THURSDAY, JANUARY 9, 1913.

SCIENCE AND TECHNOLOGY.

Treatise on General and Industrial Inorganic Chemistry. By Dr. Ettore Molinari. Third revised and amplified Italian edition. Translated by Dr. Ernest Feilmann. Pp. xvi + 704. (London: J. and A. Churchill, 1912.) Price 21*s*. net.

THIS treatise, which is a translation of the third and amplified Italian edition, is divided into three parts, devoted respectively to general, non-metallic, and metallic chemistry. So far as English readers are concerned, it is open to doubt whether the general part (pp. 1–125) represents, in any sense, an improvement on the treatment of the subject to be found in standard works on historical and physical chemistry. In some cases, the views of the author are not such as would meet with unqualified acceptance by all chemists, and in these cases the translator has added emendatory notes, many of which occur in this general section (*e.g.* pp. 25, 49, 50). In the paragraphs devoted to the history of chemistry the author discusses, in some detail, the development of chemical arts among the ancient civilisations of the world. He holds that the Chinese in particular were adepts in these matters, and had actually anticipated Priestley and Lavoisier in arriving at a knowledge of oxygen and the composition of water.

The space allotted, in this section of the book, to various historical topics is not, however, proportional to their chemical interest and importance. A long footnote, occupying two-thirds of a page, refers to certain particulars in the life of Lavoisier which are of dubious import in a scientific treatise. Biographical criticism leaves us with so few illusions that we might have been spared a reference to the accusation brought against Lavoisier that he amassed, in a few years, 48,000*l*. as a *fermier-général*. This and similar items might with advantage have been replaced by such genuinely chemical matters as Rey's work on the calcination of metals, and Graham's researches on the diffusion of gases. The former of these investigators is not mentioned in connection with the anti-phlogistic theory, and the latter's experiments are dismissed in half a sentence (p. 39). A statement regarding the liquefaction of helium (p. 29) is contradicted by the facts cited on p. 312.

The descriptive portions (Parts 2 and 3) contain those distinctive features of the work which justify its translation into English. Here the author has indicated the industrial processes involved in the preparation of the more common elements and compounds, and in those cases where the manufacture has assumed considerable proportions, full details are given in order to emphasise the commercial importance of the subject. The manufacture of ordinary and fuming sulphuric acid, the utilisation of atmospheric nitrogen, and the production of hydrogen on a large scale are examples of these topics. A new departure consists in giving the commercial price of each substance, as well as a complete summary of its industrial applications. Statistics are employed to compare the past and present importance of the commoner chemicals.

In the case of manufactures carried on to a considerable extent in Italy, such as the production of sulphur and calcium carbide, the author gives interesting details on the influence of local conditions on the development of the industry. The section devoted to metals includes full accounts of the industrially important compounds of the alkali metals, the production of superphosphate fertilisers, the modern smelting of copper, and the manufacture of Portland cement. Even the less common elements are briefly mentioned, and their industrial applications indicated. The micrography of iron and steel is described in some detail, and illustrated by two phototype plates.

There are a number of minor typographical errors scattered through the book (*e.g.* pp. 110, 112, 153, 192, 265, 287, 317), some of which are not devoid of unconscious humour. Rutherford's name is effectively Germanised to Rutherdorf by the simple expedient of transposing two letters. Sulphur is said to be used in the wine-growing industry against a cryptogram (*sic*) which attacks the young bunches of grapes.

G. T. M.

THE PRODUCTION OF CANE SUGAR.

The World's Cane Sugar Industry, Past and Present. By H. C. Prinsen Geerligs. Pp. xvi + 399 + maps. (Altrincham: Norman Rodger, 1912.) Price 12*s*. net.

ABOUT the middle of the nineteenth century nine-tenths of the world's sugar was obtained from the sugar cane. At the close of the century the proportion had fallen to about one-half, and the industry was considered by many to be dying out. Then there came a revival; the quantity began to increase, and has since grown continuously. The proportion, however, remains much about the same as before, for there has been a concurrent increase in the quantity of sugar produced from beetroot. In fact, an equilibrium appears now to have been reached, sugar cane and beetroot contributing each about one-half of the world's total sugar, though sometimes the one preponderates a little, sometimes the other.

The cause of the decline was, of course, the development of the beet sugar industry in Europe. The revival has been due to the coalescence of a number of factors, chief among which are the Brussels Convention abolishing the bounty system, the Japanese acquisition and development of Formosa, the tariff privileges granted by the United States to the former Spanish colonies, and, "last but not least," as Mr. Geerligs points out, "the great advance of science in the province of sugar cane cultivation and cane sugar manufacture."

This last factor is the one which would be of chief interest to readers of NATURE: it is not, however, dealt with, except incidentally, in the book before us. The author thinks the time ripe for a connected survey of the past, the present, and the probable future of the cane sugar industry in the various producing regions. He has therefore collected and discussed a large amount of historical, industrial, and statistical information respecting each of the countries concerned in the production. An idea of the scope and method of treatment will be gathered from the following summary of the topics dealt with in a typical section:—geography, climate, area planted with sugar cane, cultivation, manufacture, import and export duties, consumption, exportation, and future prospects.

Whilst the greater part of the book is of value chiefly to specialists, the first two chapters are of somewhat wider interest. They give a general survey of the history of the sugar industry, both cane and beet; in them Mr. Geerligs describes how various economical and political conditions have influenced the production of sugar, and he explains fully the working of the bounty system and of the sugar "cartels" on the European continent.

The author prophesies great progress in the near future for the Philippines, which, since the American occupation, have shown much improvement in methods of cultivation. Cuba has made similar progress, though here the difficulty of obtaining labour is against rapid development in the future. Porto Rico, and, given stable political conditions, Mexico, are also considered to be countries where the cane sugar industry should increase largely.

C. S.

MONOGRAPHS ON BIOCHEMISTRY.

(1) *Oxidations and Reductions in the Animal Body.* By Dr. H. D. Dakin. Pp. viii + 135. (London: Longmans, Green and Co., 1912.) Price 4s. net. (Monographs on Biochemistry.)

(2) *The Simple Carbohydrates and the Glucosides.* Second edition. By Dr. E. Frankland Armstrong. Pp. viii + 171. (London: Longmans, Green and Co., 1912.) Price 5s. net. (Monographs on Biochemistry.)

(1) THOSE who have followed Dr. Dakin's work will be interested to learn his general conclusions as to the course of oxidation and reduction in the animal body. His monograph is logically arranged into general principles, including the nature of oxidising and reducing agents and the methods of investigation, and a detailed consideration of the results obtained for the various classes of chemical substances.

There is a striking difference between the amount of positive knowledge concerning the oxidation of fatty acids and of carbohydrates. This difference may be due to the greater ease with which the products of oxidation can be isolated in the former group. For instance, the following conclusions amongst others are reached concerning the catabolism of fats: the oxidation of saturated fatty acids leads to the formation of α- and β-unsaturated acids either directly or, more probably, through the intermediate formation of β-hydroxy- and β-ketonic acids; unsaturated acids give rise to the same products as do the saturated acids; they may take up water and form saturated hydroxy-acids; they may undergo direct oxidation at the double linkage; but di-hydroxy-acids such as are formed by *in vitro* oxidation of unsaturated acids are not intermediate products of biochemical oxidations.

Contrast with these the one definite statement about the carbohydrates:—"Lactic acid must therefore be regarded as one of the most important substances concerned with the intermediate metabolism of the carbohydrates."

This lack of balance is characteristic of a developing line of work, and does not imply any lack of effort. On the contrary, it is remarkable that so much information has been accumulated in a comparatively short time.

The unravelling of the processes of oxidation requires great care and patience. The methods of investigation are liable to lead to mistakes, but the author uses the results with due caution. He points out that when a supposed intermediate product gives the same end products as does the original substance, the deduction is that this product *may* be a step in the transformation, but if it does not do so, the reaction is practically certain to proceed by some other path.

From the whole tone of the book, one is led to place great confidence in the conclusions reached by the author. The collection of so many data in such accessible form is a great boon to biological chemists.

(2) The first edition of Dr. Armstrong's monograph was reviewed in NATURE nearly three years ago (May 19, 1910). The second edition is larger, and the cost is greater.

This subject has such a large literature that there was some danger that the monograph might have been a condensation of some dull and monumental work. Fortunately, the author has avoided that entanglement, and has presented a comprehensive survey of his subject without making his book a chemical inventory. The chemistry of typical carbohydrates is described, and their relationship to other sugars is indicated. Excellent tables give the required data, so that the train of thought is not interrupted by unnecessary details. After reading the monograph, one can see a connection between α- and β-glucosides, their relation to enzymes, the cause of mutarotation, and many other interesting phenomena.

Both these monographs ought to be read by all physiologists and biological chemists, as they contain much information about their respective subjects, and in addition they are well written with a broad view as to the general problems involved.

H. E. R.

BOOKS ON FORESTRY AND ARBORICULTURE.

(1) *Illustriertes Handbuch der Laubholzkunde.* By Camillo Karl Schneider. Lieferung 6–12. Pp. v+1070. Price 34 marks. Register. Pp. vii+136. Price 5 marks. (Jena: Gustav Fischer.)

(2) *The Story of Our Trees in Twenty-Four Lessons.* By Margaret M. Gregson. Pp. xii+160. (Cambridge: University Press, 1912.) Price 2*s.* 6*d.* (Cambridge Nature Study Series.)

(3) *Forestry in New England.* A Handbook of Eastern Forest Management. By Prof. R. C. Hawley and Prof. A. F. Hawes. Pp. xv+479. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1912.) Price 15*s.* net.

(4) *Identification of the Economic Woods of the United States.* Including a Discussion of the Structural and Physical Properties of Wood. By Prof. Samuel J. Record. Pp. vii+117+6 plates. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1912.) Price 5*s.* 6*d.* net.

(5) *Lightning in Relation to Forest Fires.* By F. G. Plummer. Pp. 39. (U.S. Dept. Agric., Forest Service. Bulletin 111. Washington, 1912.)

(1) THE number of trees and shrubs in cultivation in the open air in this country is astonishing. Numerous new introductions have been made of late years, mainly from China, where the discoveries of Dr. A. Henry and Mr. E. H. Wilson have opened up an immense region, replete with new and hardy species. No complete treatise on the subject has appeared in English since Loudon published his classic work, "Arboretum et Fruticetum Britannicum," in 1838, and the abridgment, "Trees and Shrubs," in 1842. We have had to depend upon German text-books. The best of these, Koehne's "Deutsche Dendrologie," was published in 1893, and is now out of date.

We hail, then, with great pleasure the appearance of the concluding part of Schneider's great work, which deals with broad-leaved trees and shrubs, the conifers not being included. This is in two volumes, the first comprising 810 pages and 460 figures, the second 1070 pages and 628 figures, supplemented by a separate index of names, covering no fewer than 136 pages. The whole forms an indispensable text-book for all interested in arboriculture and horticulture. The descriptions are short, but accurate; the references are numerous and exact. Varieties and sports, which were omitted in Koehne's work, are briefly mentioned by Schneider.

As his regions of cultivation extend from the Baltic to Istria, most of the genera which are cultivated in England are taken up; but there are curious omissions. Eucalyptus is not referred to, yet no fewer than twelve species find a home in the west of England and Scotland, and in most parts of Ireland. The account of monocotyledonous trees and shrubs is very limited. While Yucca, Ruscus, Smilax, and Agave are included, no mention is made of palms like Trachycarpus, or of any of the bamboo tribe. A translation of Schneider's treatise into English would be a very useful book, which would, in all probability, command a ready sale.

(2) "The Story of Our Trees" is a book for school-teachers, apparently ignorant of botany, who wish to interest their pupils in the study of trees. There are twenty-four lessons, the best of which are those dealing with planting and felling. The author does not seem to be well acquainted with the special botany of trees, as she prefers often to take her illustrations from humbler plants. One would have selected the germination of the oak rather than that of the broad bean, which is

prescribed for study. The fruits figured include those of sweet pea, wallflower, pansy, and dandelion. There are curious errors. The "pine" cone figured on p. 11 is the cone of the common spruce. On p. 26, the casting of twigs, a peculiar process best seen in poplars (which are not mentioned in the vague account), is confused with the natural pruning of the branches of trees due to shade. The flowers of Eucalyptus and Cactus will not be available in many schools; and teachers are directed to purchase these in a shop somewhere in Yorkshire. There is no lack of material for the study of trees, even in large towns; and the lessons would be most valuable if all the material to be studied were gathered by the children themselves.

(3) "Forestry in New England" is an interesting book intended for the general reader. The first part is an account in simple language of the general principles of silviculture, with short chapters on cognate subjects, like forest fires, insect and fungoid pests, timber valuation and measurement, &c. The second part is more novel and valuable, being a description of the forests of New England at the present day. There are excellent chapters on their area, composition, modes of management, and financial returns. To the student of ecology, the account of the four forest regions, with their subordinate types, will be of great interest. The most important region, which includes the most elevated parts of the country, is dominated by the red spruce. The author mentions a remarkable fact, that wherever planting is resorted to, the European spruce (*Picea excelsa*) is a much superior tree to the native species (*Picea rubra*), as it grows much faster and yields better pulp-wood. The book contains much information that is new, and of great interest to both the botanist and the forester.

(4) Prof. Record's treatise is a most valuable contribution to our knowledge of the numerous kinds of wood which are of economic importance in the United States. The different species are admirably distinguished in the concluding part of the book. The first part presents, perhaps, in a clearer light than anything hitherto published in English the salient points in the study of the structural and physical properties of wood in general, each section being supplied with a well-chosen bibliography, which will be of great service to students. This book should be in the hands of foresters, architects, engineers and others who have to deal with the identification and uses of timber.

(5) In U.S. Forestry Bulletin No. 111, Mr. Plummer sums up an investigation that has been made in the United States on the liability of trees to be struck by lightning. Observations were taken during the past five years by nearly 3000 forest officers over a territory about 200,000,000 acres in area. Lightning is one of the chief causes of forest fires in America, being second only to sparks of locomotives as a source of conflagration. Lightning either ignites the tree itself, or probably more often sets fire to the humus at its base.

