beginning of the meeting. It has, therefore, become necessary, in order to give an opportunity to the Committees of doing justice to the communications, that each author should forward his paper, together with an abstract, on or before August 12, to the General Secretaries of the Association.

SEVERAL summer schools for the practical study of botany will be held during the coming season in the United States—one in connection with Cornell University, and one in connection with the University of Wisconsin, both from July 8 to August 16; also one in connection with the Cambridge Botanical Supply Co., Cambridge, Mass., from July 5 for five weeks.

THE *Sitzungsberichte* of the Vienna Academy of Sciences (vol. civ.) contains a discussion of the observations of atmospherical electricity and St. Elmo's Fire on the Sonnblick by Messrs. J. Elster and H. Geitel, being a continuation of the observations to the time of the change of the former observer. The results confirm those previously obtained, and show that the yearly variation of the electrical energy at the summit is small, compared to that at the base, and that the summit of the mountain projects above those strata of the atmosphere in which electrical processes mostly occur. During the fall of fine snow the St. Elmo's Fire is mostly negative, but positive when large flakes of snow and hail are falling.

FROM a paper on early agriculture in Palestine, by Dr. H. Vogelstein, we learn the interesting fact that in the first two centuries of the Christian era, rainfall was measured by means of a receptacle. The Jewish *Mishnah* refers to two seasons, one wet and the other dry. In normal years the early rain fell soon after the autumnal equinox, and its importance to agriculture is frequently referred to in that document. The amount which fell at this season was about 21 inches, which agrees fairly well with the present measurements at Jerusalem, but the total annual fall is not stated by Dr. Vogelstein, Further particulars of this interesting communication will be found in the *Meteorologische Zeitschrift* for April.

PROF. L. H. BAILEY, of Cornell University, Ithaca, N.Y., has recently read before the Biological Society of Washington a paper entitled the "Plant-individual in the Light of Evolution." In this paper, according to the *American Naturalist*, he suggests the idea that both Lamarckism and Darwinism are true, the former finding its expression best in animals, the latter in plants. The plant is, according to him, not a simple autonomy, in the sense in which the animal is, and the parts of the plant are independent in respect to propagation, struggle for existence, and transmission of characters. According to this view there can be no localisation or continuity of germ-plasm in plants, in the sense in which these conceptions are applied to animals.

THE *El Universal* reports that the cold spell in February extended right down the Gulf of Mexico to Vera Cruz. On the 15th and 16th it was freezing over a distance of 80 leagues from Monterey to Ciudad Victoria and Tula in Tamaulipas, and the mountains were covered with snow. In the district of Tancanhuitz, State of San Luis Potosi, the sugar-canes and coffee-trees were all killed, the value of the coffee crop destroyed being estimated at a million dollars. In the Huasteca, State of Vera Cruz, sugar-canes, coffee, and tobacco were similarly killed—a loss of several million dollars—while cattle were dying by hundreds on the frost-bitten pasture lands. Owing to the frost having followed a prolonged drought, prices had risen to famine rates, and there was much sickness, especially croup and small-pox. In the district round Altotonga a very hot south wind set in on February 13, which suddenly cooled, and grew in intensity and cold. On the 14th, snow began to fall and did not cease till the 17th. Ten parishes in the temperate zone were snow-covered for eighty-four hours, resulting in the destruction of all fruit, vegetables, coffee, and tobacco. The sugar-canes were so ruined as to be unfit even for forage. The twelve parishes of the district situated in the *terra fria* lost everything; the maize had not yet been planted, and would not be ripe till November or December. At Papantla, the vanilla centre, it was snowing on February 17, and the temperature had fallen from 30°C. to freezing point. At Misantla snow fell all night, and many fowls, animals, and cattle died from the cold.

UNDER the title, "Illustrations of Darwinism, and other Papers," Sir Walter L. Buller, F.R.S., has sent us a reprint of his presidential address to the Wellington Philosophical Society in 1894. Its main subject-matter is a discussion of the various ways in which the peculiarities of structure, colour, distribution and habits of New Zealand birds, serve to illustrate the theory of Natural Selection, and often to afford very strong arguments in its favour. The address is very clear and forcible, full of interesting facts and suggestive observations, and will be read with interest by all naturalists. One or two points only call for any critical observation. Sir W. Buller objects to the Apteryx being classed by Mr. Wallace as among "the lowest birds," because, he says, it is really "an extremely specialised form." But surely the Ratitæ are lower than the Carinatæ; and the Apteryx is specialised so as to be almost the least bird-like of the Ratitæ. If it is not to be classed among the lowest existing birds, where are these to be found? Again, the statement that the larger forms of animals have universally preceded the smaller in geological time (p. 101), is only a half-truth, if so much, since all these large forms have been developed from smaller ones, as shown in the case of the horse, as well as that of the early marsupials of the Meszoic period. Even more open to objection is the statement (p. 102), that the Siberian mammoth "would clearly have required a growth of tropical luxuriance to satisfy the wants of its capacious stomach"; and that its being found by thousands embedded in ice or frozen soil implies "a revolutionary change of climate." A sufficient answer to which theory is the fact that leaves and cones of firs have been found in the stomach, showing that it fed only a few degrees south of the places where it is now embedded.

A VALUABLE addition to the various suggestions for the measurement of geological time is made by Dr. G. K. Gilbert in the *Journal of Geology* (vol. iii. No. 2). He has been struck with the regular, rhythmical cycles of sedimentation displayed over and over again by the shaly beds of the Cretaceous of Colorado (Benton, Niobrara, and Pierre groups). Such regularity, he suggests, can only be due to causal variations of a periodic character, and only astronomical changes have the regularity required. There seem to be only three astronomical cycles that can be reasonably appealed to for an explanation of rhythm in sedimentation: the periods of the earth's revolution around the sun, of the precession of the equinoxes, and of the variation in eccentricity of the earth's orbit. Dismissing the first as too short, and the last as too irregular, Prof. Gilbert considers there are three ways in which the second cycle might influence local sedimentation: (1) By periodic changes in winds, and therefore in marine currents; (2) by alternate glaciation of the two hemispheres, resulting in periodic advance and recession of coast-lines, and hence of sedimentation-boundaries; (3) alternation in terrestrial climates of moist periods—when, through the abundance of vegetation, chemical denudation would be at a maximum, and mechanical at a minimum—and dry periods, when the reverse would be the case. Assuming the rhythm of sedimentation in the case considered to coincide with the rhythm of the equinoxes, Dr. Gilbert estimates the time represented by the Benton, Niobrara, and Pierre epochs as 20,000,000 years, or, allowing the number 2 as a factor of safety, between 10,000,000 and 40,000,000 years.

WE have received the Supplement to the Calendar of the Royal University of Ireland for 1895, containing examination papers set last year.

SO little attention is generally paid in public libraries to the wants of students of science, that we are glad to give a word of praise to a catalogue of books on mathematics, mathematical physics, engineering and architecture, contained in the two public libraries at Halifax. The list has been compiled by the librarian, Mr. J. Whiteley, and it should be found a useful guide to the scientific literature in the two libraries.

THE *Bulletin* of the American Museum of Natural History (vol. vi.) has been received. Among the articles in the volume, we notice one "On the Birds of the Island of Trinidad," by F. M. Chapman; "On the Seasonal Change of Colour in the Varying Hare (Lepus Americanus)" by J. A. Allen; "Fossil Mammals of the Lower Miocene White River Beds," by H. F. Osborn and J. L. Wortman. There are also papers on North American Orthoptera and Moths, by W. Beutenmüller; on some North American Mammals, by J. A. Allen, and by F. M. Chapman; and on new forms of marine algæ from the Trenton limestone; by R. P. Whitfield.

THE authorities of the Royal Gardens, Kew, publish a "Hand-list of Ferns and Fern-allies cultivated in the Gardens." This remarkably rich collection consists of 802 species and varieties of ferns, and 48 of fern-allies and natives of this country; besides no less than 586 varieties of British ferns. This latter collection is due to the bequest of Mr. W. C. Carbonell, who left it to the Gardens. It consists of 4261 specimens, found by him at Rhiew Castel, Usk, Monmouthshire. The rest of the collection owes its completeness largely to the zeal and assiduity of the late Mr. John Smith, curator of the Gardens from 1841 to 1863.

THE text of a series of six Lowell lectures, by Prof. Gantano Lanza, on "Engineering Practice and Education," which has been appearing in the *Journal* of the Franklin Institute since May 1894, is now concluded. Some interesting examples are given of the engineering works of the world, and the functions of the engineer are passed in review. Prof. Lanza holds sound ideas as to the education of an engineer. "There are two things," he says, "which are absolutely necessary to make a successful engineer: first, a knowledge of scientific principles and of the experience of the past; and second, his own experience. . . . The two fundamental sciences upon which the scientific principles of engineering are especially dependent are mathematics and physics, and no proper course in engineering can be arranged without insisting upon these as fundamentals." He shares the general opinion that the education of the engineer should include some knowledge of the differential and integral calculus, if not of higher mathematics.

WE have often found occasion to express satisfaction at the work carried on by many local scientific societies. Labourers in the field of science are not wanting, but their work frequently needs direction. Wisely organised, the multitude of willing amateur observers can greatly assist the growth of natural knowledge. A programme just received from the Yorkshire Naturalists' Union, showing the excursions, meetings, and committees of research for 1895, is a sufficient proof that the operations of the Union are conducted with definite objects in view. There is a boulder committee, appointed to collect information as to the distribution of erratic blocks in the county of York; a committee to observe the present changes and past condition of the sea-coast, in order to determine the rate of erosion; a fossil flora committee, which aims particularly at determining the vertical range of the genera and species of the various formations; a geological photographs committee; a committee to promote the investigation of the marine zoology of the Yorkshire Coast; a micro-zoology and micro-botany committee; a committee to consider proposals for the legislative protection of wild birds' eggs; and a committee having for its object the investigation of the mycological flora of Yorkshire. Upon each of the committees we notice the names of numerous well-known scientific workers; and, as the committees co-operate, when possible, with British Association committees, the Union forms the connecting link between the local societies and the Association. This kind of organisation seems to be the one calculated to produce the greatest amount of useful work. While referring to natural history societies, we may mention that the West Kent Natural History, Microscopical, and Photographic Society has sent us their report for 1894-95. The report contains an address by the President, Mr. H. J. Adams, on "Colour Photography," and a paper on "The Birds of Blackheath," by Mr. H. F. Witherby.

H. MOISSAN has attempted to produce argon compounds by acting on argon, under various conditions, with some of the rarer elements which unite more or less readily with nitrogen (*Comptes rendus*, May 6). 100 c.c. of the new gas were placed at his disposal by Prof. Ramsay. In a part of this, titanium, boron, and lithium were strongly heated without apparent change. Similarly, uranium (containing 3½ per cent. of carbon) did not absorb an appreciable amount of the gas when heated with it for twenty minutes. A quantity of the gas was conducted into a platinum tube of special construction, and there exposed to the action of pure fluorine, both at the ordinary temperature and in presence of induction sparks; in neither case could any reaction be observed whatever the proportion of argon present. The difficulty of manipulating fluorine has not allowed of the effect of long-continued sparking being observed. The results were entirely negative; under the conditions of these experiments, no compounds of argon have been produced.

BY saturating an ethereal solution of ferric chloride with nitric oxide, and concentrating the product at the ordinary temperature in the vacuum desiccator, V. Thomas has succeeded in obtaining crystals of the composition $FeCl_2.NO.2H_2O$. (*Bull. Soc. Chim.* [3], xiii.-xiv. No. 8). The anhydrous compound may be obtained in smaller yellow crystals by crystallisation at 60° on a porcelain plate. Peligot found that nitric oxide dissolved in ferrous chloride solution in the proportion required to form a compound $2FeCl_2.NO$, and this solution lost all its gas on heating. It is interesting and significant that the new crystalline product dissolves completely in cold water without evolution of gas to form a pale yellow solution, and that the solid compound is quite stable in vacuo at the ordinary temperature. Of considerable interest also is the observation by the same author, that nitric oxide gives abundant crystalline precipitates when passed through solutions of antimony tribromide or antimony trichloride.