Mr. Plummer's conclusions are opposed to the current belief that some species of trees are more liable to lightning-stroke than others. According to Fischer's theory, oak and poplar, the wood of which contains much starch, are good conductors and attract lightning; while birch and beech, which have wood containing much oil, are bad conductors and escape. Mr. Plummer denies this, being of the opinion that "the greatest number of trees struck in any locality will be of the dominant species." He agrees, however, with previous writers that trees taller than others, those in an isolated position, and those with deep roots, are most in danger from lightning. Trees in general are most liable to be struck when their conductivity is increased, as is the case when their stems are wet with rain.

European statistics show that the species most often damaged by lightning on the Continent is the black Italian poplar (*Populus serotina*). The explanation is simple. This tree is extensively planted, always in more or less isolated positions, as along roads or in pastures, or on the sides of streams; moreover, it grows to a much greater height than the other species that are planted in similar situations. Mr. Plummer is in error in supposing this poplar, which is of hybrid origin, to be identical with the American *Populus monilifera*, which is usually a moderate-sized tree with a rounded crown, seldom struck by lightning in its native country.

OUR BOOKSHELF.

Primeval Man: The Stone Age in Western Europe. By A. Hingston Quiggin. With an introduction by Dr. A. C. Haddon, F.R.S. Pp. 140. (London: Macdonald and Evans, 1912.) Price 1*s*. 6*d*. net.

MRS. QUIGGIN has succeeded remarkably well in a praiseworthy attempt at striking the mean of anthropological opinion on primeval man, for the benefit of "the hard-working primary teacher or for upper forms." The value of that opinion on many points may be reasonably questioned, and the task of compiling a didactic work on the subject must have been a very difficult one. The author, however, cannot be held responsible for canvassed opinions. But who, in such a case, is responsible for the omission from such a book of most material evidence, as definitely scientific as any evidence summarised? There is very little in the book showing that any progress has been made in the interpretation of Neolithic monuments, the epithet "sepulchral" being applied to the archæological dead wall in that direction. The notion that the religion of the monument-builders is to be interpreted by existing savage life seems to be extremely fallacious, where evidence of a high culture is hypothetically reconciled with the lowest savagery (pp. 64, 65).

There is a body of other evidence of Neolithic culture which in this book is formally ignored, but just in the connection where one would expect a brief summary of that evidence, one finds the strongest expression, and by far the weakest argument, to be found in the book. "Popular belief generally attributes the megaliths to the Druids, but the connection is absolutely unsupported by evidence, and the idea is of recent (eighteenth century) origin" (footnote, p. 99). That there was no connection between the Druids and the megaliths is absolutely unsupported by evidence. The idea is certainly older than the eighteenth century, but it is to be admitted that the best evidence in point is as recent as the best on the classification of primeval skulls, in as bewildering an abundance as the latter is scarce, much less problematical, accessible to every archæologist, and so well appreciated when it can be understood that the blank, fruitless negations with which Mrs. Quiggin disposes of the subject materially assist, by demonstrating their own futility, in securing for the new evidence a fair examination.

JOHN GRIFFITH.

Katalog der paläarktischen Hemipteren (Heteroptera, Homoptera—Auchenorhyncha und Psylloideae). By B. Oshanin. Pp. xvi+187. (Berlin: Friendländer und Sohn.) Price 12 marks.

THIS useful list of Palæarctic Hemiptera and Homoptera is practically a fifth edition of Dr. Puton's "Catalogue des Hémiptères de la Faune Paléarctique," the fourth edition of which was published in 1899. The failing health and subsequent blindness of the French author prevented him from continuing the study of these insects, and M. Oshanin, therefore, has done good service by bringing the catalogue up to date. He takes a wider view of the Palæarctic region than Puton, including Wallace's Mandchurian subregion, that is, Japan and the greater part of China. Altogether, 5476 species are enumerated under fifty-five families and 1005 genera, and the classification adopted is that of O. M. Reuter. The year of publication of each of the genera and species, with the habitat, is given, as was done by Puton, and an alphabetical list of the species and varieties is to be found on pp. 131–177. The recently published "Verzeichnis der palaearktischen Hemipteren mit besonderer Berücksichtigung ihrer Verteilung im russischen Reiche," by the same author, gives a full reference to the works in which the species were described.

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 Influence of Icebergs on the Temperature of the Sea.

IN the early 'seventies of last century I took considerable interest in oceanic circulation. Dr. Carpenter had previously shown that when the warm water moves from the equator towards the poles it gradually cools and sinks near the poles, and he showed that when this current meets with icebergs they have a cooling effect and produce downward currents; this he illustrated by placing some ice at one end of a tank of sea water, when a downward current was produced under the ice, which flowed away along the bottom of the tank towards the other end, where it rose and flowed back along the surface towards the ice. In 1873 I pointed out that Dr. Carpenter's description of the two currents did not give a full statement of what was taking place; that his surface current was not at the surface, but only near it, and that above it was another formed of a mixture of sea water and the fresh water of the melted ice, which had a lower specific gravity, though colder, than the sea water. This cold water flowed away from the ice over the surface of the warmer water. That the ice-cooled sea water was lighter than the sea water was also shown by dividing the experimental tank into two parts by means of a movable vertical partition. The water in one half was cooled by means of ice in varying amounts, and on removing the partition the cold water always flowed over the hot.

These are all laboratory experiments, and though they help us to understand something of what is taking place while ice is melting in sea water, yet they are not likely to contain all the conditions existing in nature. For this reason the recent investigations of Prof. Barnes on the rise of temperature near icebergs, found by him by means of his microthermograph, are most interesting, though I must admit very puzzling. In his Royal Institution discourse (NATURE, June 20, 1912) he gives a diagram of the temperature gradient of the sea water when approaching an iceberg. In this case, when at a distance of a little more than two miles from the berg, the temperature was rising, and rose 0·6 of a degree C. by the time the observing vessel had approached to within a mile of the berg. From this point the temperature began to fall, and at half a mile from the berg it had fallen 2·3°. On passing beyond the berg the temperature began to rise, and at a distance of about six miles it had risen about 1·7°, after which it began to fall.

In the very interesting and full diagram, showing the temperatures all round an iceberg, given by Prof. Barnes in NATURE of December 12, 1912, the temperature is shown to be rising on all sides as the berg is approached. Beginning to rise at a distance from it of five miles, it goes on rising right up to the berg, rising from 4·2° to 5·2° C. If these two diagrams represent something typical, why this difference in the two cases? In the first a rise of temperature stopping within a mile on one side and six miles on the other, and then a steady fall in temperature on both sides up to within half a mile of the berg, which was as near as it was approached; and in the other case a steady rise all round right up to the berg. There does not seem to be much difference in the conditions in the two cases so far as they are given in the papers; and as for the sea temperatures, they are alike, in both cases a little more than 4° C.

The two cases seem to me to represent two totally different conditions to which we have no clue. The first condition is what we might, according to the old theory, expect a ship would experience when sailing past a berg with a stern wind—the berg surrounded by ice-cooled water on the surface, extending one mile to windward and six miles to leeward, the temperature falling quickly when approaching the berg, and again rising slowly as the distance increased. In the second case this cold surface current is entirely absent, there is no fall of temperature as the berg is approached, but rather a decided rise of temperature, and the observer found no diluted sea water close to the berg. Still, that does not explain the difference. If the fall in temperature in approaching the berg in the first case was caused by diluted sea water on the surface, why was there none in the second?

As to the explanation of the rise of temperature when nearing icebergs, found by Prof. Barnes, in his Royal Institution discourse he attributes it to the sun's action on the fresher water of the surface current. He thinks that as the water of this current tends to keep to the surface and get warmed by the sun, it will have less tendency to mix with the lower water than sun-heated sea water; but as sun-heated sea water also tends to keep to the surface, any advantage in that way of the fresher water will not be great, and in both cases the mixing will be determined principally by the waves. Prof. Barnes, however, in his letter in NATURE of December 12, departs from this theory of surface heating, after finding there was no evidence of any weak sea water near the iceberg, and he now attributes the high temperature near the ice to a surface current which he thinks flows towards the ice. This current he considers will prevent the vertical circulation which elsewhere tends to keep the surface of the sea cooler; but he does not mention how, in the absence of ice, this vertical circulation is produced.

The results of Prof. Barnes's investigations are extremely interesting, but they are so much at variance with each other, and with the results obtained by others with less delicate methods, that we cannot help hoping he will continue his work under different conditions of temperature, &c., so as to help us to understand more clearly what is taking place near icebergs. In investigations of this kind, more information is required as to the size of the berg observed, since its size will determine the area of disturbance, and the amount of the deviation of the temperature from that of the surrounding area. We also require to know something about the force of the wind and the waves, as they have much to do with the mixing of the hot and cold waters; and information is also required as to the drift of the berg in relation to the surface water. If bergs surround themselves with indraught and outflow currents, then these currents will tend to have definite boundaries, and rapid changes of temperature may take place in small differences of depth. Thermometers at different depths might therefore give valuable information. We also require records of sunshine, as well as information with regard to the temperature of the sea at the depth of the bottom of the iceberg.

After reading Prof. Barnes's last letter I made some further investigations as to what takes place while ice is melting in sea water. The experiments are all laboratory ones, and therefore somewhat inconclusive, since, as I have already said, we cannot reproduce all the conditions in nature. Further, I may mention that owing to the distance to the nearest sea I had to experiment with common household salt and water of the density of sea water, but this is not likely to produce any important difference in the results.

The temperature circulation in the sea is profoundly modified by the presence of the salts. In a lake of fresh water attaining its maximum density at a temperature of about 39° F. the downward currents produced by surface cooling stop at about that temperature, and further cooling of the water causes it to tend to keep at the surface. In the sea, however, this is not the case, as sea water does not attain its maximum density until it is cooled much below 39° F. If the salinity be small, then the temperature of maximum density may only be lowered some two or three degrees below that of fresh water. But if the salinity be that of ordinary sea water, then the temperature of maximum density is below the freezing point of fresh water. We see from this that whenever sea water is cooled by the presence of melting ice it is made denser and so caused to sink. It is this cooled sea water which causes Dr. Carpenter's downward current.

One cannot help wondering what was the nature of the oceanic circulation before the salts began to accumulate, and how this circulation was gradually modified and the temperature at the depths slowly lowered to what it is at the present day.

It seems strange that when ice is melting in sea water we should have Dr. Carpenter's downward current of cold water, while parallel with it all round the ice there should be a rising current of cold but weak sea water; and one of the questions which suggested itself was: Is there any intermingling of the oppositely flowing streams? Does the cooled weak sea water of the upward current mix with the cooled downward one. In other words, does any of the melted ice go to mix with and cool the downward current? To test this point some ice was prepared by freezing some water which had been previously well boiled to expel the air, so as to avoid any air bubbles in the ice which might aid the rising current. Before freezing there was added to the boiled water a little aniline blue. The product was a piece of transparent blue ice. This ice was moored in the sea water at about mid-depth, so that there was water both above and below it. As the ice melted a stream of blue water was seen rising from it and spreading itself over the surface of the water, but not a vestige of blue could be detected in the bottom water, showing that the downward current is cooled by radiation.

Another question that may be asked is: May not the downward current overpower the upward one? If the ice goes deep down in the water the descending current will gain volume and velocity as it descends; may it not, therefore, overcome and carry down the melted ice current? Of course, one cannot in a laboratory get a satisfactory answer to such a question. The best I could do was a miniature berg of about one foot deep. A rod of blue ice of that length was prepared. This was placed vertically in a tall jar of sea water and the currents noted, but no difference in the circulation could be seen. A current of blue water flowed up close to the rod, and a downward cold current flowed to the bottom, but no blue went to the bottom of the jar. The rod, instead of standing vertically, was next placed at a considerable angle; but even then all the blue went to the top, the cold blue water, though it no longer travelled along the rod, but left it and rose over the rod, fighting its way to the surface through the clear water.

In order to study what takes place in the neighbourhood of melting ice the following experiment was made. In a vessel of sea water was moored, at a small distance from the surface, a piece of clear ice (see Fig. 1). By means of a pipette the end of which was drawn out into a long capillary tube, a fine line was drawn through the water in aniline blue dissolved in some of the sea water. The tube being very fine, no disturbance was made by its passage through the water, and the coloured line remained quite distinct. A straight line was drawn horizontally a little above the top of the ice and its deformation by the currents was watched, and the results are shown in the figure. The end of the line over the ice quickly curved upwards towards the surface. At a short distance from the ice it slowly bent downwards, and the successive positions it assumed are shown in the figure. Next the ice the line kept only a small distance from it all the way down, the upward current flowing between it and the ice, while the downward current carried the line down to the bottom of the ice, where it curved under the ice and was carried to the bottom of the water.

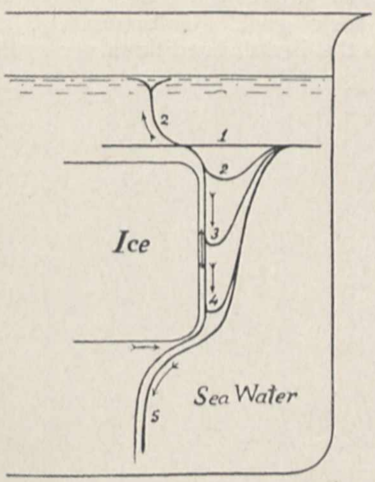

FIG. 1.—1, the coloured line drawn through the water; 2, 3, 4 and 5, position of the line at successive intervals of time produced by the currents.