A NEW series of iron nitrosocompounds have been discovered, by K. A. Hofmann and O. F. Wiede, which possess interest both from the point of view of the gas-analyst and in consequence of the example they afford of the synthetical production of complex inorganic substances. A current of nitric oxide is passed through a concentrated solution of 200 grams ferrous sulphate and 300 grams of potassium thiosulphate. A compound is precipitated in red-brown leaflets, which has the composition $Fe(NO)_2S_2O_3K.H_2O$. This substance may be dried in the vacuum desiccator without change. It is difficultly soluble in water, and dissolves in concentrated sulphuric acid without decomposition, giving an intensely greenish yellow coloured solution. Ammonium and sodium salts of similar composition and properties have also been prepared. The formation of the ew acid, dinitrosoferrothiosulphuric acid, of which these salts are derivatives, is facilitated by the presence of an excess of ferrous salt. It may be considered that the essential reaction in its formation consists of a replacement of the group $(KS_2O_3)$ by NO in ferrous potassium thiosulphate, viewing the latter as $KO_3S_2.Fe.S_2O_3K$. The displaced radical probably forms potassium tetrathionate which does not react further. Cobalt compounds, in which the cobalt replaces the iron in this series, can be obtained, though with much greater difficulty. The connection of these new substances with the tetra- and heptanitroso compounds of Pawel and Marchlewski and Sachs is yet under investigation.

THE additions to the Zoological Society's Gardens during the past week include two Arabian Baboons (*Cynocephalus hamadryas*, ♂ ♀) from Somaliland, presented respectively by Mr. Francis G. Gunnis and Mrs. E. Lort Phillips; a Japanese Ape (*Macacus speciosus*, ♂) from Japan, presented by Dr. G. L. Johnston; a Rhesus Monkey (*Macacus rhesus*, ♂) from India, presented by Messrs. A. S. and E. Boatfield; a Naked-footed Owlet (*Athene noctua*), European, presented by Mr. Walter Chamberlain; a Black Tanager (*Tachyhonus melaleucus*) from Brazil, presented by Mr. Edward Hawkins; a Hawfinch (*Coccothraustes vulgaris*), British, presented by Mr. H. G. Devas; two Common Peafowl (*Pavo cristatus*, ♂ ♀) from India, presented by Mr. L. G. Whatman; two Pyrenean Newts (*Molge aspera*) from Lac d. Oncet, Pyrenes, presented by Dr. Jacques de Bedriaga; two Indian Pythons (*Python molurus*) from India, presented by Mr. G. Stephen; a Koodoo (*Strepsiceros kudu*, ♀) from Somaliland, a Kinkajou (*Cercoleptes caudivolvulus*, ♀), a Ring-tailed-Coati (*Nasua rufa*) from Brazil, a Dusky Bulbul (*Pycnonotus obscurus*) from Morocco, deposited; two Ruddy Sheldrakes (*Tadorna casarca*, ♂ ♀), European, a Red-fronted Amazon (*Chrysotis vittala*) from Porto Rico, a Yellow-fronted Amazon (*Chrysotis ochrocephala*) from Guiana, purchased; a Large Red Flying Squirrel (*Pteromys inornatus*) from India, received in exchange; two Japanese Deer (*Cervus sika*, ♂ ♀), a Barbary Sheep (*Ovis tragelaphus*, ♂), born in the Gardens.

## OUR ASTRONOMICAL COLUMN.

ALGOL.—The periodic variations in the intervals between the minima of Algol have been explained by Dr. Chandler by supposing that the bright star, with its eclipsing companion, revolves round a distant centre of gravity determined by its relation to another dark body. M. Tisserand, however, considers that the phenomena may be produced by the changes in the line of apsides due to a polar compression of Algol (NATURE, vol. li. p. 328). The latter hypothesis requires that considerable variations in the duration of the minima should be observed; while, on Dr. Chandler's hypothesis, there should be a periodic inequality of the proper motion of Algol. Prof. Lewis Boss has recently discussed the question from the point of view of the proper motion of the star; but since the coefficient is probably less than 0"·7, the investigation is a very delicate one. Taking the result of his computation, apart from any considerations of the behaviour of Algol as a variable star, Prof. Boss is of opinion that there is a preponderance of probability in favour of the real existence of a periodic element in the proper motion, such as is required by Dr. Chandler's hypothesis. Supposing them to be real, they indicate that the apparent motion is in an ellipse, the semi-axis major of which is 0"·522 ± 0"·103 and the semi-axis minor 0"·224; the position angle of the northern end of the major axis is 34°, and the inclination of the real orbit to our line of sight is 23°. The computation further indicates that the star passed the major axis of the apparent orbit within three or four years of the most probable date derived from the observated light-changes. Prof. Boss considers the evidence in favour of Dr. Chandler's hypothesis to be sufficient to justify a very thorough investigation of the meridian observations, as well as continued determinations of position. (*Astronomical Journal*, No. 343.)

PARALLAX AND ORBIT OF η CASSIOPEIÆ.—Twenty-seven photographs of the region round this star, taken by Dr. Rutherford more than twenty years ago, have been utilised by Mr. H. S. Davis for the determination of the parallax (*Astronomical Journal*, No. 343). Six pairs of comparison stars were employed, and the combined results give the value 0"·465 ± 0·044, corresponding approximately to a distance of η Cassiopeiæ from the earth of 43,113,000,000,000 miles, or 7¼ light years. Though the new value exceeds previous ones, it is not considered improbably large if the Rutherford plates are subject to no systematic error. Using Grüber's values of the orbital elements, the combined masses of the components is two-tenths as great as that of the sun, and the distance between the components 19 astronomical units, the relative orbit thus being about the same size as that of Uranus. These numbers, however, may require some modification, as Dr. See has recomputed the elements of the orbit, with the results slightly differing from those adopted by Mr. Davis. Dr. See states that during the next ten years the position angle will increase from 204° to 251°, while the distance will diminish from 4"·52 to 3"·33.

A Belgian Astronomical Society.—A Société Belge d'Astronomy has been founded at Brussels. The object of the Society is to popularise astronomy and the sciences connected with it (geodesy, meteorology, terrestrial physics, &c.), and to encourage research into the domains of those branches of knowledge. The President of the Society is M. F. Jacobs, and among the Council are General Tilly, Prof. Dusausoy, Prof. Goemans, M. Lagrange, Prof. Pasquier, Prof. Rousseau, and M. Terby. Two of the Secretaries are M. Stroobaut and M. Vincent, both observers at the Royal Observatory, Brussels.

## THE IRON AND STEEL INSTITUTE.

THE annual spring meeting of the Iron and Steel Institute was held on Thursday and Friday of last week, in the theatre of the Society of Arts, under the chairmanship of the new President, Mr. David Dale. The following is the list of the papers set down for reading:—

"On Metal Mixers, as used at the Works of the North-Eastern Steel Company," by Mr. Arthur Cooper.

"On the Effect of Arsenic upon Steel," by Mr. J. E. Stead.

On the Iron Ore Mines of Elba," by Mr. H. Scott.

"On the Manufacture of Steel Projectiles in Russia," by Sergius Kern.

"On Ternary Alloys of Iron with Chromium, Molybdenum, and Tungsten," by James S. De Benneville, of Philadelphia.

The last two papers were taken as read. After the usual formal proceedings, the President presented the Bessemer medal, which had this year been awarded to Mr. H. M. Howe, of Boston, U.S.A. As Mr. Howe was not able to be present, Prof. Roberts-Austen accepted the medal on his behalf.

Mr. Dale next proceeded to read his inaugural address. Those who know the good work done by Mr. Dale in the conciliation of labour disputes will not be surprised to learn that the chief interest of the address was in the domain of economics rather than metallurgy. The address was none the less welcome on this account, as no class are more affected by disturbances in the labour market than the iron and steel makers. Mr. Dale showed very clearly the disastrous effects upon British trade of strikes and industrial disputes, and dwelt upon the ever-enlarging area of competition in the manufacturing markets of the world; for now we have not only the continental nations of Europe to contend with, but have to meet the products of the still cheaper labour of the far East.

Mr. Cooper's paper, though short, supplied a valuable contribution of knowledge to the practical steel maker. Uniformity of product is at once one of the most desirable and most difficult things for the steel maker to secure. No matter what care may be taken, the product of the blast furnace will vary in regard to those minute percentages of alloys which exercise so important an influence on the characteristics of the steel producer. Efforts have been made to equalise the analysis of the pig iron by mixing the ore, but these have been only partially successful. It is desirable, from an economic point of view, that molten iron should be taken direct from the blast furnace and used in the converter; but, in the basic process, the need of uniformity has prevented this course being followed. It has been therefore necessary to follow the original plan of running the molten iron from the blast furnace into pigs, and then remelting it in cupolas. In this way, by using the product of several furnaces, and by a system of careful analysing and selection, uniformity has been generally obtained. In spite of all care taken, however, there will be at times differences in the product of the cupolas, owing to irregularities in working which could not be guarded against, and it would frequently happen that though a standard mixture of pig might be charged into the cupola, the amount of silicon or manganese would vary considerably, owing to larger quantities of these metals being oxidised at one time than another. The mixer is a vessel in appearance like a large Bessemer converter. Into this the molten metal from the blast furnace is run, together with a certain amount of cupola iron in the case of the North Eastern Steel Company's works, with the plant of which the paper deals. The mixer is largely used in America, Mr. Carnegie stating during the discussion that at his works they were about to erect some of 600 tons capacity. The mixers, of which there are two at the North Eastern works, are each 150 tons capacity. For drawing the metal off into the ladle the mixer is tilted, swinging on trunnions like a converter, hydraulic machinery being provided for the purpose. In the discussion which followed the reading of the paper, many steel makers corroborated the account, given by the author, of the excellent results obtained by the use of the mixer.

The chief feature of the meeting was the reading and discussion of Mr. Stead's excellent contribution on the effect of arsenic in steel—a paper we should have described as exhaustive had it not been that the author states he is about to follow up the experiments of which he gives an account by further investigation in the same field. Mr. Stead commenced by a reference to the well-known memoir on the same subject, which Messrs. Harbord and Tucker contributed to the meeting of the Institute held in 1888. In that paper it was shown that a large quantity of arsenic is decidedly injurious to steel; and it has generally been thought that smaller quantities would be similarly injurious in a corresponding degree. Mr. Stead did not consider such an hypothesis necessarily sound, and determined to carry out the elaborate series of experiments, details of which are given in the paper. The results, as we have said, are of the utmost importance to steel makers, for arsenic and phosphorus are frequently bracketed in analyses, as the separation of the two is a long and tedious process. If small quantities of arsenic are not injurious, as would appear from Mr. Stead's investigations, phosphorus is undeniably a deleterious ingredient.

The general conclusions the author drew from his investigations were that between 0·10 per cent. and 0·15 per cent. of arsenic in steel for structural purposes does not have any material effect so far as mechanical properties are concerned. The tenacity is but slightly increased, the elongation is apparently not affected, and the reduction in area of the fractured test-pieces is practically equal to that of the same steel without the addition of arsenic. With 0·20 per cent. arsenic the difference, although slight, is noticeable in samples of acid open-hearth steel tried; but even in this case the only serious difference evidently caused by the arsenic is the inferiority of the bending properties of the pieces cut from the plates across the direction of rolling after they had been tempered. With larger amounts of arsenic the effect is decisive. When 1 per cent. is present the tenacity is increased, and the elongation slightly reduced. The bending properties of the steel are, however, fairly good. When the arsenic amounts to about 1½ per cent. the tenacity is still further increased, and the elongation and contraction of area still further reduced, whilst the bending properties are poor. With 4 per cent. of arsenic the tenacity is increased, and the contraction becomes *nil*. The author points out, however, that the trials with steel containing the higher percentages of arsenic could not be considered quite satisfactory, because the ingots on which the experiments were made were of very small size, and consequently a small amount of work only could be put upon them before testing. Mr. Stead considered it would have been highly probable that had larger masses been dealt with the results would have been more satisfactory. The effect of quenching the steel, after heating to a red heat, in every case where arsenic was in large quantity, was to improve its bending property.

Hot working is not affected by even 4 per cent. of arsenic, such an alloy appearing to stand about as much heat without burning as a steel containing 1 per cent. of carbon. When heated below the burning point such material can readily be hammered and rolled, and appears to be as soft in that state as steel containing about ·05 per cent. carbon. From this the author considers it safe to conclude that arsenic has not the slightest tendency to produce red-shortness. Mr. Stead had made experiments to ascertain the rate of corrosion of arsenical steel. He had submerged wires in a 2 per cent. solution of sal-ammoniac, had placed others in fresh water, and still another sample to a pile of the wharf at the Middlesbrough Ironworks in such a position as to be alternately covered and exposed as the tide ebbed and flowed. The conclusions arrived at were that arsenical steel is not more liable to corrosion than the same material without arsenical addition; in fact, oxidation is retarded by the presence of small quantities of arsenic.

It is in steel that is to be used in positions where it will require to be welded that arsenic appears most injurious, for that process is rendered more difficult by even very small quantities of arsenic; so that, as Mr. Stead says, when welding material is required, arsenic should be most carefully avoided. In regard to electrical conductivity, too, arsenic is injurious, for the value of the material in this respect is materially reduced by even small quantities of arsenic. A quantity equal to 0·25 per cent. diminishes the conductivity by about 15 per cent.