There is still another question to which an answer is required. In these experiments all the water is at the same temperature, while in the sea this is not the case; the temperature there falls with the depth. And the question now is: How will this affect the circulation? Will the cold melted ice and sea water rise up through the warmer water? To get an answer to this question a tall jar about one foot deep was filled with sea water and surrounded for fully half its depth with ice and water. No salt was put in the cooling mixture lest the low temperature so produced should cause some of the sea water to freeze and so increase the density of the bottom water and interfere with the circulation. The water in the jar was cooled until the bottom temperature was 34° F., the surface temperature 41°, and the temperature at mid-depth 37·5°. A long rod of blue ice was now placed in the water. The rod extended from the bottom to the surface. The result was that all the blue as before came to the surface, showing that even the fall of temperature with depth in the sea does not seem likely to interfere with the rise of the ice-cooled water. This result might have been anticipated, because the ice-cooled water tends to rise at whatever temperature the melting takes places, and, having started to rise, it gradually acquires the temperature of the warmer water through which it rises.

All these tests tend to prove that the ice-cooled sea water will come to the surface, while Prof. Barnes's latest investigations on icebergs show that in certain cases it does not. I am sure the readers of NATURE will look forward with interest to any further observations Prof. Barnes may make with his very ingenious and delicate microthermograph, which may help to clear up the difference he has observed in the surface water surrounding different icebergs, and also the difference he has found in actual icebergs compared with laboratory experiments. Prof. Barnes, in your issue of December 12, gives a sketch to show the way in which he thinks an iceberg is eaten away by the sea water. The current is shown flowing on the surface towards the iceberg and eating it away quickest at the line of flotation. On looking at the sketch one cannot help asking, What has become of the light ice-cooled water? Should anyone be fortunate enough to see an iceberg tumble over on its side he may gain some information from an examination of its shape and from noting where the greatest amount of eating away had been done. But for his observations to be of value he would require to know something about the temperature of the sea at the bottom of the iceberg as well as at the surface; because, while ice melts quickest at the bottom, where the rising current first comes in contact with the ice, if the temperature is the same all the way down, yet we cannot expect this to happen if the temperature at the bottom of the berg is much lower than at the surface.

JOHN AITKEN.

Ardenlea, Falkirk, December 27, 1912.

AMUNDSEN'S ANTARCTIC EXPEDITION.[1]

MR. MURRAY has produced in a singularly attractive form a remarkably clear and readable translation by Mr. Chater of Captain Roald Amundsen's account of his expedition to the Antarctic regions in the *Fram*, which culminated in the attainment of the south pole, and settled the last of the old romantic problems of exploration. The main and avowed object of Amundsen's expedition was to reach the pole; everything else, including scientific observations, was merely incidental, so that at first sight it might appear that little notice need be taken in a scientific journal of the story of a big piece of record-breaking. In other places the ethics of record-breaking have been freely discussed in connection with this expedition, and the question has been raised whether it is decent and permissible for two explorers to try to reach the same point at the same time from different bases and by different means. The controversial aspects of Captain Amundsen's book do not concern us here, nor need we allow our national feelings to affect our opinion as to the manner in which the Norwegian expedition was designed, executed, and described.

The pursuance of the main aim of the expedition was a splendid example of efficiency in plan, equipment, transport, physical strength and skilled leadership. The plan was simplicity itself. It was to land and set up winter quarters on the Great Ice Barrier at 163° 30′ W. and 78° 30′ S., to form depots at intervals as far south as 82° before winter set in, and to store the farthest depot with sufficient food to carry a sledge-party from there to the pole and back and leave enough in reserve to secure their return to the base; then in the Antarctic spring to travel with light sledges and many dogs to the farthest depot, there to complete supplies and proceed due south to the pole, trust-

[1] "The South Pole." An Account of the Norwegian Antarctic Expedition in the *Fram*, 1910–1912. By Roald Amundsen. Translated from the Norwegian by A. G. Chater. Vol. i., pp. xxxv+392+plates+map. Vol. ii., pp. x+449+plates+maps. (London: John Murray, 1912.) Price, 2 vols. 2*l* 2*s*. net.

ing to find a way from the surface of the Barrier to the summit of the plateau on the meridian along which the route was directed, lightening loads by depositing sufficient supplies for the return journey to the next depot to the north at intervals of a degree of latitude.

Thanks to the careful choice of his companions, his dogs and his stores, Amundsen succeeded without a hitch. He took great risks, but the skill and preparedness of himself and his companions reduced these risks to a minimum. On the whole, the weather favoured him; but that was largely because he was able to distinguish the nearly invisible line between perseverance and stubbornness and to return to winter quarters after his first start on the great journey to the south when the severity of the weather began to tell on the dogs.

What distinguishes this expedition from all other polar sledging journeys is the fact that there was never a lack of provisions, not even of fresh meat, for no less than sixty tons of seal carcases had been prepared, and three tons of provisions carried to the depots at 80°, 81°, and 82°, the last being one-third of the way to the pole.

The incidents were only those familiar in Antarctic travel, the avoidance of crevasses on the Barrier, not only near the land, but in one or two places where the vast block of ice seems to have yielded locally to stresses of unknown origin, the negotiation of the Devil's Glacier, by which the ascent of the plateau was made through the mountain range about 160 miles south-east of the Beardmore Glacier, which served as Sir Ernest Shackleton's stairway, and the long journey across the lofty snow surface of the plateau until the immediate neighbourhood of the pole was reached. The telling of them reveals the point of view of the explorers, which differs somewhat from that often taken by persons of other nationalities, displaying an indifference to physical comfort and a resistance to fatigue that appear remarkable, while at the same time there is a general levity of spirits which, unless one reads between the lines, might mask the unshakable determination which drove the united party of five straight to their goal. Unfortunately, no precise data as to the health conditions are available, as the expedition did not include a medical man. As regards clothing, the system of woollen underclothing and wind-proof outer garments introduced by Captain Scott was used only for moderate temperatures. In extreme cold Captain Amundsen's party fell back on fur clothing. They introduced a new form of tent more quickly erected and more proof against the weather than that hitherto used, and of a particularly dark colour to reduce the glare of light which interferes with sleep in the unending sunshine of the polar day.

FIG. 1.—On Scott's Nunatak. From "The South Pole."

The scientific results, with the exception of those on oceanography, are of trivial importance, but they yield some scraps of new information and help to confirm the important facts discovered by Captain Scott, Sir Ernest Shackleton and others.

The results of the expedition, as regards geography, consist in the confirmation of Shackleton's discovery that the south pole was probably situated on a plateau more than 10,000 feet above sea-level; and of the extension of the great coast range of South Victoria Land with peaks of undiminished height in a south-easterly direction to latitude 88° S. at least.

It appears that this can no longer be regarded as merely a coast range, for Amundsen brings evidence to show that the Barrier, which represents the area believed to belong to the sea, terminates about 80° S., and there a spur of mountains runs off at right-angles to the main range in a north-easterly direction. There is no certain indication as to whether this range runs on to King Edward Land or not. The determination of the position of the pole on the uniform level surface of the plateau was accomplished by sextant observations with artificial horizons, the altitude of the sun being observed at hourly intervals by four separate observers for more than twenty-four hours. The readings are not given, but the result, as calculated by Mr. Anton Alexander, shows a latitude between 89° 57′ and 89° 59′ S.

Geological observations were confined to bringing home about fifty rock specimens from the mountains of South Victoria Land and from Scott's Nunatak on King Edward Land, which was visited for the first time by Lieutenant Prestrud in an interesting subsidiary expedition. The examinaton of the specimens shows that they consist only of granitic and schistose rocks.

The meteorological observations taken at the Bay of Whales at 78° 38′ S. do not cover a full year, but were taken three times daily from April 1, 1911, to January 29, 1912. The warmest month was December, with an approximate mean temperature of −6·6° C.; the coldest, August, with an approximate mean temperature of −44·5° C. The highest reading observed on the warmest day was just below freezing point. There was a marked predominance of easterly winds, this direction being most frequent with storms. It is almost incredible that there were no minimum thermometers on the expedition, and the maximum thermometers proved unworkable. Much snow was experienced at the base, but the stakes set out on the Barrier farthest south to mark the depots in autumn remained unconcealed after the winter's snowfall in the following spring, showing no appreciable accumulation of snow in eight months.

FIG. 2.—Hell's Gate on the Devil's Glacier. From "The South Pole." Reproduced by permission of *The Illustrated London News.*

The oceanographical observations are discussed by Prof. Helland Hansen and Dr. Nansen, who point out that the preliminary trip in the North Atlantic in 1910 furnished results of great value for comparison with those of the simultaneous voyage of the *Michael Sars* under the charge of Sir John Murray and Dr. Hjort.

During the wintering of the land party in 1911 the *Fram* made two complete oceanographical sections in the South Atlantic about 700 miles apart and comprising sixty stations between South America and Africa, furnishing material of the utmost value concerning the circulation of the ocean. This will certainly prove to be by far the most valuable result of the expedition, and will be of special importance in comparison with Dr. Bruce's fine work in the *Scotia*.

There is little reference to biological observations, the most interesting point noticed being the discovery of lichens on Scott's Nunatak on King Edward Land.

HUGH ROBERT MILL.

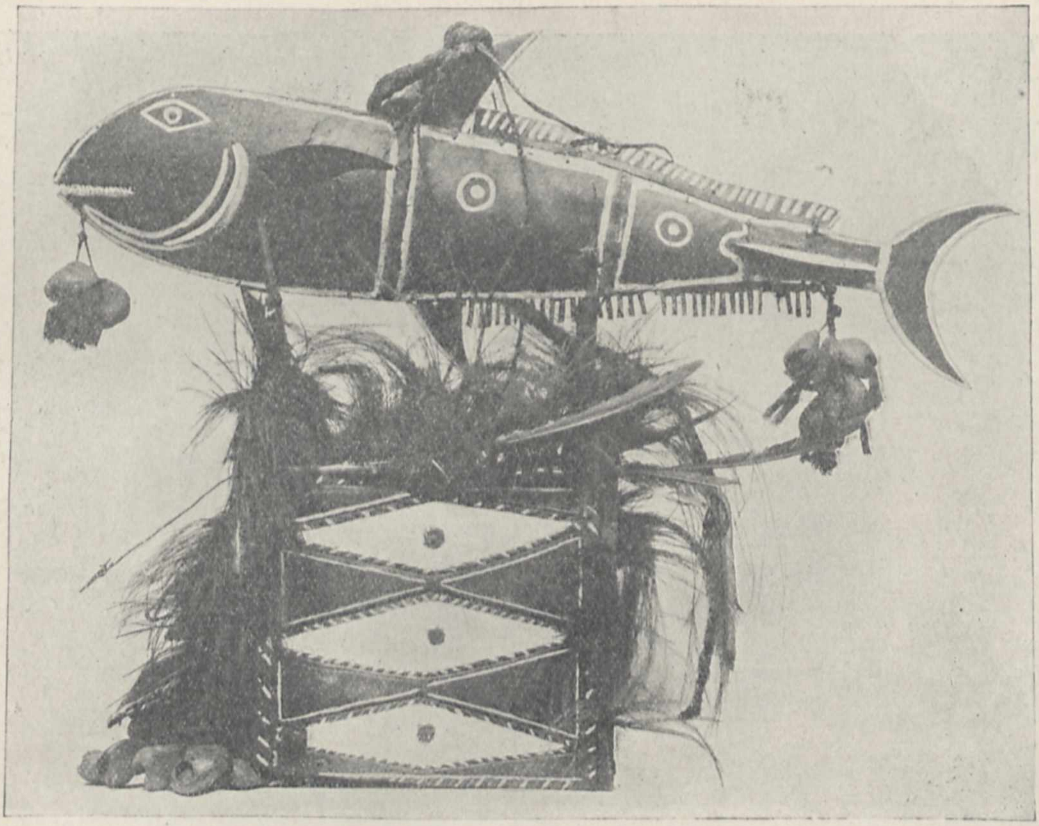

FIG. 1.—Box-mask with a bonito, made in Moa, obtained in Nagir. British Museum. The fish is 71 cm. (28 in.) long. From "Reports of the Cambridge Anthropological Expedition to Torres Straits." Vol. iv., Arts and Crafts.

ARTS AND CRAFTS IN THE TORRES STRAITS.[1]

THE fourth volume of the Reports of the Cambridge Anthropological Expedition to Torres Straits deals with the arts and crafts of the islanders, and the labour involved in its production is probably greater than that which went to the making of any other volume of this almost classical series. The writing up of technological data is laborious in the extreme, and, moreover, requires a special knowledge in many departments of human activity. Yet in spite of this the greater portion of the volume is the work of Dr. Haddon, the catholicity of whose anthropological knowledge appears to full advantage. He is responsible for the sections on daily life, decoration of the person, personal ornaments and clothing, domestic utensils and tools, food and its preparation, horticulture, hunting and fishing, weapons, transport and canoes, sound-producing instruments, songs, dances and dance-paraphernalia, games and toys, and the important chapter on art. He has also edited and completed the section on houses, which the untimely death of its author, the late Anthony Wilkin, had left unfinished. A very valuable chapter on textiles (baskets and mats) is contributed by Mrs Hingston Quiggin; Dr. Rivers deals with astronomy, Dr. Myers with music, and Mr. Ray with greetings and salutations and the calendar. Mr. J. Bruce contributes to the section on various social customs.

The book gives a practically complete picture of the economic and artistic life of a people who were hampered by several important restrictions; on the one side lack of water, ignorance of pottery and the carving of wooden vessels, on the other the want of efficient tools and the entire absence of metal. To deal with it at length is beyond the scope of a short notice, and it is possible only to direct attention to a few of the most interesting features.

Torres Straits has not been untouched by ex-

[1] "Reports of the Cambridge Anthropological Expedition to Torres Straits." Vol. iv., Arts and Crafts. Pp. xxiv + 393 + xl plates. (Cambridge: University Press, 1912.) Price 25s. net.

ternal influences, and, as might be expected, the neighbourhood of New Guinea has had great effect upon the ethnography. Australian influence, on the other hand, appears to have been very slight, though at least one of the tattoo designs characteristic of the islands has found its way to Cape York. More unexpected is the presence in Mer of a form of shell pendant representing the larva of the ant-lion, which appears to have been introduced by a native of the New Hebrides. The practice of moulding the heads of infants, in the desire to give them a shape so far as possible removed from that of the Australian, seems to hint at some racial antipathy, in spite of the fact that one of the heroic figures of Torres Straits mythology appears to have been a native of Cape York. The harpooning of dugong and the capture of turtle by means of the sucker-fish are treated in full, and are interesting since the methods are peculiar to these islands. In this connection one would venture to disagree with Dr. Haddon's use of the word "butt" to designate that end of the harpoon-shaft into which the point fits; surely this term can be applied only to the other end.

The native canoe is explained in painstaking detail, and this section would be even more valuable if a sketch-plan of a typical native craft had accompanied it. It might be suggested also that "baler," and not "bailer," is the proper term for the utensil with which canoes are baled. In dealing with the native art, Dr. Haddon is handling a subject of which he has made a particular study, and the result is excellent. Besides purely formal patterns, the figures of fish occur most often in native design, but the people of Torres Straits are noteworthy as having risen in one or two cases to the portrayal of scenery, an accomplishment extremely rare amongst primitive folk.

The subject of the degeneration of patterns receives full treatment and is very illuminating, but the section on the names and significance of patterns and designs is disappointingly short. This, however, is due to no fault of the author, but to lack of information. While speaking of degeneration, we may congratulate Dr. Haddon for his ingenuity in discovering that a peculiar ornament, now worn only at dances, is the survival of the spare bowstring carried on the arm by warriors in the bad old days. Of amusements, top-spinning holds first place, and was pursued with such devotion by the natives that, as cricket in Fiji, it had to be limited by legislation. Dr. Rivers's chapter is one of the most complete and extensive discussions of the astronomy of a primitive people which has appeared, and the indications which he gives of the existence of private property in constellations are particularly interesting.

FIG. 2.—Top-spinning, Mer. From "Reports of the Cambridge Anthropological Expedition to Torres Straits" Vol. iv., Arts and Crafts.

The entirely adequate treatment of such diverse material may be assumed from the unimportant nature of the criticisms made above. It should be added that the illustrations are furnished on the most generous scale, and consist of forty well-printed plates and nearly 400 line-drawings, of which those included in the chapter on textiles deserve a special word of praise. If anything is lacking at all it is perhaps in the binding, since in the particular copy under review the explanation of Pl. XVI. is duplicated, while that for Pl. X. is missing. To speak generally, all that need be said is that no one who sets out to deal with the art and technology of a primitive tribe can find a better model for the presentation of his results than the volume discussed above.

LÉON PHILIPPE TEISSERENC DE BORT.

THE announcement of the death of M. L. Teisserenc de Bort, which appeared in *The Times* of Monday, January 6, will be received with profound regret by meteorologists in all parts of the world, for he was conspicuous among the pioneers in the investigation of the upper air. The history of his connection with that investigation is one of the most encouraging episodes of modern physical science.

Born in Paris on November 5, 1855, the son of an engineer, with ample private means, he began his scientific career in 1880 at the Bureau Central Météorologique as *chef de service* of the department of general meteorology, under the directorship of Mascart. His interests were wide. He spent his vacations in 1883, 1885, and 1887 in the study of terrestrial magnetism and geology in Algeria and Tunis, including the Sahara. In later years his leisure hours were mostly devoted to painting in oils. He remained unmarried.

His contributions to general meteorology while still an official of the Bureau mark him out at once as belonging to the school that regards the treatment of the meteorology of the globe in its entirety as a condition for effective progress. His charts of the distribution of pressure at the level of 4000 metres are a real contribution to the practical study of the general circulation of the atmosphere. They were preceded by studies of the distribution of pressure, winds and clouds, which introduced the idea of "centres of action." They were followed, after he had left the Bureau, by the book on "La Météorologie dynamique—Histoire de nos Connaissances," written in conjunction with his older friend H. H. Hildebrandsson, now emeritus professor at Upsala, and by the proposals now represented by the Commission du Réseau Mondial for putting the study of daily weather upon a "world" basis by collecting daily telegrams from about thirty stations distributed over the whole globe.

In 1892 he was excused from further daily attendance at the Bureau Central, and became *météorologiste* to the Bureau, presumably unpaid, and free to work in his own way. In 1896 he founded an observatory for the study of dynamical meteorology at Trappes, on an open plain near Paris, not far beyond Versailles. The first object of the new observatory was to carry out measurements of clouds in connection with the scheme of the International Meteorological Committee for cloud observations in the years 1896–7. That purpose satisfied, Teisserenc de Bort went on to study the upper air by means of kites, in association with his friend Rotch, the founder of Blue Hill Observatory, whose untimely death occurred only last year. His chapter of accidents with stray kite-wires is known to some of his friends, but is not published.

The next stage was a paper in the *Comptes rendus* of June 15, 1908, containing an account of three ascents of sounding balloons, *ballons sondes*, according to the plan suggested by Hermite and Besançon, whereby records on self-recording instruments are obtained from heights up to nearly thirty kilometres in exceptional cases, far beyond the limits attainable by manned balloons. The three ascents of June 8, 1898, had become ninety records by August, 1899, and 1100 records by 1906; and by that time it had been clearly proved that our atmosphere is divided into two shells by a surface at a height of about ten kilometres, just above the level of the highest clouds. In the upper shell, which Teisserenc de Bort called the "stratosphere," there is practically no change of temperature in a vertical column; below that is the lower shell, the "troposphere," the region of vertical temperature gradient and convection. Teisserenc de Bort used balloons of varnished paper, which do not so easily reach great heights as the expanding india-rubber balloons introduced by Assmann; so that the honours of the identification of the stratosphere are divided, but the name is Teisserenc de Bort's.

This achievement secured, his energy and enterprise were indeed astonishing. He managed to get corresponding investigations carried out (probably at his own charges) over the Danish seas, in the high latitudes of Sweden, over the Zuyder Zee, the Mediterranean, and subsequently over the intertropical region of the Atlantic Ocean. For the last-mentioned investigation, in the most critical period of the war between Russia and Japan, he bought a Hull "fish-carrier" (after selling his large house in Paris). The vessel was transformed into the s.y. *Otaria,* which was equipped and manned with the assistance of his friend Rotch, and made two voyages to study the currents above the trade winds.

The thermal condition of the stratosphere being more or less settled, Teisserenc de Bort next set himself to determine its chemical composition by capturing samples for analysis from a height of twelve or fourteen kilometres, but as yet no striking results have been obtained.

Teisserenc de Bort was always a delightful companion, and frequently a charming host at international meetings of meteorologists. No one knew better that meteorology is a cooperative science, and no one was more ready to help his colleagues. From 1903 onwards he paid frequent visits to England or Scotland. In the course of one of these visits he formed the acquaintance of Prof. Chrystal, and was invited to give a lecture before the Royal Society of Edinburgh. In 1908 he came to London to receive the Symons medal of the Royal Meteorological Society, bringing with him the first samples of his raid upon the stratosphere. He was never robust, and always most careful, but increasing ill-health kept him away from the meeting of the Commission for Scientific Aëronautics at Vienna in 1912, and he was away from the Time Signal Conference at Paris in October for the same reason. A New Year's card received only last week spoke of exhaustion following enteritis, which has apparently brought to a close at the early age of fifty-seven a career still full of promise, but yet triumphant in its accomplishments. It is only recently that he was elected a member of the Academy of Sciences, for which meteorology has to count as physics, although meteorology is a cooperative science, and physics, as generally understood, is distinctly individualist. But what is of more importance is that, by his maintenance of the observatory at Trappes, Teisserenc de Bort enabled France to keep her place in the front rank of the scientific investigation of the upper air. The provision for the future will be looked for with anxious interest. W. N. SHAW.

NOTES.

SIR HENRY ROSCOE celebrated his eightieth birthday on Tuesday, January 7, at his country house, Woodcote Lodge, West Horsley. His former students and friends having decided to commemorate the occasion by the presentation of his bust to the Chemical Society of London as a tribute of appreciation of his long life and work, a representative deputation visited him on Tuesday to convey to him the congratulations of his former students and to acquaint him with their proposal for the commemoration of his birthday. The deputation consisted of Sir Edward Thorpe, C.B., F.R.S., who acted as chairman, Prof. Smithells, F.R.S., Prof. Bedson, Dr. Charles A. Keane, Dr. A. Harden, F.R.S., Prof. Crossley, F.R.S., Mr. E. J. Bevan, and Mr. Watson Smith. A congratulatory address was presented, in which reference was made to Sir Henry's continued and successful services to chemistry and to the large debt of thanks that was owed to him by his pupils, his science, and his country. It was pointed out that although it was twenty-seven years since he resigned the chair of chemistry at Owens College, his influence as their teacher and friend had continued, and that amongst his former pupils there were many who, thanks to the teaching they had received at his hands, had been enabled to contribute to the advancement of science, and in their turn, both in academic work and in industry, had been privileged to train a second generation of men, whose labours it was hoped would add further testimony to the value of his guidance and example.

THE Royal Geographical Society has convened, for January 15, in the Theatre, Burlington Gardens, at 4.30, a special general meeting with agenda of much interest and considerable moment. The question of the admission of women to the fellowship of the society is again to the fore. It was the subject of discussion, not unaccompanied by heat, in 1893, when the opponents of the proposal enforced their view, having a technical point of procedure to strengthen the foundation of their arguments. On the present occasion the supporters of the proposal who take part in the meeting will have the knowledge of the existence of a preponderant body of opinion among the fellows generally in favour of the resolution which will be brought forward :—"That the society approves of the election of women as fellows," for a postcard referendum has been taken, with a result which has been announced as follows :—"Yes," 1796; unsigned, 43; "No," 578; conditional, 33.

WE regret to see the announcement of the death, in his eighty-first year, of M. L. P. Cailletet, whose work with Pictet on the liquefaction of gases, in 1877 and 1878, is memorable in the history of physical science.

THE twenty-first anniversary of the Institution of Mining and Metallurgy will be celebrated by a conversazione to be held at the Savoy Hotel on Monday next, January 13.

PROF. J. E. DUERDEN, Rhodes University College, Grahamstown, South Africa, has been invited by the Government of British East Africa to visit the Protectorate to lecture and advise upon ostrich-farming.

THE Secretary of State for War has approved of the following appointments on the Army Medical Advisory Board :—As civilian physiologist, Dr. Leonard Hill, F.R.S., and as civilian sanitary expert, Dr. Henry S. Kenwood.

SIR SYDNEY OLIVIER, K.C.M.G., Governor of Jamaica, has been appointed to be permanent secretary of the Board of Agriculture and Fisheries.

THE tenth International Congress of Agriculture will be held at Ghent, Belgium, on June 8–13, concurrently with the International Exhibition. The work of the congress will be classified under the following five heads :—(1) Rural economy; (2) science of agriculture, special crops, and agricultural education; (3) cattle-breeding; (4) agricultural engineering; and (5) forestry. A strong British committee, under the chairmanship of Sir George Fordham, is being formed to secure adequate representation of this country at the congress. Further particulars may be obtained from the secretary to the British committee, Craven House, Northumberland Avenue, W.C.

ON Tuesday next, January 14, Prof. W. Bateson will begin a course of six lectures at the Royal Institution on the heredity of sex and cognate problems; on Thursday, January 16, Mr. Seton Gordon will deliver the first of two lectures on birds of the hill country; and on Saturday, January 18, Dr. H. Walford Davies will commence a course of three lectures, with musical illustrations, on aspects of harmony : (1) "Chord Progression"; (2) "Added Dissonance"; (3) "The New Whole Tone Chord and its Predecessors." The Friday evening discourse on January 17 will be delivered by Sir J. J. Thomson on further applications of the method of positive rays, and on January 24 by Prof. J. O. Arnold on recent advances in scientific steel metallurgy.

THE President of the Board of Education has appointed an advisory council for the Science Museum. The council will be asked to advise the Board on questions of principle and policy arising from time to time, and to make an annual report on its proceedings to the Board, together with any observations on the condition and needs of the museum which it may think fit to make. The following will be the first members of the council :—Sir Hugh Bell, Bart. (chairman), Mr. R. Elliott Cooper, C.E., Dr. J. J. Dobbie, F.R.S., Mr. W. Duddell, F.R.S., Mr. E. B. Ellington, Sir Maurice FitzMaurice, C.M.G., Sir Archibald Geikie, K.C.B., P.R.S., Dr. R. T. Glazebrook, C.B., F.R.S., Sir Alfred Keogh, K.C.B., the Right Hon. Sir William Mather, Sir John Murray, K.C.B., F.R.S., Sir William Ramsay, K.C.B., F.R.S., the Right Hon. Sir Henry E. Roscoe, F.R.S., Sir William H. White, K.C.B., F.R.S. The secretary will be Captain H. G. Lyons, F.R.S., of the Science Museum.

WE record with regret the death, on January 4, at the age of eighty-five years, of Mr. B. Leigh Smith, prominent for his work in Arctic exploration. From *The Times* we learn that in 1880 Mr. Smith succeeded in reaching Franz Josef Land on its southern coast west of the region visited and discovered several years before by an Austrian expedition. He went out again in 1881. After surveying the coast up to Cape Lofley, his ship was crushed in the ice near Cape Flora, and he and his crew had to pass the winter under very trying conditions. In the following summer they managed to reach Novaya Zemlya in their boats, and were rescued by Sir Allen Young, in the *Hope*, sent out by a relief committee organised in England for the purpose, which received the support of the Government. His expedition added materially to the knowledge of the Franz Josef Archipelago. Mr. Smith, when in the *Diana*, rescued Nordenskjold's party, which had been frozen up in Spitsbergen. Mr. Smith continued to the end to take a keen interest in polar exploration. He was a fellow of the Royal Geographical Society, as well as of the Zoological and other societies.

ANOTHER polar explorer whose death we have to record is Captain F. H. Johansen, the companion of Dr. Nansen in his famous sledge journey across the north polar ice from the drifting *Fram*, and a member of the Amundsen Antarctic expedition. From an obituary notice in yesterday's *Times* we learn that Johansen was born at Skien, in Norway, in 1867, and matriculated at the university in 1886. In 1891–2 he went to the Military School, and became a supernumerary officer. He was so eager to take part in Nansen's expedition that, as no other post could be found for him, he accepted that of stoker. When the *Fram* drifted in the ice during 1893–4–5 to about 84° N., and Nansen decided to trust himself to a sledge and push his away over the moving ice as far north as possible, Johansen was selected to accompany his chief. After the return of the expedition to Norway, Johansen obtained Government employment. When the *Fram* was again fitted out to drift once more in the Arctic ice across the pole if possible, Johansen joined Captain Amundsen, and afterwards consented to accompany the ship to the south when Amundsen announced his change of purpose.