The paper concludes with an appendix in which the author gives a method he has worked out in detail for determining the arsenic in iron ores, in steel, and in pig iron. It has been the general practice to precipitate the arsenic as sulphide or hydric sulphide from the distillate, and either weigh the pure sulphide after drying at 212° F. or to oxidise it in bromine and hydrochloric acid, and then precipitate the arsenic acid with ammonia and magnesia solution, and weigh the precipitate produced. This process, although accurate, is tedious and takes at least twenty-four hours to complete. Mr. Stead has found that if the distillation is conducted in a special manner the whole of the arsenic may be obtained in the distillate, unaccompanied with any traces of chloride of iron, and that if the hydrochloric acid is nearly neutralised with ammonia and finally completely neutralised with acid carbonate of soda, the arsenic can be determined volumetrically with a standard solution of iodine, using starch solution as an indicator.

Emil Fischer proposed the process of distillation with ferrous chloride and titration of the distillate with iodine solution; but, as the details are not given in "Crookes' Select Methods," Mr. Stead had to work them out for himself. These he gives in full in his paper, to which we must refer our readers, as it would take too much space to describe the process in full. Mr. Stead says that a more simple and accurate device for the determination of small quantities of arsenic it would, he thinks, be impossible to conceive.

The discussion of this paper, although of an interesting nature, did not produce any new facts of importance. The majority of those who spoke were either steel makers or those interested in the production of steel, and they naturally congratulated themselves on the conversion of a long-supposed enemy into a neutral, if not into an ally. It should be remembered, however, that the meeting consisted chiefly of persons only too anxious to reduce the difficulty and cost of steel making; and not likely to accept any explanations tending to that end in a captious spirit. No one is likely to question the scientific accuracy or *bona fides* of so eminent and conscientious an observer and experimentalist as Mr. Stead, yet there may be something to say on the other side. This appears more likely from the remarks of the one user of steel who spoke—Mr. Wigham, the manager of a wire-drawing firm—who had made a report to Mr. Stead, which was quoted in the paper. It should be remembered, also, that Mr Stead himself says that further experiments are necessary.

The only remaining paper that was read was Mr. Scott's contribution on the Iron Mines of Elba. This was not discussed.

The autumn meeting of the Institute will take place in Birmingham, commencing Tuesday, August 12.

## *THE SCHORLEMMER MEMORIAL LABORATORY.*

AN interesting ceremony took place at the Owens College, Manchester, a few days ago, when Dr. Ludwig Mond formally opened the Schorlemmer Laboratory for Organic Chemistry, together with a large laboratory for medical students and a room for the preparation and storage of reagents. It may be remembered that, after the death of Prof. Schorlemmer, his friends and pupils, under the lead of Sir H. E. Roscoe, late professor of chemistry at the College, took steps with a view to fittingly commemorate his services to the College and to the advancement of organic chemistry. It was generally felt that the best memorial would be the erection of a laboratory for organic chemistry, to be called after his name, and a subscription list was accordingly opened. The appeal, which was generously headed by Dr. Mond, was so well responded to, both in this country and in Germany, that in a short time a sum of £2500 was subscribed. Meantime the Council of the College had to take into serious consideration the rapid growth of the chemical department. Originally designed for 100 students, the laboratories had for several years been overcrowded, and the private rooms built for research work had to be given up for the general instruction of the students. The number of the students in the chemical laboratories has steadily increased during the past five years, and, in view of this increase, the Council became convinced of the necessity of extending the chemical department. They accordingly accepted the fund raised by the Schorlemmer Memorial Committee, and instructed Mr. Alfred Waterhouse to prepare plans for a "Schorlemmer" Organic Laboratory, and for a new laboratory for elementary students, on a plot of land adjoining the present laboratories acquired by the College for the purpose of their extension. The Schorlemmer Laboratory, designed by Mr. Waterhouse, is at the end of the main corridor in the old chemical building. It measures sixty feet by thirty feet, and has an arched roof thirty feet high. The laboratory is designed to accommodate a professor, two demonstrators, and thirty-six students. It is fitted in the most complete manner with every requisite for the important work which is to be carried on within it, and in some particulars is arranged after the plan of the Munich organic laboratories. The lower laboratory is designed for forty-five students. The fittings are similar to those in the old laboratories designed by Sir Henry Roscoe. The total cost of the new building was £4800.

A full report of the opening ceremony is given in the *Manchester Guardian*, to which source we are indebted for the following condensed account:—

In connection with the inaugural proceedings, a large and representative company gathered in the Chemical Theatre of the College. Messages regretting inability to attend, and wishing prosperity to the laboratory, were received from a number of eminent chemists. Prof. H. B. Dixon referred to the esteem in which Schorlemmer's name was held, and expressed, on behalf of his colleagues and himself, their admiration of the life and character of the man to whose memory the laboratory had been erected.

Sir H. E. Roscoe sketched Schorlemmer's life, and, in the course of his address, said:—Schorlemmer added another name to the list of distinguished foreigners who had found a home in these islands. Never again could it be said that England failed to recognise and appreciate the value of the services of those who sought her shores. The names of Herschel, of Hofmann, of Max Müller, and, lastly, of Schorlemmer indicated that we are not slow to give honour to those who were once strangers in the land, but who had made themselves members of our national family. They might have good hopes that the time would soon come when the leaders in chemical industry would appreciate the necessity of a thorough scientific training, as had long been the case in Germany; and that as Giessen was, under Liebig, the means of raising the standard of chemical education throughout the Fatherland, so the chemical department of Owens College might, under the direction of Prof. Dixon and Prof. Perkin, the director of the new laboratory, be pointed out as the institution in England which had done the same for this great empire.

Dr. Ludwig Mond next addressed the meeting. He remarked that the opening of the first laboratory solely devoted to the study of organic chemistry, at the only University in England which could boast of a professor of that science, was a distinct step forward in the development of science in this country. He considered it a great step in advance to have a special laboratory and special professors appointed for the study of the chemistry of carbon, because the subject-matter of chemistry now covered so vast a domain, and was increasing at such an immense rate, that for any one desiring to further contribute to it, it had become a necessity, after mastering the main facts of the science, to give his attention specially to the details of one or other part of it. While it was true that carbon was only one out of many elements, it possessed such very special properties that the multitude of its compounds probably outnumbered those of all the rest of the elements together, and it had the unique interest that all the innumerable substances that were found in plants and animals, which built up their tissues, and by their constant changes produced the phenomenon we called life, were all compounds of carbon. It was for this reason that they called the chemistry of these compounds organic chemistry, and it was very natural that that branch of their science should be nearer to their hearts than any other branch. But there was another and stronger reason for having special laboratories of organic chemistry. The methods of investigation and the way of analysing organic compounds differed considerably from those applied to inorganic chemistry. In the latter, if we had ascertained by an accurate analysis of a pure substance its percentage composition, that, together with the determination of a few simple physical properties, was usually sufficient to give us a perfect insight into its chemical composition and behaviour. The laboratory methods required for that study were simple and most of them well known, so that they could be acquired by sufficient experience. In organic compounds the matter was very different. The percentage composition and the physical properties told them very little of their chemical individuality and behaviour. Many substances of exactly the same percentage composition possessed widely different qualities, which were not explained by their physical properties. They must find out how these compounds, many of which were very complex, were built up. They had to unravel the structure of those substances to attain their end, which in chemical investigation always meant to give an explanation of all the various properties of a substance through its chemical constitution. To ascertain its structure they had to break the organic substance down by degrees, to take it gradually to pieces; and even that was not enough, but to make sure of the actual arrangement of those pieces in the substance they had to put them together again, to rebuild the substance from its proximate constituents, and only after having accomplished that could they consider that they knew its constitution. The methods employed in that work were entirely different from those of ordinary analysis. They were very manifold. The investigator had to make his own choice which of them to apply in any individual case, and wherever he broke new ground and undertook the study of a new series of compounds, he had to discover and work out new methods before he could achieve success. It was evident that a student who aimed at qualifying himself for such high-class work should enjoy special facilities, and should, after having gone through a regular course of analytical chemistry, have a chance of prosecuting special organic work in a laboratory fitted specially for it, and where he was undisturbed by the army of beginners who thronged an analytical laboratory. And there he might point out that in his opinion the reason why this country had not advanced in organic chemistry as fast as other countries, the reason why Hofmann's prediction in his report on the Exhibition of 1862 that "England will be unquestionably at no distant date the greatest colour-producing country in the world," had not been fulfilled, and that Germany had almost entirely taken this industry out of her hands, although it was inaugurated by an Englishman (Dr. W. H. Perkin), had been that so few English students of chemistry had devoted sufficient time to the prosecution of their studies. It was evident, therefore, in order to attain the necessary experience and certainty in carrying out original investigation in organic chemistry, that four to five years of close study and attention, under the leadership of a competent professor, were a necessity; and for carrying on successfully the manufacture of artificial colours it was indispensable that the chemist should be able to carry out independent original research because new colours had year after year to be discovered and manufactured, and the processes for their production had to be constantly improved in order to compete successfully with rival manufacturers. The success of an industrial enterprise depended not, indeed, upon the workman, not the foreman, as so many people in this country still believe, but upon the leading mind who directed the manufactory, who had a thorough grasp of scientific principles and had been trained to habits of scientific thought. He agreed that it was desirable to cultivate physical chemistry and inorganic chemistry much more than had been done, and he was very glad that the great supremacy which organic chemistry had enjoyed—more particularly in Germany, the home of chemistry—was now being contested by other and equally important branches of the science. But great, and very great, as had been the progress of organic chemistry, it had greater and more important problems still to solve; and in this country, which had given birth to so many of the most important steps in advance of that science, it had not received that amount of general attention which it had deserved in the past, and which it still deserved in the future. He therefore specially and heartily welcomed the opening of the first laboratory exclusively devoted to it in England. Prof. Schorlemmer, in his excellent and most suggestive little work "On the Rise and Development of Organic Chemistry," after giving a lucid review of the steps by which the great edifice of that science had been built up, gave in his concluding remarks a perspective of the problems still to be solved wide enough for the most expansive imagination of any searcher after truth. If to-day we still could not make morphine, quinine, and similar bodies artifically, the time was near at hand. If we could not make quinine, we had already found a partial substitute in antipyrine, and its introduction into therapeutics had lowered the price of quinine considerably. Another important problem was the synthesis of the ingredients of our daily food, such as sugar, gum, and starch. Those bodies were nearly related to each other, for we could convert the two latter into different kinds of sugar, and sugars again into gums. That the synthesis of sugar was imminent had already been stated. But it was quite different with those important parts of our food which had been called the albuminous bodies. Kekulé, in discussing the scientific aims and achievements of chemistry, brought forward the idea that if ever chemists should succeed in obtaining albuminoid bodies artificially it would be in the state of living protoplasm, perhaps in the form of those structureless beings which Haeckel called the "Monera." All attempts hitherto made for the purpose of producing living matter artificially had failed. The enigma of life could only be solved by the synthesis of an albuminous compound. Prof. Fischer, in a lecture delivered not long ago in Berlin, also expressed himself full of confidence that the time would arrive when we might attack successfully even the problem of the constitution and synthesis of the albuminoids, and might thus approach the problem of the origin of life. Surely with such a prospect before them as the ultimate result of the pursuit of organic chemistry, no amount of work, no amount of thought, no amount of time and trouble devoted to that study would be too much if it was well employed in leading successfully to the great end in view, although the goal might not be reached for generations to come.

The company afterwards adjourned to the new laboratory, which was declared open by Dr. Mond.

## *THE MIGRATIONS OF THE LEMMING.*

UNDER the title "Myodes Lemmus, its Habits and Migrations in Norway," Prof. R. Collett, of Christiania, gives a valuable account of his researches into the habits and migrations of that interesting little rodent, the lemming, which has become so notorious on account of its periodic wanderings in vast hordes down the Scandinavian valleys. Prof. Collett finds the earliest notice of the lemming in an old Norse manuscript dating from the latter end of the thirteenth century, and reproduces a curious and striking woodcut from the great history of Olaus Magnus (1555), in which is graphically figured the descent of the lemmings from the clouds according to the prevalent belief. But the most valuable parts of the memoir are those which depend upon the author's personal knowledge of the lemming. The nature and habits of the lemming are clearly described, and much light is thrown upon the causes which from time to time lead such vast numbers of these animals to leave their native uplands and to begin their suicidal wanderings. The migrations seem to be directly due to over-population. In certain years, termed by the writer "prolific years," an abnormal fecundity is exhibited by the lemming; this phenomenon is not, however, confined to this species, but is shown also in numerous families of mammals, birds, and insects. The consequences of this great multiplication in the case of the lemming are thus described by Prof. Collett. "The enormous multitudes require increased space, and the individuals, which, under normal conditions, have each an excessively large tract at their disposal, cannot, on account of their disposition, bear the unaccustomed proximity of the numerous neighbours. Involuntarily the individuals are pressed out to the sides until the edge of the mountain is reached. In a short time they enjoy themselves there, and the old individuals willingly breed in the upper regions of the forests, where, at other times, they are entirely wanting. New swarms, however, follow on; they could not return, but the journey proceeds onwards down the sides of the mountains, and when they once reach the valleys, they meet with localities which are quite foreign to them. They then continue blindly on, endeavouring to find a home corresponding to that they have left, but which they never regain. The migratory individuals proceed hopelessly on to a certain death." Sooner or later all the wanderers meet their death—thousands are drowned in rivers or fjords, thousands are attacked by beasts and birds of prey, and thousands perish from the effects of cold and damp; but the greater number die from the effects of a peculiar epidemic which attacks them in the lowlands. It is pointed out by the writer that the wandering instinct developed during migratory years is probably of distinct service to the species in reducing the surplus population.

## *THE AUSTRALASIAN ASSOCIATION.*

WE gave, a fortnight ago, the presidential address delivered by the Hon. A. C. Gregory to the Australasian Association for the Advancement of Science at this year's meeting in Brisbane. Full reports of the proceedings in the different Sections have reached us, from the General Secretary, Mr. J. Shirley, but limits of space prevents us from printing more than a brief summary of them.

The public proceedings of the meeting were opened by a popular lecture on "Star Depths," by Mr. H. C. Russell. Mr. Russell traced the growth of knowledge concerning the distance of the stars, and the structure of the stellar universe, and illustrated his description by a selection from the excellent photographs of celestial scenery taken at Sydney Observatory.

We give a synopsis of the work of the various sections.

### ASTRONOMY, MATHEMATICS, AND PHYSICS.

Mr. Alexander M'Aulay, as President of Section A, delivered an address "On Some Popular Misconceptions on the Nature of Mathematical Thought."

Mr. P. Baracchi, contributed a paper on "the most probable value and error of Australian longitudes, including that of the boundary lines of South Australia with Victoria and New South Wales." Dr. Ralph Copeland sent "Some Notes on the New Royal Observatory, Edinburgh," and Mr. H. C. Russell read a paper "On a Photographic Transit Instrument."

### CHEMISTRY.

Mr. J. H. Maiden delivered the presidential address in this Section, entitled, "The Chemistry of the Australian Indigenous Vegetation." Mr. E. A. Weinberg contributed a paper on the refractory gold ores of Queensland: their sources and treatment. Prof. A. Liversidge, F.R.S., read a paper on "Variations in amount of Ammonia in Water on keeping." He also described the internal structure of some Australian nuggets, of different sizes, which had been closely examined and photographed. The etching was conducted according to the following plan:—A clean section was made and highly polished, and acted upon by chlorine water or bromine water, tincture of iodine or potassium cyanide, or sodium chloride mixed with nitric acid. The crystals less readily soluble stand up in relief and resemble the well-known figures seen in metallic meteorites when etched. One curious fact observed was that when the nuggets were subjected to heat, bubbles or blebs were formed on the surface, which burst with a sharp report, probably due to water included in the nugget being converted into high-pressure steam. Several beautiful photographs showing the crystalline nature of the nuggets were exhibited. Other papers read were: "On the Corrosion of Aluminium," and "Contributions to the Bibliography of Gold," by Prof. Liversidge; "Pharmacy as a Science and its Future," by Dr. W. Finselbach; "Notes and Analyses of some of the Artesian Waters of New South Wales," by John C. H. Mingaye; "On the Economic Treatment of Gold Ores," by Geo. H. Irvine; "Queensland Native Astringent Medicines," by Dr. Joseph Lauterer; "Portland Cement after Fifty Years," by W. M. Doherty; "Some Remarks on the Teaching of Elementary Chemistry," by A. J. Sach; "Analysis of Eucalyptus Gums," by Dr. Wilton Love; "The Ointments of the British Pharmacopœia," by F. W. Simmonds; "Notes on the Poisonous Constituents of Stephania Hernandiiafolia," by Prof. Edward H. Rennie; "Preliminary Notes on the Bark of Carissa Ovata, *R. Br.* v. Stolonifera, *Bail*," by H. G. Smith; "On a Method of Shortening certain Chemical Calculations," by W. A. Hargreaves.

### GEOLOGY AND MINERALOGY.

Prof. T. W. Edgeworth David, in his address to this Section, reviewed briefly some recent geological discoveries of special interest. A paper by Mr. E. F. Pittman, Assoc. R.S.M., entitled "Notes on the Cretaceous Rocks in the North-western Portion of New South Wales," gave the results of a recent geological journey by him over 1150 miles of country. The geological examination was made chiefly with the object of determining approximately the area and boundaries of the artesian water formation.

Among other papers read before this Section were:—"Anticlines and Synclines and their Relation to Mining," by Ernest Lidgey; "On the Nomenclature of Crystals," by Prof. A. Liversidge, F.R.S.; "The Development and Progress of Mining and Geology in Queensland," by William Fryar; "On the Present State of our Knowledge of the Older Tertiaries of Southern Australia," by G. B. Pritchard; "The Antiquity of Man in Victoria," by W. H. Ferguson; "The Glacial Deposits of Victoria," by G. Officer, L. Balfour, and E. G. Hogg; "Notes on Tin Mining at Herberton," by John Munday.

### BIOLOGY.

Prof. A. Dendy took for the subject of his presidential address, "The Cryptozoic Fauna of Australasia." Mr. F. M. Bailey read a paper on peculiarities of the Phanerogamic Flora of Queensland. The paper chiefly contained descriptions of indigenous fruits recommended for cultivation. Mr. D. Le Souef furnished a paper on the Tree Kangaroo (*Dendrolagus Bennettianus*), describing its mode of climbing, its food, and the way it is captured by the natives. In a paper on the eating of earth by the larger Macropodidæ, by J. Douglas Ogilby, evidence was given of the eating of earth by kangaroos in the Bourke district, New South Wales. This habit does not appear to have been previously recorded, though in the district under notice it plays no unimportant part in the economy of the larger marsupials.

Dr. M. C. Cook sent a paper entitled "Pestiferous Fungi and their Modes of Attack." Dr. Charles Chilton gave a general account of history, occurrence, distribution and habits of the blind Amphipoda and Isopoda found in the underground waters of the Canterbury Plains in New Zealand. Miss Lodder furnished a revised list of the Marine Mollusca of Tasmania. Some plants peculiar to the Burnett Basin were described by James Keys. In a paper entitled "Notes and Observations on the Genus Nephila," W. J. Rainbow dealt with—(1) the localities in which spiders of the genus Nephila abound; (2) the strength and elasticity of their webs, in the sticky meshes of which certain birds of weak wing-power are caught; (3) the question as to whether the Nephilæ eat birds thus captured; (4) the mode by which silk may be obtained from these spiders by artifical means, and the experiments made by certain naturalists with a view to ascertaining the amount that could be obtained from individuals of this genus in a season, the object of which was to endeavour to prove that the product might be used for economic purposes.

Dr. J. Müller, of Geneva, Switzerland, contributed a paper on the Pyrenocarpeæ of the Lichen family. Mr. A. J. Campbell described the nests and eggs of Australian Hawks. Mr. A. G. Hamilton, in a paper entitled "The Fertilisation of some Australian Plants," gave many of his own observations as to the mode by which fertilisation is effected. Mr. W. M. Maskell gave a synoptical list of the Coccidæ reported from Australasia and the Pacific Islands up to December 1894.

Mrs. W. Martin gave the life-history of the vegetable growth known as Native Bread (*Mylitta Australis*). Australian mosses were enumerated by Richard A. Bastow, and some notes on the poisonous constituents of *Stephania hernandiæfolia* were read by E. H. Rennie and E. F. Turner. Picrotoxine and an alkaloid possessing strongly poisonous properties and marked chemical characteristics have been isolated from an extract from the plant.

"Economic Entomology" was the title of a paper by the Rev. E. H. Thompson, who pointed out the great benefit resulting to a country from a properly conducted Government Entomological Department, and urged, in order to increase its usefulness: (1) the formation of a federal entomological department with a head staff and field observers in each of the colonies; (2) a federal agricultural and scientific journal for all the colonies, subsidised by all; (3) elementary entomology to be taught in the State schools, special reference being given to the insect pests peculiar to each district or colony; and (4) the formation of school museums and prizes given for the best collections.

Mr. G. B. Barton gave a concise historical account of the first discovery of the Eucalyptus, including the names and nationalities of those to whom the honour has been ascribed by various writers.

A paper by Dr. J. Lauterer contained physiological and microchemical researches on the Eucalyptus, and contributed some new items with regard to the life-history of those trees connected with the origin of the gum exuded by their bark.

### GEOGRAPHY.

The President of the Section, Baron von Mueller, was absent, but his address, on "The Commerce of Australia with Neighbouring Countries in Relation to Geography," was read.

Mr. C. L. Wragge gave an account of his investigations of ocean currents by means of bottles thrown into the sea. He was of opinion from the results obtained that many of the bottles had been influenced more by winds than by ocean currents; but if this were not the case, the bottles cast adrift in the Australian Bight distinctly indicated that a strong current sets from the neighbourhood of Kangaroo Island towards the head of the Bight and Israelite Bay. The most interesting of the bottle papers is one that was cast adrift near the Cocos Islands, in the north-eastern portion of the Indian Ocean, and which was found a few months afterwards on the shores of German East Africa. Papers cast adrift by Mr. Wragge during a voyage to England, in the neighbourhood of the Sargasso Sea, were picked up at Hayti, on the Alabama coast, and on the Louisiana coast. Others thrown overboard with a view to testing Rennel's current, which sets towards the coast of Ireland, from the neighbourhood of Cape Finisterre, were certainly influenced by the strong west-southwest winds which were experienced on that occasion between the Western Islands and the English Channel. None of these appear to have followed the current, but went straight across it, some being found on the west coast of France, and near the islands of Sein, while one was picked up at Brighton. It appears to be highly desirable, judging from the results obtained, that the bottles should be weighted with sand or other material, with a view to more completely sinking them in the water, and thus minimising the influence of the winds.

Among other papers contributed to this Section were—"The Southern Alps of New Zealand," by Mr. A. P. Harper; "The Bissagos Islands," by M. Max Astrie; and "Physiography of the Victorian Gold Fields," by James Stirling.

### ETHNOLOGY AND ANTHROPOLOGY.

Mr. Thomas Worsnop, President of the Section of Ethnology and Anthropology, delivered an address upon the prehistoric arts of the Australian Aborigines. Messrs. W. J. Enright and R. H. Matthews described the aboriginal drawings in the Wollombi Caves, New South Wales. A paper was contributed by Mr. Thomas Petrie, on the habits and customs of the wild tribes as he saw them in 1837, from Brisbane to Maroochy. "Foods of North-west Aboriginals" was the title of a paper by J. Coghlan. Mr. John F. Small contributed a paper on customs and traditions of the Clarence River aboriginals. The paper dealt with the traditions, funeral ceremonies, marriage laws, and the Bora ceremony. Mr. E. Thorne read a paper entitled "Curious Aboriginal Marriage Custom." The paper was the result of investigations made by the author in the Laguna Bay.

The other papers communicated to this Section included: "'Boomerang' and 'Woomera,' Evolution, Varieties, and Distribution," by Mr. A. Weston; "The Ancient Government of Samoa," by Rev. S. Ella; "Notes on Tokelau, Gillbert, and Ellice Islands," by Rev. J. E. Newell; "A Comparative View of some Samoan Customs," by Rev. J. B. Stairs; "Early Samoan Voyages and Settlements," by Rev. J. B. Stairs; and "Gaelic Contributions to Folk Lore," by Rev. A. C. Sutherland.

### AGRICULTURE.

In a paper on the teaching of agricultural botany, Mr. C. T. Musson said that the object to be aimed at by instructors in agricultural botany should be to impart such information to the prospective cultivator as would make him acquainted with plant structure and the more important useful plants. Practice alone would not make a good farmer, but practice, when based upon a knowledge of the animate and inanimate objects he was dealing with, and their surroundings, would make the man of resources best fitted for his work. Mr. T. B. Guthrie contributed a paper on examinations of different varieties of wheat grown in New South Wales. He also read a paper on "soil analysis," in which the value of soil analysis to the farmer was discussed, and different methods for the determination of the available plant food in soils were reviewed. The paper embodied a suggestion for a scheme of soil analysis, the results of which should be of practical use to the farmer, based upon the determination of those conditions which conduce to fertility rather than to the chemical constitution of the soil. Of the remaining papers read before this section, the following were of more than technical interest:—

"Climatic Influences on Contagious Diseases of Live Stock," by P. R. Gordon; "How to Grow Fruit," by Albert H. Benson; "Floods and Forests," by Philip MacMahon; "Semi-Tropical Horticulture," by Leslie G. Corrie; "Forage Plants and Grasses of Australia," by Fred. Turner; "The Agricultural Chemistry of the Sugar Cane," by Joseph Fletcher.