DR. R. M. FERGUSON, whose recent death at the age of eighty-three has deprived Edinburgh of one of her best-known citizens and educationists, was a skilled chemist and physicist. As a young man he had studied for several years in Germany under Bunsen and others, and although in later life much engrossed by his duties as headmaster in the Edinburgh Institution, he found time to work at his favourite subject of electricity. He published several papers on the telephone and on the action and theory of the induction coil in the Proceedings of the Royal Society of Edinburgh, and in the Transactions of the Royal Scottish Society of Arts, at the meetings of which he frequently exhibited experiments of an educational character. In 1867 he contributed an excellent book on electricity to "Chambers's Educational Series," and was also the author of the articles, "Electricity," "Galvanism," "Magnetism," &c., in the first edition of "Chambers's Encyclopædia." While preparing some scientific experiments for his classes in 1898 he met with a very serious accident, which left him lamed for life. He served for three terms of office on the Council of the Royal Society of Edinburgh, and was its representative on the Heriot Trust until about a year ago, when increasing frailty compelled him to resign. He was active in promoting the interests of the Edinburgh Mathematical Society, which, after the first few years of its existence, held (and still holds) its meetings in his school.

WE regret to see the announcement of the death of the veteran American astronomer, Mr. Lewis Swift, at the age of eighty-two. His enthusiasm for astronomy manifested itself at an early age; after working at business during the day he devoted his nights to studying the stars with the help of a small cheap telescope, a star atlas, and a single book, constructing his own primitive observatories at Marathon, N.Y., and afterwards at Rochester, in the same State. His first reward was the discovery of the comet of 1862 II., the elements of which are almost indentical with those of the August meteor shower. A little later he was provided with a 16-in. telescope by public subscription, and Mr. H. H. Warner built him an observatory. While at the Warner Observatory he discovered several comets and 900 nebulæ. Mr. Warner's failure compelled Swift to leave the observatory, and in 1894 he removed to a new one just erected on Echo Mountain, California, by Prof. Lowe. All the instruments were taken to the Lowe Observatory, where Swift, now assisted by his son, continued his work of discovering comets and nebulæ. He was compelled to leave the Lowe Observatory in 1901, and, his eyesight beginning to fail, was able to do little more astronomical work. He died at Marathon, New York, the scene of so many of his early struggles. Swift received three medals from the Vienna Academy, and several comet medals from the Astronomical Society of the Pacific. In 1881 the Paris Academy of Sciences awarded him the Lalande prize for his many discoveries, and in 1897 he was the first recipient of the Jackson Gwilt medal and gift from the Royal Astronomical Society, of which he had been a fellow since 1879.

AT the Northern Photographic Exhibition, which was opened in the Manchester City Art Gallery on January 3, a considerable amount of space has been devoted to a scientific section. The photographs in this section are divided into seven groups:—(1) Natural history; (2) radiograms; (3) photomicrographs; (4) geology, meteorology, and astronomy; (5) physics and chemistry; (6) photomechanical processes; (7) transparencies, in monochrome and colour. The natural history group includes birds, mammals, and insects of various kinds. An honourable mention is awarded to Mr. Alfred Taylor for a series of sixteen prints showing the life-history of the cuckoo from the egg to the age of migration (Nos. 17 and 18). Miss Frances Pitt shows six delightful animal studies —fox cubs, badgers, a rat, a cat, a hedgehog, and a spider. The radiograms of Drs. Bythell and Barclay and Dr. C. Thurston Holland are very striking and remarkably clear. Both are "honourably mentioned." The plaque is awarded to Dr. D. Hutchinson for two large frames showing twenty-eight stages in the development of the ovum of the Axolotl. An important contribution is that of Mr. W. F. A. Ermen, "The Rendering of Coloured Objects in Monochrome." He photographs clouds, flowers, a lady, &c., on an ordinary plate, and a Wratten panchromatic plate, with and without light filters. Dr. H. H. Hoffert has four sets of prints showing the effect produced when a heavy single discharge from a Leyden jar is allowed to pass over the surface of a photographic dry plate. This and the previous exhibit have both been awarded honourable mention. Messrs. G. R. Makin and J. W. Watkinson show autochrome photomicrographs of the various colour plate screens now on the market, and how the autochrome plate translates patches of single colours.

WE have received the annual report of Livingstone College for the year 1911–12, which shows that there is a deficiency on the ordinary funds of 700*l*. at the end of the financial year. The college is doing excellent work in training missionaries in the elements of medicine, and an earnest appeal is made for funds to further this object.

The South African Journal of Science for November (vol ix., No. 4, 1912) contains a summary by Mr. John Muller on the practical medico-legal use in South Africa of the "precipitin" test for the recognition of bloodstains and of what animal's blood they consist. In a number of criminal cases the test has proved of the greatest value.

IN *The Quarterly Journal of Experimental Physiology* (vol v., No. 4), Mr. A. J. Clark describes experiments on the destruction of alkaloids by the body tissues. He finds that the livers of the frog and rabbit possess the power of destroying atropine, and that this power persists when all living cells are destroyed, and is due to a soluble substance resembling a ferment in its action. In the frog the heart and kidneys, and in the rabbit the blood, have a similar but less marked power, but no other tissues have any such power. In the cat, rat, and dog none of the tissues has any such power.

THE Selborne Society is to be congratulated on a marked increase in its membership during the past year. According to an editorial note in *The Selborne Magazine* for January, it has been decided to divide the society into sections, an arrangement which it is expected will increase the output of special work.

To the wet summer of 1912 is attributed a falling off in the number of persons attending the excursions of the Clifton College Scientific Society, the report of which for 1911–12 is to hand. This, however, forms no sufficient excuse for the small competition for the Joshua Saunders prize, which was awarded for an essay on the local distribution of newts.

IN the Report of the Indian Museum, Calcutta, for 1911–12, reference is made to the opening of the art galleries during the visit of their Majesties the King and Queen, and also to the temporary housing of the Victoria Memorial Exhibition within the building. A considerable falling off in the number of visitors during the year under review is tentatively attributed to the closing of the museum on several occasions.

VOL. viii., part 31, of *Spolia Zeylanica* is devoted to the first part of "A Guide to the Collections of the Colombo Museum," this section dealing with archæology and ethnology. It is illustrated with forty-four well-executed plates of objects of special interest. Among these attention may be directed to sculptures (plate i.) and designs on flags (plate xx.), which appear undoubtedly to represent lions, some of the former dating from about 320 B.C. (p. 167). As most if not all of the other animals represented in native Sinhalese art are indigenous to the island, the question naturally arises as to the source of the concept of the lion. In former times lions were found over central and north-western India, but there appears to be no record of their occurrence further to the south on the mainland, let alone in Ceylon. No allusion to this interesting point is made by Dr. J. Pearson, the author of the guide.

THE current number of *The Quarterly Journal of Microscopical Science* contains no fewer than three papers on the experimental hybridisation of Echinoderms, by Prof. Macbride, Dr. G. Debaisieux, and Dr. Cresswell Shearer, Mr. W. de Morgan and Mr. H. M. Fuchs. Many memoirs have appeared on this subject during the past few years, and perhaps the most remarkable thing about them is the startling want of harmony between the results obtained by different observers, and even by the same observer at different times. It is evident that as yet we know very little of the factors which determine in what proportion maternal and paternal characters will be transmitted to the hybrid offspring. Careful and accurate observations, such as those recorded by the workers above mentioned, can scarcely fail, however, in the long run, to throw much light upon this extremely difficult problem.

A TIMELY paper on foot-and-mouth disease has been published by Prof. Bang, of Copenhagen, in the Journal of the Board of Agriculture (No. 8). This disease affects ruminants and pigs, and occasionally also man; it is characterised by the formation of vesicles in the mouth and occasionally on the lips, snout, and nostrils, and on the skin round the hoofs. These are very painful, so that the animal is unwilling either to walk or to eat. Whatever the causative agent, it is very minute, it exists in the matter contained in the vesicles, and it passes through the pores of a filter; a very small amount, even 1/5000 c.c. of the contents of a vesicle, is sufficient to cause the disease. To young animals the disease is generally fatal, but adult animals often recover; the loss, however, is so serious that even the most drastic action is justified in coping with it. Prof. Bang looks forward with some uncertainty to the immediate future, but thinks that the situation is tolerably well in hand.

THE composition of buffalo milk in India has been investigated by Messrs. Meggitt and Mann, and the results are published in No. 4 of the Chemical Memoirs of the Pusa Research Institute. The percentage of fat is remarkably high, being 8 per cent. in place of the 3 per cent. found in cow's milk; the percentage of total solids is also high, rising to 18 or even 20 per cent., an amount higher than is found in some of our fruits and vegetables. The effect of changes of conditions on the composition of the milk could not be fully investigated, but so far as the work went it indicated that they are of the same character as in the case of cows.

AN interesting instance of the effect of caponising an ostrich is described by Mr. Fitzsimons, director of the Port Elizabeth Museum, in the Agricultural Journal of the Union of South Africa (No. 3, 1912). The ovaries were removed from three hen ostriches four years of age. Shortly afterwards the birds began to lose their characteristic female appearance and to take on the external characters of the male; the body feathers no longer remained drab-coloured, but assumed the glossy jet-black colour of the cock bird, while the wing and tail feathers were so completely transformed in every detail that feather experts to whom they were shown declared them to be typical cock feathers. One of the birds was killed, and is mounted in the Port Elizabeth Museum.

"THOUGHT as the mainspring of development" forms the subject of a powerful article by Prof. C. J. Patten, of Sheffield, translated into German by Dr. W. Breitenbach, and published in the *Neue Weltanschauung* (vol. iv.).

IN the Transactions of the American Mathematical Society (xiii., 4), Mr. Wm. H. Roever discusses the southerly and easterly deviations of falling bodies for an unsymmetrical field of gravitational force, this problem referring to cases where, owing to the attraction exerted by mountain ranges, the ordinary formula becomes inapplicable.

UNDER the title, "Rising Prices and the Public," Prof. John Bauer, writing in *The Popular Science Monthly* for December, 1912, discusses an economical problem which has recently assumed practical importance. His general conclusions are to the effect that the evils which result are not due to high prices so much as to increases in prices which affect incomes of some classes more rapidly than others. The social effects are to foster speculation at the expense of industry by penalising the cautious investor whose "safe" income has depreciated in value; further high prices lead to increased extravagance and luxury. He considers that for the public at large everything should be done to prevent considerable changes, either upward or downward, in the price level.

A PLEA for the more general cultivation of "nature-study" is contained in an article in *Symons's Meteorological Magazine* for December on phenological observations, by Mr. R. H. Hooker. The records collected under the auspices of the Royal Meteorological Society are of a simple character, and "aim more directly at a knowledge of the effect of the weather upon the commonest plants, birds, and insects, and at obtaining some measure of the lateness or earliness of the season." For many years such observations were collected and analysed by the Rev. T. A. Preston, of Marlborough, and more recently, in a reduced form, by Mr. E. Mawley, of Berkhamsted. The Royal Meteorological Society undertakes to send forms and instructions to anyone willing to assist in the work. At present only parts of the south of England can be said to be fairly represented; observations in Scotland, the north of England, and in Ireland are very scanty. As one instance of the practical utility of similar observations, reference is made to the recent investigation by Dr. Unstead, who, from the dates of sowing and harvesting wheat, in combination with data as to temperature, was able to indicate, *inter alia*, the regions in Canada where any attempt at wheat-growing would be foredoomed to failure.

THE recent disastrous storms and high seas in the English Channel and the North Atlantic, together with the serious damage to the P. and O. liner *Narrung* and other large vessels, have directed attention to the heights of waves. The chief officer of the above vessel estimated that the wave that caused the principal damage was 70 ft. high. Admiral FitzRoy ("Weather Book," 1863, p. 388) quotes a case experienced by himself near the Bay of Biscay in which the waves were not less than 60 ft. high. He says: "I never saw such seas before, and have never seen any equal to them since, either off Cape Horn or the Cape of Good Hope, during two circumnavigations, and many years of foreign service." This case is referred to in an article on ocean waves in the Meteorological Office Chart of the Indian Ocean for January, 1913, and several other trustworthy reports of extraordinary waves are quoted. Among these we may mention (1) one by Captain David, R.D., R.M.S. *Corinthic*, about 45° S., 102° E., estimated to be 50 ft.; (2) Captain Kiddle, ss. *Celtic*, determined a height of 70 ft. for several waves in mid-Atlantic from good measurements. The late Admiral Sir W. J. L. Wharton (formerly hydrographer to the Navy) expressed the opinion that seas of 40 to 90 ft. in height may be experienced, albeit the most probable maximum is 50 or 60 ft.

THE November number of *Le Radium* contains a memoir by M. A. Zaroubine on the ionisation currents produced in a solid dielectric by the gamma rays from radium. A sheet, two millimetres thick, of the hard paraffin known as ozokerite was placed between aluminium electrodes to which differences of potential up to 2200 volts could be applied. The gamma rays entered the dielectric through one of the electrodes, and the currents produced were measured by means of a Dolezalek electrometer. Up to 2000 volts they follow Ohm's law. If the dielectric is first ionised, the radium removed, and the electric field then applied, the current falls off with time according to a hyperbolic law. The law of superposition of effects due to several causes does not apply to the ionisation currents. Under the action of the radiation the dielectric develops an electromotive force which is capable of producing a current analogous to that of polarisation.