### ENGINEERING AND ARCHITECTURE.

Mr. James Fincham, President of this Section, delivered his presidential address on "Architecture and Engineering."

Prof. W. C. Kernot contributed a paper on wind pressure. The paper was a continuation of one read at the Adelaide meeting. It dealt with the relation between velocity and pressure, and detailed series of experiments leading to the formula $P = \cdot 0033 V^2$, which approximates very closely to the rule given by Dines, and disagrees with the rules given by Smeaton and Crosby. The pressure of wind upon roofs was also dealt with, and experiments were quoted to show that the ordinary method of computing the pressure is fairly accurate when the roof is supported on thin columns, so that the wind can pass freely below, but is altogether wrong when the roof is supported on walls. In this latter case the pressure is greatly reduced, and when the walls terminate in parapets is often rendered negative, the roof having a distinct tendency to lift.

Other papers communicated to this section were:—"Experiments on the Waterproofing of Bricks and Sandstones with Oils," and "Experiments on the Porosity of Plasters and Cements," by Prof. A. Liversidge, M.A., F.R.S.; "On Teredo-Resisting River Structures," by Thomas Parker; "Earthquakes in Relation to Building Construction," by Thos. Turnbull.

### SANITARY SCIENCE AND HYGIENE.

The President of the Section of Sanitary Science and Hygiene, Dr. J. W. Springthorpe, read an address on "The Teaching of Science in Matters of Health."

Among the papers read were:—"The Promise of 'Serum Therapeutics' in regard to Tuberculosis," by Dr. J. Sidney Hunt; "Contagiousness of Tuberculosis," by F. H. Vivian Voss; "The Prevalence and Intercommunicability of Human and Animal Tuberculosis," by S. S. Cameron; "Leprosy," by Dr. C. E. Dumbleton, and also by A. Francis; and "Etiological Views of the Maintenance of Leprosy," by Dr. J. A. Thompson.

### MENTAL SCIENCE AND EDUCATION.

Prof. F. Anderson, the President of this Section, delivered his address on "Education in Politics."

Dr. Henry Belcher contributed a paper on the use and abuse of examinations. The advantages of the examination system were shortly stated as follows:—It enables the teacher to stimulate the intelligence and test the progress of the pupil, and to fill up flaws and gaps due to imperfect apprehension, carelessness, or defective memory; it is a power almost indispensable to the teacher's efficiency, and is thus a potent factor in general education; it had an alterative and prophylactic effect upon private adventure schools, raising their tone both intellectually and morally. The author doubted whether it was wise to entrust the examination of pupils to persons other than their teachers. The disadvantages of the examination system were that the best part of a teacher's work escapes analysis; methods of higher teaching rise in quality and character, while methods of examination lie behind; by the selection of set books, and the publication of manuals thereon, an intolerable yoke and shackle is placed upon elementary scholarship; examinations appeal to the lower side of human nature—what will pay becomes the pupil's ruling thought. Certain subjects of great importance are neglected because they do not largely count for prizes and honours; and research is altogether neglected.

Among the remaining papers read were:—"Science as a Subject in Girls' Schools," by Miss F. E. Hunt; "The Curriculum of Secondary Education," by D. H. Hollidge; 'The Technical Element in a State System of Education," by Antony St. Ledger; "A Contribution towards the Study of the Relation of Ethics and Science," by the Rev. J. S. Pollock; "The Importance of Mental Science as a Guide in Primary Education," by James Rule.

The business of the Association concluded with a meeting of the General Council, at which the following recommendations, among others, were adopted:—

(1) That the committee for the investigation of the thermodynamics of the voltaic cell be reappointed without grant.

(2) That the report of the Seismological Committee be printed, and that the committee be reappointed and allowed a grant of £10 towards the cost of the erection of the instruments presented by Dr. Von Rebeur-Paschwitz at Timaru.

(3) That the following be a committee—namely, Messrs. F. M. Bailey, R. L. Jack, A. Gibb Maitland, A. Meston, C. W. De Vis, and H. Tryon—to investigate the geology, land flora, and natural resources generally of the islands and islets of the Great Barrier Reef.

(4) That the New Zealand Government be asked to set apart Stephen's Island, Cook Strait, as a reserve for the Tuatara Lizard.

(5) That the committee for the investigation of glacial deposits in Australasia be Messrs. Hutton, R. L. Jack, R. Tate, R. M. Johnston, F. W. E. David (secretary), G. Sweet, J. Shirley, W. Houchins, E. G. Hogg, E. J. Dunn, A. Montgomery, and E. F. Pittman.

(6) That a committee—consisting of Messrs. H. C. Stanley, A. B. Brady, Thomas Parker, Prof. Warren, Prof. Kernot, Henry Moncrieff, and James Fincham—be appointed to inquire into the habits of the teredo, and the best means of preserving timber or structures subject to the action of tidal waters.

(7) That the committee on psycho-physical research be appointed without a grant.

The next meeting of the Association will be held at Sydney in 1897, under the presidency of Prof. Liversidge, and the following meeting will take place at Melbourne.

## *ELECTRIFICATION OF AIR, AND THERMAL CONDUCTIVITY OF ROCK AT DIFFERENT TEMPERATURES.**

### (I.) "ON THE ELECTRIFICATION OF AIR."

§ 1. CONTINUOUS observation of natural atmospheric electricity has given ample proof that cloudless air at moderate heights above the earth's surface, in all weathers, is electrified with very far from homogeneous distribution of electric density. Observing, at many times from May till September, 1859, with my portable electrometer on a flat open sea-beach of Brodick Bay in the Island of Arran, in ordinary fair weather at all hours of the day, I found the difference of potentials, between the earth and an insulated burning match at a height of 9 feet above it (2 feet from the uninsulated metal case of the instrument, held over the head of the observer), to vary from 200 to 400 Daniell's elements, or as we may now say volts, and often during light breezes from the east and north-east, it went up to 3000 or 4000 volts. In that place, and in fair weather, I never found the potential other than positive (never negative, never even down to zero), if for brevity we call the earth's potential at the place zero. In perfectly clear weather under a sky sometimes cloudless, more generally somewhat clouded, I often observed the potential at the 9 feet height to vary from about 300 volts gradually to three or four times that amount, and gradually back again to nearly the same lower value in the course of about two minutes.† I inferred that these gradual variations must have been produced by electrified masses of air moving past the place of observation. I did not remark then, but I now see, that the electricity in these moving masses of air must, in all probability have been chiefly positive to cause the variations which I observed, as I shall explain to you a little later.

* Two communications to the Philosophical Society of Glasgow meeting, in the Natural Philosophy Lecture-room of the University of Glasgow, March 27, "On the Electrification of Air": "On the Thermal Conductivity o fRock at different temperatures."

† "Electrostatics and Magnetism" (S William Thomson), xvi. §§ 281, 282.

§ 2. Soon after that time a recording atmospheric electrometer* which I devised, to show by a photographic curve the continuous variation of electric potential at a fixed point, was established at the Kew Meteorological Observatory, and has been kept in regular action from the commencement of the year 1861 till the present time. It showed incessant variations quite of the same character, though not often as large, as those which I had observed on the sea-beach of Arran.

Through the kindness of the Astronomer Royal, I am able to place before you this evening the photographic curves for the year 1893, produced by a similar recording electrometer which has been in action for many years at the Royal Observatory, Greenwich. They show, as you see, not infrequently, during several hours of the day or night, negative potential and rapid transitions from large positive to large negative. Those were certainly times of broken weather, with at least showers of rain, or snow, or hail. But throughout a very large proportion of the whole time the curve quite answers to the description of what I observed on the Arran sea-beach thirty-six years ago, except that the variations which it shows are not often of so large amount in proportion to the mean or to the minimums.

§ 3. Thinking over the subject now, we see that the gradual variations, minute after minute through so wide a range as the 3 or 4 to 1, which I frequently observed, and not infrequently rising to twenty times the ordinary minimum, must have been due to *positively* electrified masses of air, within a few hundred feet of the place of observation, wafted along with the gentle winds of 5 or 10 or 15 feet per second which were blowing at the time. If any comparably large quantities of negatively electrified air had been similarly carried past, it is quite certain that the minimum observed potential, instead of being in every case positive, would have been frequently large negative.

§ 4. Two fundamental questions in respect to the atmospheric electricity of fair weather force themselves on our attention:—(1) What is the cause of the prevalent positive potential in the air near the earth, the earth's potential being called zero? (2) How comes the lower air to be electrified to different electric densities whether positive or negative in different parts? Observations and laboratory experiments made within the last six or eight years, and particularly two remarkable discoveries made by Lenard, which I am going to describe to you, have contributed largely to answering the second of these questions.

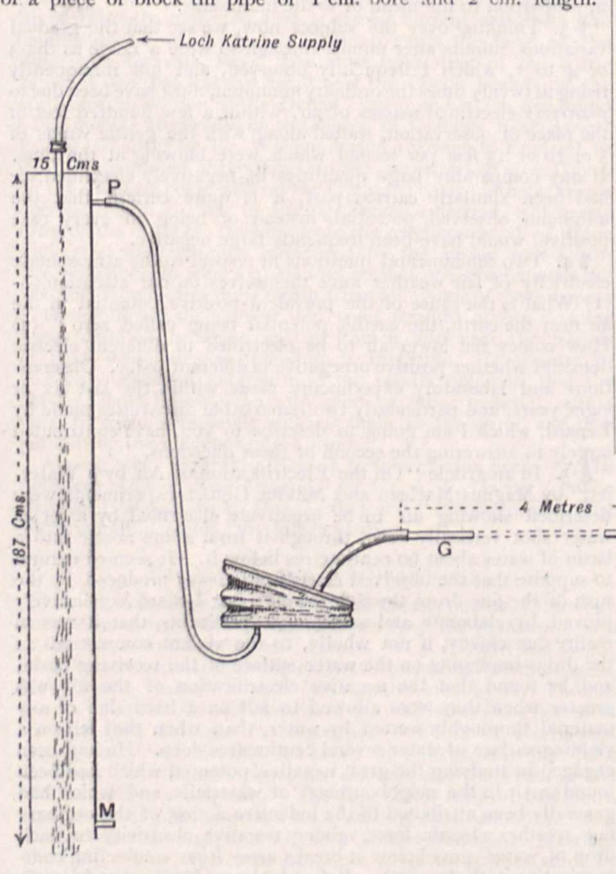
§ 5. In an article "On the Electrification of Air by a Water-jet," by Magnus Maclean and Makita Goto,† experiments were described showing air to be negatively electrified by a jet of water shot vertically down through it from a fine nozzle into a basin of water about 60 centimetres below it. It seemed natural to suppose that the observed electrification was produced by the rush of the fine drops through the air; but Lenard conclusively proved, by elaborate and searching experiments, that it was in reality due chiefly, if not wholly, to the violent commotions of the drops impinging on the water surface of the receiving basin, and he found that the negative electrification of the air was greater when they were allowed to fall on a hard slab of any material thoroughly wetted by water, than when they fell on a yielding surface of water several centimetres deep. He had been engaged in studying the great negative potential which had been found in air in the neighbourhood of waterfalls, and which had generally been attributed to the inductive action of the ordinary fine weather electric force, giving negative electricity to each drop of water-spray before it breaks away from conducting communication with the earth. Before he knew Maclean and Goto's paper, he had found strong reason for believing that that theory was not correct, and that the true explanation of the electrification of the air must be found in some physical action not hitherto discovered. A less thorough inquirer might have been satisfied with the simple explanation of the electricity of waterfalls naturally suggested by Maclean and Goto's result, and might have rested in the belief that it was due to an electrifying effect produced by the rush of the broken water through the air; but Lenard made an independent experimental investigation in the Physical Laboratories of Heidelberg and Bonn, by which he learned that the seat of the negative electrification of the air electrified is the lacerated water at the foot of the fall, or at any rocks against which the water impinges, and not the multitudinous interfaces between air and water falling freely in drops through it.

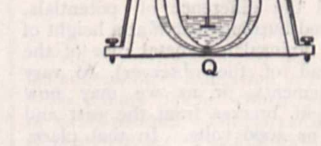
§ 6. It still seems worthy of searching inquiry to find

* "Electrostatics and Magnetism" xvi. §§ 271, 292.

† *Philosophical Magazine*, 1890, second half-year.

electrification of air by water falling in drops through it, even though we now know that, if there is any such electrification, it is not the main cause of the great negative electrification of air which has been found in the neighbourhood of waterfalls. For this purpose an experiment has been very recently made by Mr. Maclean, Mr. Galt, and myself, in the course of an investigation regarding electrification and diselectrification of air with which we have been occupied for more than a year. The apparatus which we used is before you. It consists of a quadrant electrometer connected with an insulated electric filter* applied to test the electrification of air drawn from different parts of a tinned iron funnel, 187 centimetres long and 15 centimetres diameter, fixed in a vertical position with its lower end open and its upper end closed, except a glass nozzle, of 1·6 mm. aperture, admitting a jet of Glasgow supply water (from Loch Katrine) shot vertically down along its axis. The electric filter (R in the drawing), a simplified and improved form of that described in the *Proceedings* of the Royal Society for March 21, consists of twelve circles of fine wire gauze rammed as close as possible together in the middle of a piece of block tin pipe of 1 cm. bore and 2 cm. length.




One end of it is stuck into one end of a perforation through a block of paraffin, K, which supports it. The other end (G') of this perforation is connected by block tin pipe (which in the apparatus actually employed was 4 metres long, but might have been shorter), and india-rubber tubing through bellows to one or other of two short outlet pipes (M and P) projecting from the large funnel.

§ 7. We first applied the india-rubber pipe to draw air from the funnel at the *upper* outlet, P, and made many experiments to test the electricity given by it to the receiving filter, R, under various conditions as to the water-jet; the bellows being worked as uniformly as the operator could. When the water fell fairly through the funnel with no drops striking it, and through 90 cm. of free air below its mouth, a small negative electrification of R was in every case observed (which we thought might possibly be attributable to electrification of the air where the water was caught in a basin about 90 cm. below the mouth of the funnel). But when the funnel was slanted so that the whole shower of drops from the jet, or even a small part of it, struck the inside of the funnel, the negative electrification of R was largely increased. So it was also when the shower, after falling freely down the middle of the funnel, impinged on a metal plate in metallic communication with the funnel, held close under its mouth, or 10 or 20 cm. below it. For example, in a series of experiments made last Monday (March 25), we found ·28 of a volt in 15 minutes with no obstruction to the shower; and 4·18 volts in five minutes, with a metal plate held three or four centimetres below the mouth of the funnel; the air being drawn from the upper outlet (P). Immediately after, with P closed, and air drawn from the lower outlet (M), but all other circumstances the same, we found ·20 of a volt in five minutes with no obstruction; and 6·78 volts in five minutes with the metal plate held below the mouth as before.

§ 8. These results, and others which we have found, with many variations of detail, confirm, by direct test of air drawn away from the neighbourhood of the waterfall through a narrow pipe to a distant electrometer, Lenard's conclusion that a preponderatingly strong negative electrification is given to the air at every place of violent impact of a drop against a water-surface, or against a wet solid. But they do not prove that there is *no* electrification of air by drops of water falling through it. We always found, in every trial, decisive proof of negative electrification; though of comparatively small amount when there was no obstruction to the shower between the mouth of the funnel and the catching basin 90 cm. below it. We intend to continue the investigation, with the shower falling freely far enough down from the mouth of the funnel to make quite sure that the air which we draw off from any part of the funnel is not sensibly affected by impact of the drops on anything below.

§ 9. The other discovery* of Lenard, of which I told you, is that the negative electrification of air, in his experiments with pure water, is diminished greatly by very small quantities of common salt dissolved in it, that it is brought to nothing by ·011 per cent.; that positive electrification is produced in the air when there is more than ·011 per cent. of salt in the water, reaching a maximum with about 5 per cent. of salt, when the positive electrical effect is about equal to the negative effect observed with pure water, and falling to 14 per cent. of this amount when there is 25 per cent. of salt in the solution. Hence sea-water, containing as it does about 3 per cent. of common salt, may be expected to give almost as strong positive electrification to air as pure water would give of negative in similar circumstances as to commotion. Lenard infers that breaking waves of the sea must give positive electricity to the air over them; he finds, in fact, a recorded observation by Exner, on the coast of Ceylon, showing the normal positive electric potential of the air to be notably increased by a storm at sea. I believe Lenard's discovery fully explains also some very interesting observations of atmospheric electricity of my own, which I described in a letter to Dr. Joule, which he published in the *Proceedings* of the Literary and Philosophical Society of Manchester for October 18, 1859.† "The atmospheric effect ranged from 30° to about 420° [of a heterostatic torsion electrometer of 'the divided-ring' species] during the four days which I had to test it; that is to say, the electrometric force per foot of air, measured horizontally from the side of the house, was from 9 to above 126 zinc-copper water cells. The weather was almost perfectly settled, either calm, or with slight east wind, and in general an easterly haze in the air. The electrometer twice within half an hour went above 420°, there being at the time a fresh temporary breeze from the east. What I had previously observed regarding the effect of east wind was amply confirmed.

* Kelvin, Maclean, Galt, "On the Diselectrification of Air." *Proc.* Roy. Soc., March 14, 1895.

* "Ueber die Electricität der Wasserfälle." Table xvii. p. 628. *Annalen der Physik und Chemie*, 1892, vol. xlvi.

† Republished in "Electrostatics and Magnetism." "Atmospheric Electricity," xvi. § 262.

Invariably the electrometer showed very high positive in fine weather, before and during east wind. It generally rose very much shortly before a slight puff of wind from that quarter, and continued high till the breeze would begin to abate. I never once observed the electrometer going up unusually high during fair weather without east wind following immediately. One evening in August I did not perceive the east wind at all, when warned by the electrometer to expect it; but I took the precaution of bringing my boat up to a safe part of the beach, and immediately found by waves coming in that the wind must be blowing a short distance out at sea, although it did not get so far as the shore. . . . On two different mornings the ratio of the house to a station about sixty yards distant on the road beside the sea was ·97 and ·96 respectively. On the afternoon of the 11th instant, during a fresh temporary breeze of east wind, blowing up a little spray as far as the road station, most of which would fall short of the house, the ratio was 1·08 in favour of the house electrometer—both standing at the time very high—the house about 350°. I have little doubt but that this was owing to the negative electricity carried by the spray from the sea, which would diminish relatively the indications of the road electrometer."

§ 10. The negative electricity spoken of in this last sentence, "as carried by the spray from the sea," was certainly due to the inductive effect of the ordinary electrostatic force in the air close above the water, by which every drop or splash breaking away from the surface must become negatively electrified; but this only partially explains the difference which I observed between the road station and the house station. We now know, by the second of Lenard's two discoveries, to which I have alluded, that every drop of the salt water spray, falling on the ground or rocks wetted by it, must have given positive electricity to the adjoining air. The air, thus positively electrified, was carried towards and over the house by the on-shore east wind which was blowing. Thus, while the road electrometer under the spray showed less electrostatic force than would have been found in the air over it and above the spray, the house electrometer showed greater electrostatic force because of the positively electrified air blown over the house from the wet ground struck by the spray.

§ 11. The strong positive electricity, which, as described in my letter to Joule, I always found in Arran with east wind, seemed at first to be an attribute of wind from that quarter. But I soon found that in other localities east wind did not give any very notable augmentation, nor perhaps any augmentation at all, of the ordinary fair weather positive electric force, and for a long time I have had the impression that what I observed in this respect, on the sea-beach of Brodick Bay in Arran, was really due to the twelve nautical miles of sea between it and the Ayrshire coast east-north-east of it; and now it seems to me more probable than ever that this is the explanation when we know from Lenard that the countless breaking waves, such as even a gentle east wind produces over the sea between Ardrossan and Brodick, must every one of them give some positive electricity to the air wherever a spherule of spray falls upon unbroken water. It becomes now a more and more interesting subject for observation (which I hope may be taken up by naturalists having the opportunity) to find whether or not the ordinary fine weather positive electric force at the sea coast in various localities is increased by gentle or by strong winds from the sea, whether north, south, east or west of the land.

§ 12. From Lenard's investigation we now know that every drop of rain, falling on the ground or on the sea,* and every drop of fresh water spray of a breaking wave, falling on a fresh water lake, sends negative electricity from the water surface to the air; and we know that every drop of salt water, falling on the sea from breaking waves, sends positive electricity into the air from the water surface. Lenard remarks that more than two-thirds of the earth's surface is sea, and suggests that breaking sea-waves may give contributions of positive electricity to the air which may possibly preponderate over the negative electricity given to it from other sources, and may thus be the determining cause of the normal fair weather positive of natural atmospheric electricity. It seems to me highly probable that this preponderance is real for atmospheric electricity at sea. In average weather, all the year round, sailors in very small vessels are more wet by sea-spray than by rain, and I think it is almost certain that more positive electricity is given to the air by breaking waves than negative electricity by rain. It seems also probable that the positive electricity from the waves is much more carried up by strong winds to considerable heights above the sea, than the negative electricity given to the air by rain falling on the sea; the greater part of which may be quickly lost into the sea, and but a small part carried up to great heights. But it seems to me almost certain that the exceedingly rapid recovery of the normal fair weather positive, after the smaller positive or the negative atmospheric electricity of broken weather, which was first found by Beccaria in Italy 120 years ago, and which has been amply verified in Scotland and England,* could not be accounted for by positively electrified air coming from the sea. Even at Beccaria's Observatory, at Garzegna di Mondovi in Piedmont, or at Kew, or Greenwich, or Glasgow, we should often have to wait a very long time for reinstatement of the normal positive after broken weather, if it could only come in virtue of positively electrified air blowing over the place from the sea; and several days, at least, would have to pass before this result could possibly be obtained in the centre of Europe.

§ 13. It has indeed always seemed to me probable that the rain itself is the real restorer of the normal fair weather positive. Rain or snow, condensing out of the air high up in the clouds, must itself, I believe, become negatively electrified as it grows, and must leave positive electricity in the air from which it falls. Thus rain falling from negatively electrified air would leave it less negatively electrified, or non-electrified or positively electrified; rain falling from non-electrified air would leave it positively electrified; and rain falling from positively electrified air would leave it with more of positive electricity than it had before it lost water from its composition. Several times within the last thirty years I have made imperfect and unsuccessful attempts to verify this hypothesis by laboratory experiments, and it still remains unproved. But I am much interested just now to find some degree of observational confirmation of it in Elster and Geitel's large and careful investigation of the electricity produced in an insulated basin by rain or snow falling into it, which they described in a communication published in the *Sitzungsberichte* of the Vienna Academy of Sciences, of May 1890. They find generally a large electrical effect, whether positive or negative, by rain or snow falling into the basin for even so short a time as a quarter of a minute, with however, on the whole, a preponderance of negative electrification.

§ 14. But my subject this evening is not merely natural atmospheric electricity, although this is certainly by far the most interesting to mankind of all hitherto known effects of the electrification of air. I shall conclude by telling you very briefly, and without detail, something of new experimental results regarding electrification and diselectrification of air, found within the last few months in our laboratory here by Mr. Maclean, Mr. Galt, and myself. We hope before the end of the present session of the Royal Society to be able to communicate a sufficiently full account of our work.

§ 15. Air blown from an uninsulated tube, so as to rise in bubbles through pure water in an uninsulated vessel, and carried through an insulated pipe to the electric receiving filter, of which I have already told you, gives negative electricity to the filter. With a small quantity of salt dissolved in the water, or sea water substituted for fresh water, it gives positive electricity to the air. There can be no doubt but these results are due to the same physical cause as Lenard's negative and positive electrification of air by the impact of drops of fresh water or of salt water on a surface of water or wet solid.

§ 16. A small quantity of fresh water or salt water shaken up vehemently with air in a corked bottle electrifies the air, fresh water negatively, salt water positively. A "Winchester quart" bottle (of which the cubic contents is about two litres and a half), with one-fourth of a litre of fresh or salt water poured into it, and closed by an india-rubber cork, serves very well for the experiment. After shaking it vehemently till the whole water is filled with fine bubbles of air, we leave it till all the bubbles have risen and the liquid is at rest, then take out the cork, put in a metal or india-rubber pipe, and by double-acting bellows, draw off the air and send it through the electric filter. We find the electric effect, negative or positive according as the water is fresh or salt, shown very decidedly by the quadrant electrometer: and this, even if we have kept the bottle corked for two or three minutes after the liquid has come to rest before we take out the cork and draw off the air.

§ 17. An insulated spirit lamp or hydrogen lamp being con-

* "Ueber die Electricität der Wasserfälle." *Annalen der Physik und Chemie*, 1892, vol. xlvi. p. 631.