HALF the December 22 number of the *Naturwissenschaftliche Wochenschrift* is devoted to an article by Prof. Valentiner on new facts in physics. More than a dozen important advances are described in clear and simple language, which would be readily understood by those whose work lay outside the particular fields selected for description. Most of the advances which receive notice have been mentioned in these notes, but there are two which have not, and which deserve attention. Messrs. Reboul and De Bollement have found that copper and silver at 500° C. eject particles in a vacuum in oxygen, air, and carbonic acid, which form deposits on the walls of the containing vessel. In hydrogen no deposit occurs. Prof. Wiener has directed attention to the possibility of protecting balloons from lightning by replacing the cord netting now in use by netting containing wire, so that the balloon is virtually in a wire Faraday cage. He has also suggested the insertion in the gas valves of the Davy lamp arrangement of fine copper wire netting so as to protect the gas inside the balloon from the effects of electric sparks outside.

AN interesting contribution to the study of the stereoisomerism of the oximes is contained in a paper by Mr. F. Carlo Palazzo on trichloroacetaldoxime (*Atti R. Accad. Lincei*, vol. xxi., ii., 530). Hitherto only one oxime, melting at 39–40°, has been obtainable from chloral, but it is now shown that this substance probably consists of a mixture of two stereoisomerides, as with water it gives what is apparently a mixture of the corresponding stereoisomeric oximino-acetic acids, one of which is readily decomposed further by alkalies, giving hydrogen cyanide, whilst the other forms a stable alkali salt. These changes are easily interpreted by writing them as follows :—

$$\text{I.}\quad \begin{array}{c} H.C.CCl_3 \\ \| \\ OH.N \end{array} \longrightarrow \begin{array}{c} H.C.CO.OH \\ \| \\ OH.N \end{array} \longrightarrow H_2O + CO_2 + H_2O$$

$$\text{II.}\quad \begin{array}{c} H.C.CCl_3 \\ \| \\ N.OH \end{array} \longrightarrow \begin{array}{c} H.C.CO.OH \\ \| \\ N.OH \end{array} \longrightarrow \text{stable salt.}$$

The view that the trichloroaldoxime, melting at 39°, is really a mixture is confirmed by the fact that it can be obtained with a considerably higher melting point, viz. 56°, when carefully freed from its syrupy congener, although it is still doubtful whether this material represents a definite individual.

The Engineer for January 3 says that there is no hesitation and temporising about the report which Sir Francis Fox has presented to the Dean and Chapter of St. Paul's Cathedral. Sir Francis states that the cathedral is overloaded, and is actually moving and cracking; the eight great piers supporting the dome have moved, and have sunk from 4 to 6 in. It is to be hoped that this report will settle once and for all questions affecting the injury that is to be anticipated from subterranean work in the neighbourhood of the cathedral. *The Builder* of the same date, commenting on this subject, says that, in view of the report, the abandonment of the London County Council proposal to construct a tram subway in the immediate vicinity of the fabric is practically assured; in face of such a report it would be folly to proceed.

AN interesting article in *Engineering* for January 3 on the Daimler motor-omnibus gives some account of the process of elimination whereby the present highly efficient motor-omnibus has been produced. In this process of natural selection, the police authorities gave very great assistance by avoiding the institution of any initial standard of perfection, and gradually increasing their requirements as experience was gained. The forward drives on the present omnibus are either direct or through chains, spur-gearing being used solely for the reverse. This plan is in consequence of the pressure of the London police authorities, who insisted that the omnibus should run as silently on low gear as on high. Helical wheels were tried, but failed to satisfy the demands of the authorities. In desperation almost, chain drives were installed, though the makers of the chains declared that they did not think that they would last a week, since not only was the pressure transmitted high, but the chain speed exceeded 2000 ft. per minute. As the event has proved, however, these prognostications were falsified, the chains giving a very satisfactory service. The chain pinions are of high-carbon steel, unhardened; the spur-gears used for the reverse are of nickel-chrome steel, case-hardened.

OUR ASTRONOMICAL COLUMN.

THE ATTRACTION OF SUN-SPOTS FOR PROMINENCES.—In an illustrated article appearing in No. 4, vol. xxxvi., of *The Astrophysical Journal*, Dr. Slocum shows that in some cases sun-spots apparently have a very strong attraction for prominences. He deals especially with a large group of spots which first crossed the solar disc between August 2 and 15, 1910, and received the Greenwich number 6874; at the next apparition it was numbered 6880, and, reappearing on September 27, as an extended group, its parts were numbered 6894 and 6893.

At each apparition active prominences and large flocculic areas were observed in the immediate neighbourhood of the spot, the best prominence displays occurring at the west limb on October 8, and at the east limb on October 22. Photographs, in calcium light, taken on the former date, show that the prominences were pouring down from both sides right into the large spot. So many jets are visible that there can apparently be no doubt as to their common direction; moreover, the measures of successive photographs indicate accelerated velocities for the matter forming these jets. Three bright knots, shown on photographs taken at 4h. 26·6m. and 4h. 34·9m., respectively, show velocities along the apparent trajectories of 16, 20, and 60 km. per second at distances of 170,000, 130,000, and 75,000 km. from the centre of attraction; other points recognised on two photographs give velocities ranging from 15 to 90 km. per second. In addition to the general feature of attraction there is also evidence of repulsion, but the jets showing this are very short-lived.

The distances over which the attractive force of the spot appeared to exert its influence are remarkable. The prominences covered 45° of the solar limb, and prominences 260,000 km. (162,500 miles) from the spot were evidently drawn towards it.

Both Hale and Evershed have previously found evidence for this spot attraction, but Dr. Slocum's observation differs from theirs inasmuch as he finds accelerated velocities for the prominence matter, whereas their observations indicated diminishing velocities.

THE NEXT RETURN OF ENCKE'S COMET.—In a communication to M. Flammarion, Mr. F. E. Seagrave gives the results of his calculations concerning the return of Encke's comet in 1914. From the elements, corrected for the Jovian perturbations, it is seen that perihelion passage should take place on December 5·89, 1914, while the ephemeris shows that the comet should be circumpolar and near to the earth about October 27, 1914; on this date its distance from us will be about 42 million kilometres (26·2 million miles), and the comet should be of about the fourth magnitude. The period found by Mr. Seagrave is 1204·8001 days. (*L'Astronomie*, December.)

THE MAGNITUDE AND COLOUR OF BROOKS'S COMET, 1911*c*.—In a note appearing in No. 4619 of the *Astronomische Nachrichten*, Herr Max Valier gives the magnitudes, diameters, and colours of Brooks's comet (1911*c*), as observed by him during the period September 7 to November 4, 1911. Both magnitudes and colours were regularly progressive until October 21, the former going from 5·0 to 1·8, the latter from bluish, through blue, greenish, greenish-yellow, yellowish-red, to white; the order was then reversed in both cases.

JOHN GOODRICKE.—A portrait of John Goodricke, the astronomer who discovered the periodicity of Algol in 1783, and suggested the accepted explanation of the star's variability, has recently been presented to the Royal Astronomical Society by Mr. C. A. Goodricke, of Hampstead. It is not generally known that John Goodricke was deaf and dumb from birth, yet, although he died in 1786, at the early age of twenty-two, his scientific attainments had earned for him the fellowship of the Royal Society and the award of the Copley medal; his astronomical work was done at York. An interesting letter, giving the chief facts concerning Goodricke's life, appears in No. 1, vol. lxxiii., of *The Monthly Notices*.

"THE COMPANION TO THE OBSERVATORY."—This useful annual, for 1913, contains practically the same matter as last year, with the various tables revised. Messrs. Denning and Lewis have revised the "Meteor Showers" and "Double Stars" sections respectively, and a welcome addition is a list of the principal star clusters and nebulæ. It is interesting to note, from the page dealing with the universal time system, that every State of any importance, except Russia, now uses a standard time directly depending upon the Greenwich meridian; Russian time depends upon the Pulkowa meridian, and is 2h. 1m. fast on Greenwich. We remark that the editorship of *The Observatory* has changed hands, the new editors being Mr. F. J. M. Stratton, of Cambridge, and Mr. A. S. Eddington and Dr. S. Chapman, of Greenwich, in place of Messrs. T. Lewis and H. P. Hollis. The "Companion" is published by Taylor and Francis at 1*s*. 6*d*., and should be in the hands of every astronomical observer.

DEVELOPMENTS OF NATIONAL EDUCATION.

THE papers read at the North of England Education Conference, at Nottingham, on January 2, 3, and 4, give evidence of a growing realisation of the principal weaknesses of English public education. One of the most remarkable and significant developments in national education, and one to which considerable prominence was given in papers read by the Rev. W. Temple, headmaster of Repton School, and Mr. P. E. Matheson, New College, Oxford, respectively, is the valuable work of university level being done by the Workers' Educational Association. Mr. Temple stated that there are now more than 100 university tutorial classes in different parts of the country, with nearly 3000 students, which have been organised and provided by this association. These classes are limited to thirty students, who undertake to attend throughout a three-years' course. The class meets once a week for twenty-four weeks during the winter session. Each student writes an essay once a fortnight. The essays are pronounced by distinguished scholars to be equal in value to the work done in Oxford by men who take a first class in the honours history school. Mr. Temple concludes from the experience of the association, that "not only is a vast amount of intellectual capacity going to waste in England at this moment for lack of opportunity," but "that men who have only had an elementary education and no secondary can none the less do work of a university type at the proper age. Of course, they have not the *knowledge* . . . but apparently their intellectual capacity has gone on growing."

The advantages of practical and manual work of various types in elementary schools were frequently insisted upon. Mr. Bird, superintendent of handicraft, Leicester Education Committee, criticised effectively the defects of the present methods of manual training in schools, in which so much stress is laid upon mere copying of models, and so little attention given to developing the ingenuity and originality of the boys. A suggestive criticism was made by Mrs. Ogilvie Gordon in a paper on "trade schools" upon the much-quoted Continuation Trade Schools of Munich. She stated that "a weak point in the Munich system, and in most of the Continental systems, is that there is no easy bridge by which the public elementary and trade continuation class scholar can pass into the higher ranks of his vocation and complete his studies in the polytechnic or university. The avenue to these higher courses is solely through the gymnasial high schools."

Sir William Mather, in a weighty and important paper on the cooperation of employers and education authorities, complained "of the want of aptitude and intelligence, application and interest, displayed by a considerable majority of the boys and girls coming to work direct from the elementary schools." From his experience as an employer who had for some years made attendance at evening continuation schools compulsory upon his junior employees, he strongly urged a similar course of action upon all employers of labour. In a paper upon the educational responsibilities of the employer, Councillor George Cadbury, jun., described the remarkably complete scheme of continued education (mental and physical) in operation at the Bournville Works for the junior employees. The main features of the scheme are (1) compulsory attendance at evening continuation school, with remission of fees, and the award of prizes; (2) physical exercises and swimming during the firm's time; (3) special technical and commercial classes within the works during working hours.

J. WILSON.

THE INHERITANCE OF FECUNDITY IN FOWLS.[1]

THE application of Mendelian principles to the inheritance of an economically productive character of an animal has a twofold importance, viz. first, because it may be questioned whether or not it is possible to apply a Mendelian interpretation to the facts, and, secondly, the data and conclusions arrived at make it possible for others to outline a practical scheme of breeding with the view of an increased egg-production.

In the study before us, Mr. Raymond Pearl, an investigator well known by his work on the fecundity and breeding of fowls, sets forth in great detail the

1 "The Mode of Inheritance of Fecundity in the Domestic Fowl.' By Raymond Pearl, *Journ. Exp. Zool.*, 1912, pp. 153–268.

results of five years' work which has involved thirteen generations and several thousand individuals. Two very definite results have been obtained, and it is important that these should be grasped at the outset, viz.: (1) that the record of egg-production of a hen is not of itself a criterion of any value whatsoever from which to predict the probable egg-production of her female progeny—in short, there is no correlation between the egg-production of individuals and either their ancestors or their progeny; (2) notwithstanding the above-mentioned fact, fecundity is, in some manner or other, inherited in the domestic fowl.

The mere fact that a fowl is anatomically normal is not sufficient to ensure the laying of eggs; two physiological factors or groups of factors are essential. The first of these is termed the "normal ovulation" factor, *i.e.* the complex physiological characters which in their entirety determine the normal reproductive activity and definite periods of productivity, what are termed the winter and summer cycles, depending upon differences in the complex physiological mechanism concerned with the maturation of the oocytes and ovulation.

Winter egg-production is chosen as the basis of measure, representing as it does the cycle in which the widest difference is found between birds of high and low fecundity. Three well-defined classes are apparent; these include birds with high winter records, those with low, and those that do not lay at all. In respect to these three divisions there is a definite segregation in the Mendelian sense.

As the result of considerable work supported by a mass of evidence, the author concludes:—

There are three distinct and separately inherited factors upon which fecundity in the female fowl depends.

The first of these factors (which may be called the anatomical) determines the presence of an ovary, the primary organ of the female sex. The letter F is used throughout to denote the presence of this factor.

There are two physiological factors. The first of these (denoted by L_1) is the basic physiological factor, which, when present alone in a zygote with F, brings about a low degree of fecundity (winter record under thirty eggs). This factor is under no limitations in gametogenesis, but may be carried in any gamete, regardless of what other factors may be also present.

The second physiological factor (denoted by L_2), when present in a zygote together with F and L_1, leads to a *high* degree of fecundity (winter record more than thirty eggs). When L_1 is absent, however, and L_2 is present, the zygote exhibits the same general degree of fecundity (under thirty) which it would if L_1 were present alone. These two independent factors, L_1 and L_2, must be present together to cause high fecundity, either of them alone, whether present in one or two "doses," causing the same degree of low fecundity.

The second physiological factor, L_2, behaves as a sex-limited (sex-correlated or sex-linked) character, in gametogenesis, according to the following rule: the factor L_2 is never borne in any gamete which also carries F. That is to say, all females which bear L_2 are heterozygous with reference to it. Any female may be either homozygous or heterozygous with respect to L_1. Any male may be either homozygous or heterozygous with reference to either L_1, L_2, or both.

Numerous other matters of great interest are lucidly set forth, to which want of space forbids us to refer. The whole piece of work is an excellent example of the practical application of Mendelian principles to an important economic question, and deserves most careful study.