* "Electrostatics and Magnetism," xvi. § 287.

nected with the positive or with the negative terminal of a little Voss electric machine, its fumes (products of combustion mixed with air) sent through a block-tin pipe, four metres long, and one centimetre bore, ending with a short insulating tunnel of paraffin and the electric filter, gives strong positive or strong negative electricity to the filter.

§ 18. Using the little biscuit-canister and electrified needle, as described in "our communication" * to the Royal Society "On the Diselectrification of Air," but altered to have two insulated needles with varied distances of from half a centimetre to two or three centimetres between them, we find that when the two needles are kept at equal differences of potential positive and negative, from the enclosing metal canister, little or no electrification is shown by the electric filter; and when the differences of potential from the surrounding metal are unequal, electrification, of the same sign as that of the needle whose difference of potential is the greater, is found on the filter.

When a ball and needle-point are used, the effect found depends chiefly on the difference of potentials between the needle-point and the surrounding canister, and is comparatively little affected by opposite electrification of the ball. When two balls are used, and sparks in abundance pass between them, but little electricity is deposited by the sparks in the air, even when one of the balls is kept at the same potential as the surrounding metal. [The communication was illustrated by a repetition of some of the experiments shown on the occasion of a Friday evening lecture † on Atmospheric Electricity at the Royal Institution on May 18, 1860, in which one half of the air of the lecture-room was electrified positively, and the other half negatively, by two insulated spirit lamps mounted on the positive and negative conductors of an electric machine.]

(2) "ON THE THERMAL CONDUCTIVITY OF ROCK AT DIFFERENT TEMPERATURES."

Experiments by Lord Kelvin and Mr. Erskine Murray were described, and the apparatus used in them was shown, by which it was found that the thermal conductivity of specimens of slate, sandstone, and granite is less at higher temperatures than at lower for each of these rocks. The last tested was Aberdeen granite, for which experiments of fairly satisfactory accuracy showed the mean conductivity for the range from 146° C. to 215° C. to be 86 per cent. of the mean conductivity in the range from 81° C. to 146° C. They hope to send a communication to the Royal Society describing their work before the end of the present session. KELVIN.

* *Proceedings* of the Royal Society, March 14, 1895.

† "Electrostatics and Magnetism," xvi, §§ 285, 286.

## *UNIVERSITY AND EDUCATIONAL INTELLIGENCE.*

OXFORD.—Mr. D. R. Pike, of the Charterhouse, has been elected to an open Exhibition in Natural Science at Jesus College, and Mr. L. C. W. Brigstocke, of Haverfordwest Grammar School, has been elected to a Welsh Foundation Scholarship in Natural Science at the same College.

Open Scholarships and Exhibitions in Natural Science have been announced for competition at Merton College, New College, Magdalen College, and Corpus Christi College. Particulars may be obtained on application to the Dean in any of these Colleges.

CAMBRIDGE.—The Walsingham Medal for an original monograph on a botanical, geological, zoological, or physiological subject will be awarded in the Michaelmas Term. Essays are to be sent to Prof. Newton by October 10, 1895. Candidates must be B.A.'s not of standing to take the M.A. degree.

The subject for the Adams Prize of 1897 is connected with Bessel's Functions. It is set forth in the *University Reporter* for May 14. The prize is of the value of about £197. It is open to all graduates of the University. Essays are to be sent to the Vice-Chancellor by December 16, 1896.

THE Association of Technical Institutions has endeavoured to induce the Science and Art Department to discontinue the examinations now held in practical inorganic and organic chemistry, and to award attendance grants for instruction in those subjects, the amount of such grants to be dependent upon the report of the Department's inspectors on the efficiency of the equipment and teaching. The Association has received a reply to the effect that it is not possible for the Department to comply with their request. A new syllabus for practical inorganic chemistry will appear, however, in the forthcoming edition of the Science and Art Directory, and there seems little doubt that the instruction will be so arranged in it as to make it possible to coordinate more closely the laboratory and lecture work in that subject, and afford the same latitude to teachers as is given by the new Regulations for Organised Science Schools.

## *SCIENTIFIC SERIALS.*

*American Journal of Mathematics*, vol. xvii. No. 2 (Baltimore, April 1895).—A method for calculating simultaneously all the roots of an equation, is a paper by Dr. E. McClintock, which was read before the American Mathematical Society on August 14 and October 27, 1894. It opens with the application to an example employed by Spitzer and by Jelinek. The calculations of these mathematicians can only be done for a pair of roots at a time, and that with considerable difficulty. The method employed by our author is fairly facile. Very little has hitherto been done in the direction of this memoir, which is one of great value in the subject of algebraic equations. The writer discusses eleven examples at length, the highest degreed equation being one of the sixth degree in $x$.—Sur le logarithme de la fonction gamma, by Hermite, is a note upon Raabe's integral, in continuation of an article in the *Math. Annalen* (41, p. 581).—Sur la pression dans les milieux diélectriques ou magnétiques, by Prof. P. Duhem, corrects an error in his "Leçons sur l'Electricité et le magnétisme," and is a valuable working out of the theory of the pressures, initiated by Clerk Maxwell, and further improved by von Helmholtz, Kirchhoff, and other writers. The number closes with an article on ternary substitution-groups of finite order which leave a triangle unchanged, by H. Maschke. This paper is complementary to C. Jordan's "Sur les équations, differentielles linéaires à integrale algébrique," and "Sur la détermination des groupes d'ordre fini contenues dans le groupe linéaire."

*Zeitschrift für wissenschaftliche Zoologie*, Bd. lix. Heft 1.—Prof. A. R. von Heider gives a detailed description of a new Actinian (*Zoanthus chierchiæ*) obtained during the cruise of the *Vettor Pisani*. Prof. A. Korotneff describes the embryonic development of *Salpa democratica*. According to him the follicle-cells do not play the important part in the development of *Salpa* which Salensky attributed to them, nor do they form a temporary scaffolding for the blastomeres, as stated by Brooks. The embryo is built up of blastomeres in the normal manner, and embryonic layers are present with the same significance as in other groups. The cloaca is formed by the union of endodermal diverticula, and the pericardium develops as an outgrowth of the pharynx.—Prof. W. Schimkewitsch writes upon the structure and development of a species of *Dinophilus* living in the White Sea, near the Solovetzki laboratory. The twofold affinities of this interesting type, on the one hand with the Annelids, and on the other with the Rotifers, are succinctly stated.—Prof. Vejdovsky writes upon the sexual apparatus of *Lumbriculus variegatus*.—Dr. Montgomery deals fully with the anatomy of a new type of Nemertine (*Stichostemma Eilhardi*) discovered in fresh-water aquaria in the Berlin Zoological Institute.—Dr. McKim describes the nephridial funnel apparatus of *Hirudo*.

## *SOCIETIES AND ACADEMIES.*

EDINBURGH.

**Royal Society**, March 18.—The Rev. Prof. Flint, Vice-President, in the chair.—Prof. Crum-Brown communicated a paper, by Mr. R. Fairbairn and himself, on the action of sodium mercaptide on dibromomalonic ether.—Prof. J. C. Ewart communicated a paper, by Mr. F. J. Cole and himself on the dorsal branches of the cranial and spinal nerves in elasmobranchs.—Dr. Traquair read a paper on phosphorescent sandstones.—Prof. Tait read a note on the electromagnetic wave-surface.

April 1.—Sir Douglas Maclagan, President in the chair.—A paper, by the Duke of Argyll, on the glaciation of two glens, was read. The glens are Glenaray and Glenshira. The usual explanation of the phenomena of glaciation as observed in the West Highlands is that the glaciation was caused by an enormous ice-cap covering the whole country. His Grace does not consider that the phenomena can be so explained. Rocks are found which are striated and smoothed on one side, while the other side remains rough. Isolated blocks, without striation, are found in positions where they could not have been placed except by the agency of floating ice-floes. He considers that the marks of glaciation were caused by ice-floes, driven by strong north-east and south-west currents, in a sea whose surface reached a level on the land of from 1500 to 2000 feet over the present level. The two glens run nearly parallel in a north-easterly direction, and are separated by a range of hills and moors not much more than two miles broad. The rocks of both belong to the same geological formation, and yet the glens are entirely dissimilar in appearance. Glenshira has smooth, regular slopes, with a smooth level bottom; Glenaray is a typical highland glen traversed by a rapid river with a rocky bed and three waterfalls, and exhibits strong glaciation. His Grace does not consider that an ice-sheet, operating over the whole country, could account for these differences. Neither does he consider that local glaciers could have produced the effect, for such a glacier must have been formed on the slopes of Ben Loy and have flowed down Glenshira. On the other hand, Glenaray terminates in a low pass 480 feet above sea-level, while Glenshira is closed in by ridges 2000 feet in height. The former was therefore open to the action of floes, while the higher peaks would shelter the latter.

April 17.—Sir Douglas Maclagan, President, in the chair.—Prof. Flinders Petrie gave a lecture "On a New Race in Egypt," describing the result of his work in Egypt during the last season.

PARIS.

**Academy of Sciences,** May 6.—M. Marey in the chair.—The zoological work of James Dana, by M. Blanchard. The main outlines of James Dana's work are sketched from a zoologist's point of view. Reference is particularly made to his work on the geographical distribution of zoophytes, on coral reefs and islands, on animal distribution with reference to depth and temperature in the sea, and on Crustaceans.—The mineralogical and geological work of James Dana, by M. Daubrée. A very full account is given of the chief points in Dana's geological work, special reference being made to his publication of a "System of Mineralogy," and his "Manual of Geology."—The work of M. Carl Vogt, by M. Émile Blanchard.—Researches on the cerite earths, by M. P. Schützenberger. The author establishes the result that in cerite, cerium oxide is accompanied by small quantities of another earth of a metal with somewhat lower atomic weight, which is capable of being oxidised like cerium oxide, and of which the sulphate is isomorphous with that of cerium, and gives insoluble double sulphates with alkaline sulphates. The calcined higher oxide is of reddish-brown colour, even without presence of didymium.—Action of fluorine on argon, by M. Henri Moissan (see Notes, p. 61).—Systematic application of the potato to the feeding of cattle, by M. Aimé Girard. The results are reported of experiments on the feeding of cattle and sheep, both quantity and quality of meat obtained being considered. The best results were obtained with given proportions of cooked potatoes and hay, a very superior article being obtained yielding high profits.—Report on the table of triangular numbers of M. Arnaudeau.—On the orbit of the 1771 comet, by M. Bigourdan. A re-examination of the original manuscript of Saint-Jacques has allowed the discovery of an error made by Burckhardt in reducing observations of this comet. The result of a preliminary recalculation of the observations allows the definite rejection of a hyberbolic orbit, and renders it very probable that the orbit is an ellipse of eccentricity 0·998.—Every algebraical condition imposed on the movement of a body is realisable by means of an articulated system, by M. G. Kœnigs.—On the use of a fourth dimension, by M. de la Rive.—On fluted spectra, by Prof. Arthur Schuster. A discussion of the different interpretation of phenomena by the author and M. Poincaré. In conclusion, the author is unable to doubt the justice of M. Gouy's view, that the regularity of the vibrations, shown by the observations of Fizeau and Foucault, does not exist in the luminous movement, but is produced by the apparatus used.—Unequal absorption of dextrorotatory and lævorotatory circularly polarised light in certain active substances, by M. A. Cotton. This unequal absorption is indicated by the conversion of a plane polarised ray into an elliptically polarised ray by passage through substances such as the coloured metallic tartrates. The method of measuring the effect is indicated and results promised in a further communication.—On the freezing of solutions at constant temperature, by M. Sarrau. Solidification is produced under pressure so that no lowering of the freezing point occurs, the connection between the compensating pressure and molecular weight is considered.—Closed isothermal cycles, reversible and maintained in equilibrium by gravity, by M. A. Ponsot.—Observations on the project of a balloon expedition to the Arctic regions put forth by M. S. A. Andrée, by M. Gaston Tissandier.—Researches on mercurous sulphate, nitrate, and acetate, by M. Raoul Varet. The heats of formation from their elements taken in their actual states are: for $Hg_2SO_4$ sol. + 175 Cal.; for $Hg_2(NO_3)_2 2H_2O$ sol. + 69·4 Cal.; and for $Hg_2(C_2H_3O_2)_2$ sol. + 202·1 Cal.—On the presence of chitin in the cellular membrane of mushrooms, by M. Eugène Gilson. Chitin has been found in all the fungi examined, taking the place and fulfilling the functions of cellulose in phanerogams and cryptogams. The experimental evidence concerns Agaricus campestris, Amanita muscaria, Cantharellus cebarius, Hypholoma fasciculare, Polyporus officinalis, Polyporus fumosus, Russula, Boletus, Tricholona, Bovista, and Claviceps purpurea.—Comparative study of the "appareils odorifiques" in the different groups of Heteropterous Hemiptera, by M. J. Künckel d'Herculais.—Overlap of the Jurassic beds in the massif of the Vendée, by M. Fred. Wallerant.—Influence of de-oxygenated blood, and of some poisons, on the contractility of the lymphatic vessels, by MM. L. Camus and E. Gley.—On the scarlatinous streptococcus, by M. Ad. d'Espine.—The manuring of vines and quality of the wines, by M. A. Müntz. The supposed deleterious action of manure on the quality of wine produced from the dressed vineries has no substantial foundation in fact.