WALTER E. COLLINGE.

EGYPTIAN SODA.

A REPORT by Mr. A. Lucas on "Natural Soda Deposits in Egypt" has been issued by the Ministry of Finance as "Survey Department Paper, No. 22." Natural soda occurs in Egypt principally in the Wadi Natrun in the Libyan desert, but it is also found some fifty kilometres due north of this, at El Barnugi, in Lower Egypt, and at Mahamid, in Upper Egypt. The principal soda-lakes are in a valley the bottom of which is about 27 metres below sea-level; the lakes extend over a range of 30 kilometres, the nearest being about 38 kilometres from the Nile. In ancient times there were two lakes, which became united when water was most abundant, but at the present time they are divided into about a dozen separate areas, the smaller of which dry up almost entirely in summer, leaving only a few pools of water. The soda is found in solution in the water of the lakes, in a solid form at the bottom of some of the lakes and as an incrustation on the adjoining ground.

Analyses of the water are given for ten of the twelve lakes. In the case of the most concentrated the figures were:—Specific gravity, 1·260; Na_2CO_3, 62·15; NaCl 252·35; Na_2SO_4, 64·54; total 379·04 grams per litre. The lakes are largely fed by springs in the bed of the lakes, but also by water trickling in from the surrounding ground. At low water one of the springs is so powerful that a boat trying to pass over it is driven forcibly back; another spring, round which an iron cylinder had been placed, was found to be flowing at a height of 80 centimetres above the lake level at the end of February. These springs flow energetically all the year round, but in one case at least there is increased activity about October. Analyses of the spring and well water showed total solids ranging from 0·3 to 4·6 grams per litre, the quantity of soda ranging from 0·2 to 1·2 grams per litre, almost all in the form of bicarbonate; it is therefore probable that the soda is carried into the lakes by the inflowing water, and is there concentrated by evaporation.

The water-level in the lakes falls in summer, begins to rise again in October, and reaches a maximum in March. This variation might be attributed to the different rates of evaporation in summer and in winter; but there appears to be a definite increase of flow in October; this precedes the slight autumn rains, and must be due to an increased flow of underground water. The underground flow is from the north-east, in which direction the Nile lies nearest; this is also the side on which the visible flow into the lakes takes place. The fact that the lakes fall whilst the Nile is rising, and conversely, may be due to lag; in the case of some wells in the neighbourhood of Cairo, under constant observation for thirteen years, the time required for the water-levels to be raised by the influence of the Nile flood varied from 25 to 55 metres per day.

The lakes deposit both salt and soda. The former is practically pure, at least after washing; the latter consists mainly of the compound

$$Na_2CO_3,NaHCO_3,2H_2O,$$

but may contain an excess either of carbonate or of bicarbonate; it is often mixed with large quantities of salt (from 2 to 27 per cent.), and of sodium sulphate (from 0 to 39 per cent.).

The salt is probably of marine origin. The large excess of sulphate and the absence of iodides and bromides may be explained by the separation of gypsum and of salt on partial evaporation, and the subsequent washing away of the mother-liquors, *e.g.* by a fresh influx of sea water. The conversion of chloride and sulphate into carbonate and bicarbonate has been explained as due to a reversal of the usual interactions of these substances with calcium and magnesium carbonates, *e.g.*

$$2NaCl + CaCO_3 \rightleftharpoons Na_2CO_3 + CaCl_2$$
$$2NaCl + CaCO_3 + CO_2 + H_2O \rightleftharpoons 2NaHCO_3 + CaCl_2$$
$$Na_2SO_4 + CaCO_3 \rightleftharpoons Na_2CO_3 + CaSO_4,$$

but it is not easy to understand how such interchanges could result in the production of more than a mere trace of the alkali. A more probable explanation assumes as the first stage a reduction of sulphate to sulphide by organic matter, living or dead, with a subsequent displacement of sulphuretted hydrogen by carbonic acid:—

$$Na_2SO_4 - 4O = Na_2S,$$
$$Na_2S + CO_2 + H_2O = Na_2CO_3 + H_2S, \text{ \&c.}$$

In support of this view there are quoted statements by Lunge that the springs "are full of algæ," that "at a distance of three feet from their origin they begin to give off sulphuretted hydrogen," and that the "odour becomes more intense a little further on, but ceases at a greater distance."

The Wadi Natrun deposits were probably the oldest known occurrence of natural soda in the world, and they constituted the principal source of supply of that commodity for thousands of years. They are at present worked by the Egyptian Salt and Soda Company, who took them over from the Société Anonyme des Soudes naturelles d'Egypte, to which latter company the Government had granted at the end of 1897 a concession for fifty years. The company makes caustic soda and soda ash, and, in addition, extract and sell both natrun (raw soda) and salt. According to the customs returns the exports include 1200 tons of caustic soda, value about 10,000*l.*, and about 800 tons of natrun. But both these products are sold also for use in the country, and the company uses considerable quantities of caustic soda at its own soap factory.

The Wadi Natrun is connected with the State railway system by means of a narrow-gauge railway 50 kilometres long, running from Khatatba to the centre of the Wadi. T. M. L.

AGRICULTURE IN INDIA.

THE Agricultural Journal of India (vol. vii., part iv.) contains several articles which testify to the assiduity with which various questions are being investigated. Dr. C. A. Barber contributes a paper on seedling canes in India, and gives a brief outline of the chief phases in the cane-sugar industry and the causes which led to the raising of seedling canes in Java and Barbados. Similar work has been carried out in India, and records are being accumulated, in order to afford data for a general classification of the canes of the country. Difficulty was experienced in procuring sugar-cane arrows with a fair proportion of anthers containing fully matured pollen; in fact, the only native cane possessing this property was the Cheni of Mysore.

Mr. C. E. Low writes on the supply of agricultural cattle in India, and after giving statistical information and a description of the present situation regarding cattle supply, with an examination of the various features involved, discusses the question of the food supply in times of famine and the measures which the Government is adopting to cope with various causes which tend to a diminution in the number or efficiency of agricultural cattle. It is interesting to note, in connection with the storage of fodder as reserves for seasons of famine, that "the main objection to this proposal in the popular mind seems to be that the possession of stored fodder tempts a hostile neighbour to revenge himself by setting light to the stack."

Messrs. E. J. Woodhouse and T. Bainbrigge Fletcher report the adoption of systematic hand-picking of the caterpillars of *Agrotis ypsilon*, and the use of the Andres Maire moth-trap in the Mokameh Tal. During the season of 1911 upwards of 60,000 caterpillars were hand-picked, and 2000 Agrotis moths were caught in November by one trap. It is estimated that by the above means 6000 acres of crops were saved.

Mr. F. M. Howlett discusses the possibility of the introduction of yellow fever consequent on the opening of the Panama Canal and the shortened route from the fever-zone in the West Indies and Central America. It is pointed out that, if yellow fever were introduced, and *Stegomyia fasciata* proved to be the only effective carrier, the disease would be more or less confined to the coast districts and seaport towns, while if *S. scutellaris* also proved effective, there is no reason why it should not spread infection throughout the country. The distribution of the different species of Stegomyia in the larger seaports is now being ascertained by means of a systematic survey.

NATURAL SCIENCE PAPERS AND MEMOIRS.

IN the sixth volume of *Fortschritte der naturwissenschaftlichen Forschung*, Prof. W. Halbfass reviews the recent work on the topography, hydrography, and geology of the lakes of Asia, Africa, America, and Australia. Dr. A. Rühl, in his paper on a new method in geomorphology, pleads for the application of the deductive method to the borderland between topographical geology and geography. The exposition of the peneplain theory of Prof. Davis, as well as of other points bearing on normal marine, glacial, and arid cycles, is illustrated by photographs and diagrams. The results of recent researches in radio-activity, particularly on uranium, thorium, and actinium, form the subject of a review by Prof. Otto Hahn and Dr. L. Meitner.

In the same volume the classification of functional mental disorders, and the existence of fundamental differences between organic and functional psychoses, are discussed by Prof. O. Bumke. The problem of regeneration, in its inorganic, botanical, and zoological aspects, is surveyed by Prof. D. Barfurth, who appends to his memoir a selected bibliography containing about 500 references. After examining the various theories of regeneration, he regards that of Roux as being most nearly in accord with the facts observed, *i.e.* that, in cases where regeneration can take place, disturbance of the living organism in an adult individual gives rise to formative stimuli in the reserve germ-plasm of the adult cells or of cells not yet fully differentiated, which lead to the re-establishment of the organism as a whole. Dr. W. Hausmann, in a paper on optical "sensibilisators" in plants and animals, concludes that several pigments which occur commonly in nature are photo-biological "sensibilisators," which react under definite physiological and pathological conditions.

Dr. W. G. van Name (in Proc. Boston Soc. Nat. Hist., vol. xxxiv., pp. 413–619, plates 43–73) gives an account of the simple Ascidians of the region from the Gulf of St. Lawrence to Long Island Sound. This coast is not rich either in number of species of Ascidians or in those presenting striking structural characters. Leaving out of account all uncertain forms, thirty-four species (seven of which are new) are recorded. The genus Bostrichobranchus, known only from the Atlantic coast of North America, is the most interesting Ascidian described in this memoir. Dr. van Name regards this as the most highly specialised genus of Ascidians, and as having been derived from the genus Eugyra.

RADIATIONS OLD AND NEW.[1]

THE remarkable properties of the rays from radio-active substances which have been examined with such eagerness in recent years throw a curious and interesting light on the older attempts to find a satisfactory theory of radiation. Newton and Huygens, Young and Fresnel, and other thinkers down to our own times have discussed various hypotheses, rejecting, adopting, or amending, and each has given his reasons for his final choice. It is instructive at the present time to examine some of those reasons, and to consider the influences which prompted them to make their great discoveries. More particularly is this the case because some expressed their ideas in the language of a corpuscular theory, and we have now had for some time the opportunity of examining radiations which we know to be corpuscular.

Let me first of all set out some of the facts of the new radiations. Thanks to the recent beautiful experiments of Mr. C. T. R. Wilson, I am able to illustrate my statement by a method which would have been beyond my power even a few months ago. We have been for some years laboriously investigating the paths of the α, β, and γ rays through gases and other material substances. Our work has been conducted in the dark, so to speak, for we have been obliged to rely mainly on electrical methods, to feel our way along those paths in some cases, and in others to arrive at their form by indirect reasoning. Mr. Wilson has shown us how to obtain a clear photographic representation of the whole path of an α or β ray. The ocular demonstration is helpful from a scientific point of view, not only because of the confirmation which it has given of the work we have already done, but also because of its suggestiveness for the future. It is, if I may say so, invaluable from a lecturer's point of view, because it enables me to dispense with difficult explanations of the methods by which recent advances have been made, and to show you, on the screen, direct illustrations of the main points that I wish to emphasise.

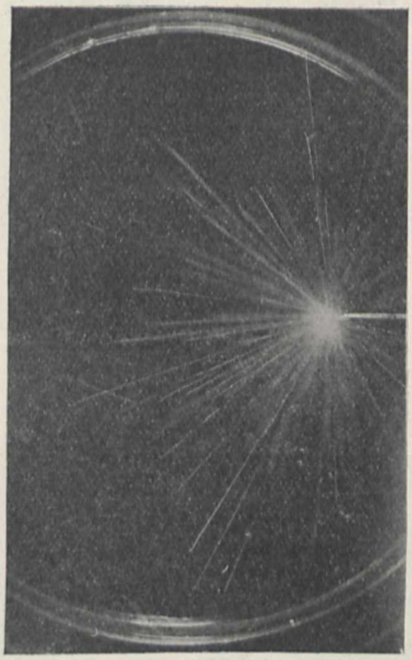

FIG. 1.—α-Rays from radium. Some of the α-particles have traversed the air before the expansion, others after the expansion.

The α ray is, as is well known, an atom of helium projected by the exploding radio-active atom with a speed of some ten or twenty thousand miles a second. Although it moves off at this excessive rate it is able to penetrate only two or three inches of air in its ordinary state, or one or two thousandths of an inch of heavier substances, like aluminium or gold. When it comes to the end of its range, it has spent practically the whole of its energy, it has lost its distinction, and sinks to the level of an atom moving with ordinary speed. Some years ago I showed that it moved in an almost perfectly straight line from start to finish; and it then became evident that on its way through a gas or a metal or any other substance it passed through every atom which it met. It does not push them out of its way, for it meets hundreds of thousands of atoms, each one, as a rule, far heavier than itself; and it does not thread its way between them, for it has no intelligence, and cannot recover a line once lost. In 1907 it was shown by Mr. Geiger, working at Manchester, that the track of the α particle was not absolutely straight, but that the particle was liable to slight deflections, especially when near the end of its path.

On the screen there is now one of Mr. Wilson's photographs of the tracks of α particles radiating from a minute speck of radium (Fig. 1). You will see how straight they are for the most part, and yet a closer examination will show slight, very sudden, deflections.

The next slide is an enlargement of two tracks, one of which shows the deflections very well (Fig. 2).

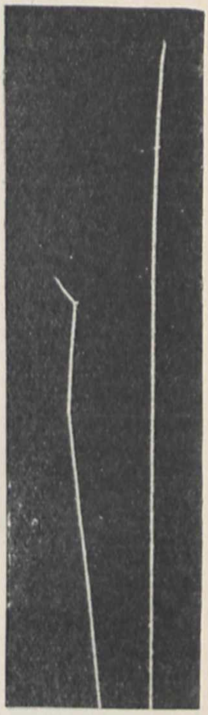

FIG. 2 —α-Rays from radium.

It is difficult to realise that we are looking at a picture of the path of a single atom through the air, recorded by its own efforts; and we may well ask how Mr. Wilson has managed to obtain so wonderful a result. As a matter of fact his method is an improvement on one which he had used and explained some years ago, but it will be well to describe it briefly once more. A short glass cylinder of about six inches in diameter—its outline can be seen in Fig. 1—is closed at one end by a glass plate; at the other end is a movable piston. The chamber is filled with moist air, which is chilled if the chamber is suddenly enlarged by the withdrawal of the piston. A fog is then formed, which settles in the first place on any "ions" which may be present. In the track of α and β rays there are trails of ions formed by the rays. It is only necessary therefore to illuminate the fog, and to photograph it, and we have such a picture as that on the screen.