BERLIN.

**Physiological Society,** April 5.—Prof. H. Munk, President, in the chair.—Prof. J. Munk had investigated the excretion of mineral waste during Prof. Zuntz' experiments on the effects of excessive exercise on metabolism. (See NATURE, vol. li. p. 503.) He found that the urinary output of sulphur was increased in correspondence with the increased proteid metabolism, the excess taking the form of sulphuric acid, not of ethereal-sulphates. Phosphorus and potassium were also similarly increased, and since neither of them are normal constituents of proteid, their greater excretion denoted some destruction of other tissues. This view was confirmed by the increased excretion of lime, which further points to a possibly greater metabolism of bone-tissue during the exercise.—Dr. Treitel had carried out observations on the perception of the vibrations of tuning-forks by the skin, and had found that the sensibility varied in different parts of its surface, and did not correspond with that for the perception of mere touch or localisation.—Dr. Schultz demonstrated the contraction of single bundles of unstriated muscle-fibres on a preparation made from the muscular coat of a frog's stomach. The fibres could be seen to slowly contract on electric stimulation, relaxing equally slowly after the stimulus had ceased.

**Meteorological Society,** April 2.—Prof. Hellmann, President, in the chair.—Dr. Less spoke on the various types of winter weather, dealing in detail with the five types established by Teisserenc de Bort as depending on the distribution of barometric maxima and minima over the Atlantic Ocean and Europe. He added to these a sixth type of mild and squally weather which most usually follows after other types of warm winter weather. He pointed out that the winter just past could for the most part not be included under any of the above six types.

**Physical Society,** April 26.—Prof. Schwalbe, President, in the chair.—Dr. Pringsheim gave an account of his experiments on the electric conductivity of heated gases. In a Chamotte-tube closed by brass caps the various gases, such as air, hydrogen, and carbon dioxide, were heated to a temperature of 700° to 900° C. The electrodes consisted of circular discs of platinum capable of being placed at varying distances from each other. A current of 1·6 to 10 volts was passed through the gases, and all the results obtained by Becquerel in 1853 were confirmed. As the electrodes were separated from each other the deflection of the galvanometer became less, and with constant distance between the electrodes the current became less the longer it flowed. This fact led to the suspicion, verified by experiment, that polarisation was here playing a part. On breaking the primary current, the polarisation of the electrodes was quite perceptible for a full half-hour. The speaker concluded from the above that conduction in heated gases is an electrolytic phenomenon, and intends to carry on his researches, using more carefully purified gases and a trustworthy pyrometer.—Dr. du Bois reported on a paper presented by Prof. van Aubel, dealing with Hall's phenomenon as investigated on thin layers of bismuth deposited electrolytically. It appeared that when the deposit was made from nitrate of bismuth the phenomenon was as marked as it is with cast plates of the metal, whereas when deposited from the tartrate the phenomenon was either extremely feeble or non-existent. The asymmetry of the phenomenon on reversal of the magnetic field was explained by the author as due to the influence exerted by the magnetic field on the electric conductivity of the metal. He further regarded the difference in behaviour of the metallic film as precipitated, on the one hand, from the nitrate, and on the other, from the tartrate or citrate, as due to the fact that in the case of the latter salts the bismuth is mixed with carbon, whereas in the case of the nitrate the metal is deposited in a pure state.

## DIARY OF SOCIETIES.

LONDON.

*THURSDAY*, MAY 16.

ROYAL SOCIETY, at 4.30.—On Measurements of Small Strains in the Testing of Materials and Structures: Prof. Ewing, F.R.S.—The Electrical Measurement of Starlight. Observations made at the Observatory of Daramona House, Co. Westmeath, in April 1895. Preliminary Report: Prof. G. M. Minchin.—The Complete System of the Periods of a Hollow Vortex Ring: H. C. Pocklington.—India's Contribution to Geodesy: General Walker, F.R.S.

CHEMICAL SOCIETY, at 8.—Ballot for the Election of Fellows.—Kjeldahl's Process for the Determination of Nitrogen; Dr. Bernard Dyer.—The Action of Nitrous Acid on 1 : 4 : 2 Dibromaniline: Prof. Meldola, F.R.S., and E. R. Andrews.—Derivatives of Succinyl and Phthalyl Dithiocarbimides: Prof. Dixon and Dr. Doran.

ROYAL INSTITUTION, at 3.—The Liquefaction of Gases: Prof. J. Dewar, F.R.S.

SOCIETY OF ANTIQUARIES, at 8.30.

*FRIDAY*, MAY 17.

QUEKETT MICROSCOPICAL CLUB, at 8.

EPIDEMIOLOGICAL SOCIETY.—Paper by Dr. Washbourn.

*SATURDAY*, MAY 18.

LONDON GEOLOGICAL FIELD CLASS (Cannon Street Station), at 2.17.—Excursion to view Escarpment Valleys from the Weald to Chalk.

GEOLOGISTS' ASSOCIATION (Cannon Street Station), at 1.35.—Excursion to Betchworth and Headley.

ESSEX FIELD CLUB (Chingford, 2 p.m., and High Beach, 4 p.m.).—Inspection of Forest, and Paper by Mr. E. N. Buxton, on Plan for forming a Protected Area for certain Birds in Old Waltham Forest District.

*MONDAY*, MAY 20.

SOCIETY OF ARTS, at 8.—Japanese Art Industries: Dr. Ernest Hart.

ROYAL GEOGRAPHICAL SOCIETY, at 8.45.—Meeting to Commemorate the Fiftieth Anniversary of the Sailing of the Arctic Expedition under Sir John Franklin.

VICTORIA INSTITUTE, at 4.30.—Prof. E. Hull, F.R.S.

MEDICAL SOCIETY, at 8.30.

*TUESDAY*, MAY 21.

ROYAL INSTITUTION, at 3.—Thirty Years' Progress in Biological Science (II.): Prof. E. Ray Lankester, F.R.S.

SOCIETY OF ARTS, at 8.—Commercial Education in Belgium: Prof. William Layton.

ZOOLOGICAL SOCIETY, at 8.30.—On the Ornithological Collections made by Dr. Donaldson Smith during his Recent Expedition in Somaliland and Gallaland: Dr. R. Bowdler Sharpe.—A Synopsis of the Genera and Species of Apodal Batrachians, with Descriptions of a New Genus and Species (Bdellophis vittatus): G. A. Boulenger, F.R.S.—List and Distribution of the Land-Mollusca of the Andaman and Nicobar Group of Islands in the Bay of Bengal, with Descriptions of some New Species: Lieut.-Colonel H. H. Godwin-Austen, F.R.S.—On a New Species of Hedgehog from Somaliland: Dr. J. Anderson, F.R.S.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Last Ballot for Members for the Session.

ROYAL STATISTICAL SOCIETY (Royal United Service Institution), at 5.—Municipal Finance: E. Orford Smith.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—Apparatus for Process Photography: Wm. Gamble.

ROYAL VICTORIA HALL, at 8.—The History of a Myth: Prof. Sollas, F.R.S.

PATHOLOGICAL SOCIETY, at 8.30.

*WEDNESDAY*, MAY 22.

SOCIETY OF ARTS, at 8.—The Dressing and Metallurgical Treatment of Nickel Ores: A. G. Charleton.

GEOLOGICAL SOCIETY, at 8.—On a Human Skull and Limb-Bones found in the Palæolithic Terrace-Gravel at Galley Hill (Kent): E. T. Newton, F.R.S.—Geological Notes of a Journey round the Coast of Norway and into Northern Russia: G. S. Boulger.—On Rhætic Foraminifera from Wedmore (West Somerset): Frederick Chapman.

*THURSDAY*, MAY 23.

ROYAL INSTITUTION, at 3.—The Instruments and Methods of Spectroscopic Astronomy: Dr. W. Huggins, F.R.S.

SOCIETY OF ARTS, at 4.30.—The Northern Balochis: their Customs and Folk-lore: Oswald V. Yates.

INSTITUTION OF ELECTRICAL ENGINEERS (Society of Arts), at 8.—On the Recent Development of the Single-Acting High-Speed Engine, for Central Station Work: Mark H. Robinson.

*FRIDAY*, MAY 24.

ROYAL INSTITUTION, at 9.—The Absolute Measurement of Electrical Resistance: J. Viriamu Jones, F.R.S.

LINNEAN SOCIETY, at 3.—Annual Meeting.

PHYSICAL SOCIETY, at 5.—On Mixtures of Ethane and Nitrous Oxide: Dr. Kuenen.—The Measurement of Cyclically Varying Temperature: H. F. W. Burstall.

*SATURDAY*, MAY 25.

GEOLOGISTS' ASSOCIATION (Paddington Station), at 10.2 a.m.—Excursion to Goring. Directors: J. H. Blake and W. Whitaker, F.R.S.

LONDON GEOLOGICAL FIELD CLASS (Waterloo Station), at 3.5.—Excursion to the Bagshot Sand Hills at Frimley.

ROYAL BOTANIC SOCIETY, at 3.45.

## BOOKS, PAMPHLETS, and SERIALS RECEIVED.

BOOKS.—Æsthetic Principles: H. R. Marshall (Macmillan).—Crystallography: Prof. N. Story-Maskelyne (Oxford, Clarendon Press).—A Primer of Mayan Hieroglyphics: Dr. D. G. Brinton (Boston, Ginn).—The Migration of British Birds: C. Dixon (Chapman).—Electricity in our Homes and Workshops: S. F. Walker, 3rd edition (Whittaker).—The Practical Telephone Handbook, J. Poole, 2nd edition (Whittaker).—The Land Birds in and around St. Andrews: G. Bruce (Dundee, Leng).—Wild Nature won by Kindness: Mrs. Brightwen, 6th edition (Unwin).—The Elements of Botany: F. Darwin (Cambridge University Press).—John Dalton and the Rise of Modern Chemistry: Sir H. E. Roscoe (Cassell).—Royal Natural History, Vol. 3 (Warne).—Geschichte der Explosivstoffe. I. Geschichte der Sprengstoffchemie der Sprengtechnik und des Torpedowesens: S. J. von Romocki (Berlin, Oppenheim).—The Scientific Transactions of the Royal Dublin Society, Vol 5 (series 2): The Brain of the Microcephalic Idiot: Prof. D. J. Cunningham (Williams).—Royal University of Ireland. Examination Papers, 1894 (Dublin, Ponsonby).—A Manual for the Study of Insects: J. H. and A. B. Comstock (Ithaca, Comstock).—Sitzungsberichte der K. B. Gesellschaft der Wissenschaften, Mathematisch-Naturwissenschaftliche Classe 1894 (Prag).

PAMPHLETS.—Summary Report of the Geological Survey Department for the Year 1894 (Ottawa, Dawson).—Elasticity a Mode of Motion: R. Stevenson (San Francisco).—Kindergarten Mathematics (series A)—Algebra, Part 1: M. H. Senior (Oldham, Bardsley).—Petroleum, its Development and Uses: R. N. Boyd (Whittaker).—Notes on the Geology of the Island of Cuba: R. T. Hill (Cambridge, Mass.).—Jahresbericht der K. B. Gesellschaft der Wissenschaften, 1894 (Prag).

SERIALS.—Proceedings of the Physical Society of London, May (Taylor).—Bulletin of the American Mathematical Society, April (New York, Macmillan).—Strand Magazine, May (Newnes).—Picture Magazine, May (Newnes).—American Journal of Science, May (New Haven).—Gazzetta Chimica Italiana, 1895, Vol. 1, Fasc. 4 (Roma).—Engineering Magazine, May (Tucker).—Journal of the Chemical Society, May (Gurney).—Morphologisches Jahrbuch, 22 Band, 3 Heft (Leipzig, Engelmann).—Himmel und Erde, May (Berlin, Paetel).—Science Progress, May (Scientific Press, Ltd.).—Astrophysical Journal, May (Chicago).—Psychological Review, May (Macmillan).—The Flowering Plants and Ferns of New South Wales: J. H. Maiden, Part 1 (Sydney).—Bulletin du Comité Internationale Permanent pour l'Exécution Photógraphique de la Carte du Ciel, Tome ii. Troisième Fasc. (Paris, Gauthier-Villars).—Reports on the Victorian Coal-Fields: J. Stirling, No. 3 (Melbourne, Brain).

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