The picture confirms so far as it goes the main conclusions we had already drawn as to the path of the α ray. On the screen is now a copy of a drawing which I made a year or two ago to show the various forms of the path as we then pictured them to our-

[1] Evening discourse delivered on September 6 before the British Association at Dundee by Prof. W. H. Bragg, F.R.S.

selves (Fig. 3). The paths, it should be explained, are shown starting parallel from a common line instead of radiating from a point. Mr. Wilson's picture shows that I have somewhat exaggerated the deflections to which I wished to direct attention; but otherwise the agreement is satisfactory.

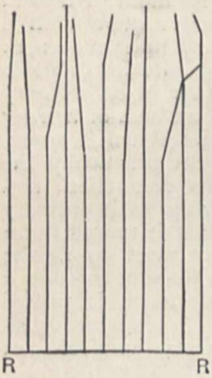

FIG. 3.

The results which I would emphasise are these, that an atom of helium can and does sometimes move at a rate comparable with that of light, and when endowed with that speed can penetrate other atoms with ease.

Before leaving the α ray, there is one other point I should like to mention. If we consider how it can be that deflections of the α particle are so rare, and yet so sharp, we find ourselves driven to consider with Rutherford that the deflection is due to a force exerted from a very small centre or central core within the atom, backed by all the mass of the atom. It is only when the flying α particle tries to pass very close to this centre that a noticeable deflection is produced. We may picture to ourselves the electrons belonging to the atom as revolving about this central core, which we must then take to be electrically positive, just as the planets move about the sun. When an α or β particle penetrates an atom and is deflected it is the central core that is in the main responsible; electron satellites are of no account. A rough analogy is to be found in the motion of a comet through the solar system.

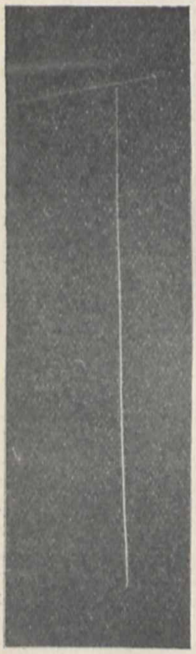

FIG. 4.—A complete α-ray from radium emanation.

When a deflection takes place we may expect a recoil of the atom in which it occurs. In some of the illustrations you will observe that there is a slight enlargement of the track at its beginning (Fig. 4). This may well be the recoil of the radio-active atom from which the α particle has been ejected. We have for some time been familiar with this recoil effect, which has been made the basis of certain important electrical methods of radio-active investigation. It is very interesting to see a well-marked little spur on one of the α ray tracks in Fig. 2, just where we should expect to find the effects of an atom of oxygen or nitrogen recoiling from its effort to turn the helium atom out of its path.

A β ray does not leave such an obvious track. It is the single electron moving with velocity very closely approaching in some cases to that of light. When it moves so fast it only ionises occasionally, so that its fog track is fainter. On these slides, some β ray tracks are clearly shown (Figs. 5 and 6); some are quite straight and are due to rays of high velocity, others show much bending, and these are made by β particles which have lost their great speed, and are knocked hither and thither by collision with the atoms of the air. It is to be remembered that the β particle is many thousands of times lighter than the α particle.

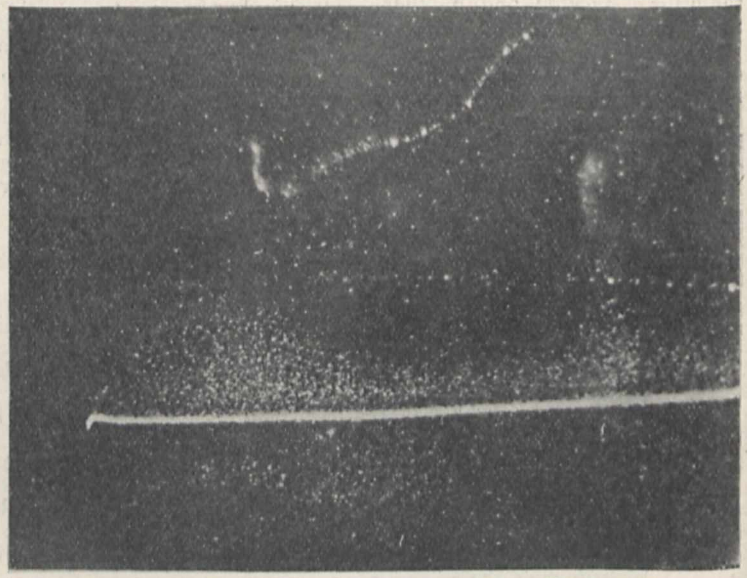

FIG. 5.—α- and β-Rays from radium.

Now we come to the third type of rays emitted by the radio-active substances, the γ ray, which is the same in kind as the Röntgen ray.

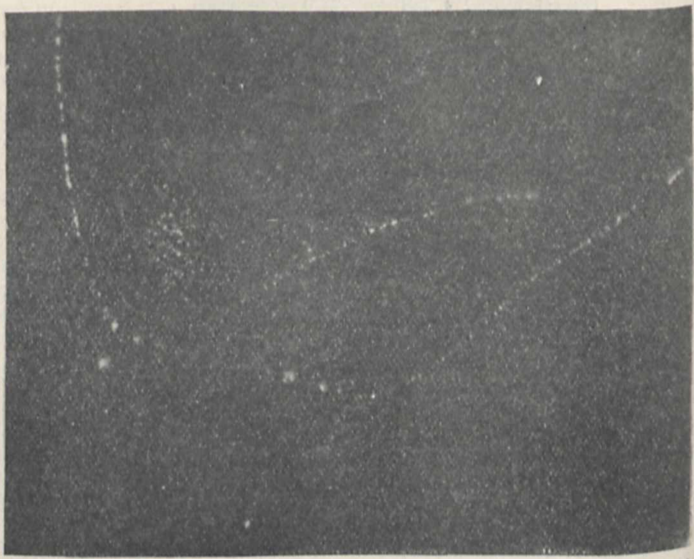

FIG. 6.—β-Rays produced by γ-radiation.

The fog apparatus shows no tracks which can be directly assigned to such rays. When the β and γ rays act together, only β ray tracks are found. When a stream of X-rays passes through the chamber the result is such as is shown in the figure (Fig. 7), a mass of short, tortuous tracks originating within the path of the X-rays, and ending indiscriminately inside or outside. Photographs made by weaker beams show the individual rays more clearly. The tracks are of the same character in the two cases, and the intensity only affects the number. These are tracks such as we should expect to be made by slow β rays—slow because they are very tortuous and do not go very far. Here is one greatly magnified, showing the individual water drops deposited along the track (Fig. 8). They are actually a few millimetres long. But the X-rays are passing in straight lines across the chamber, and you see that they leave no trace behind.

FIG. 7.—Ionisation by X-ray beam about 5 mm. in diameter.

These strange results were all expected from previous investigation. It has been known for some time that X or γ rays can excite β rays in matter on which they fall; I have in recent years tried to show that the X and γ rays can do nothing else. They do not themselves ionise the air or metal or other substance through which they pass; they merely bring to birth β rays which do. When X-rays fall upon a photographic plate and bring about a chemical change, or upon the animal skin and cause a "burn," as we vaguely denote the physiological effect, the X-rays have not been the direct agents, but the β rays, which spring from them. We may venture to make a guess as to how the action takes place. When an α particle passes through a molecule it may ionise more than one atom in that molecule; in the case of a very complex molecule it must often ionise several of the atoms. Such a molecule might be expected to break up or dissociate; and it is actually found that α particles do cause dissociation. Now the β particle ionises but rarely, as the pictures show; it will be a very complex molecule in which the β particle causes ionisation of two or three of the atoms of which it is constituted. Colwell and Russ have lately shown that X-rays can break down the starch molecule, a starch solution irradiated by X-rays becoming less viscous and showing the presence of dextrin. It is reasonable to expect the very large and complex starch molecule to be broken up by the β rays which the X-rays produce; and by this direct action of the β rays on large molecules we may perhaps be able to explain all the physiological actions of radium and of X-rays.

FIG. 8.—Portions of Fig. 7 enlarged, showing the individual ions produced along a portion of one of the kathode-ray tracks.

There is good evidence to show that each of the β rays the tracks of which you see upon the screen is due to one X-ray and no more, and that the X-ray in forming the β ray gives it all the energy which it possesses. Further, if we consider the production of X-rays, we find that each X-ray that comes out of the bulb carries with it the energy of one, and only one, of the β rays which are hurled against the antikathode. Thus in the picture I have drawn (Fig. 9) β rays striking the antikathode A, X-rays move off, each inheriting the energy of one of the β rays. The β rays of the X-rays tube have themselves but very little power of penetrating materials; they move at only one-third (or thereabouts) of the speed of the β rays of radium; but the X-ray carrying the same energy is hundreds of times as penetrating, and a large number of those which are produced at the antikathode in the bulb penetrate the glass walls. Each

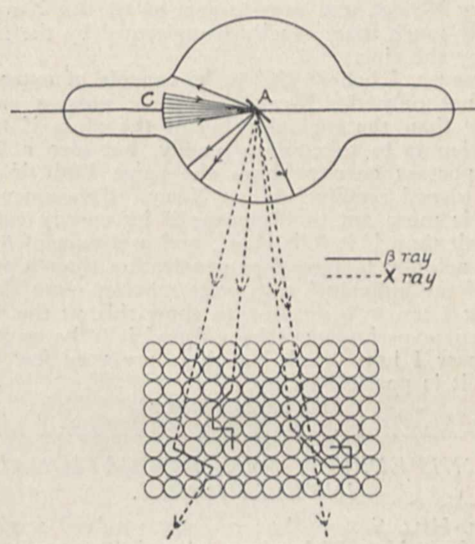

FIG. 9.

of these meets its fate sooner or later. In passing through some atom the reverse change takes place, and the X-ray disappears, handing over its energy to a β ray, which starts off with a velocity equal to that with which the original β ray finished when it disappeared in favour of the X-ray. It is as if the X-ray picked up the β ray, moved off in a straight line with it, and started it again somewhere else; or as if the β ray disappeared like a river going underground, only to reappear and continue its course. The β ray and the X-ray are interchangeable forms of energy-carrier. Further transformations may occur before the energy is spent. We may consider ourselves to be following the history of a small quantity of energy which is carried first by a β ray, then by an X-ray, then by a β ray again, and so on. The energy is kept intact in the X-ray form, but gradually frittered away in the β ray form, until finally it sinks to so low a value that it can no longer ionise or record its motion in a fog picture, and it is lost to view. Just as the α particle settles down to ordinary life as a helium atom at the end of its royal progress, so the moving electron, the β ray, becomes at last one of a crowd of electrons which are always on the move in matter, and are the carriers of heat and electricity. Whether it still undergoes transformations is a question we may well ask; I will consider it very briefly in a few minutes.

Transformation in either direction can only take place during the traverse of an atom. The atom is the transforming agent, but atoms differ in their transforming power. Usually the heavier the atom the more apt it is to bring about the transformation in an X-ray which tries to cross it, but there are regular exceptions. Every atom possesses one or more critical energy quantities; if the energy of the X-ray exceeds the critical value of the atom it is much more likely to undergo transformation than if it falls short. The critical values grow with the atomic weights, and are on the whole nearly proportional to the squares of the latter. Thus the critical energy of the zinc atom is about $1{\cdot}75 \times 10^{-8}$ ergs, of the nickel atom about $1{\cdot}67 \times 10^{-8}$ ergs. An X-ray, having an energy less than both these, is absorbed or transformed rather more readily by zinc than by nickel, but an X-ray having an energy greater than the lower but not greater than the higher (*e.g.* the X-ray given off by zinc when irradiated by sufficiently penetrating primary X-rays, and now known as the Zn X-ray) is actually much more readily transformed by the nickel than by the zinc.

Moreover, I believe this to be capable of extension. It is not only the X-ray that must possess energy greater than the critical value of the atom if transformation is to take place readily, but also a β ray must possess energy above the same limit if it is to be turned readily into an X-ray. Consequently a β ray is more apt to disappear if its energy exceeds the limit than if it falls short, and a stream of β rays seems actually to have less penetration than it would have if the individual rays were moving more slowly. I think I am in a position to show this as the result of recent experiment; I have found it to be so in the few cases I have tried, but there are very few cases which it is possible to try.

(*To be continued.*)

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

Mill Hill School has recently received a gift of 5000*l.* from Mrs. Richardson, one of the nieces of the late Lord Winterstoke, formerly chairman of the governors of the school.

Major Sir Ronald Ross, K.C.B., F.R.S., formerly professor of tropical medicine, University of Liverpool, is now professor of tropical sanitation, University of Liverpool, lecturer on malaria, Liverpool School of Tropical Medicine, and physician for tropical diseases, King's College Hospital, London.

The Rev. John H. Ellis, who died in November last, has left, subject to his widow's life interest, the residue of his property, which will amount to at least 90,000*l.*, to "the University of Cambridge to be enjoyed and applied both as to capital and income by them for the general purposes of the University in such manner as they may think fit."

The December issue of *The Reading University College Review*, in addition to its very interesting notes summarising the work recently accomplished at the college, contains an article explaining the general idea of the scheme of new buildings which the council of the University College at Reading proposes to carry out upon the main site. Another article, by Mr. J. P. Clatworthy, lecturer in mathematics at the college, deals with mathematics and the biological sciences.

The danger of over-specialisation in higher education forms the keynote of a paper on the functions of the American college, by Prof. A. K. Rogers, in *The Popular Science Monthly* for December. As the author points out, there is a constant tendency among college teachers to cater more and more for the specialist in their own particular study, whereas if the college is to maintain its influence, it should rather aim at broadening the minds of the large majority of students of average ability. The author remarks that "the exceptional man is pretty apt to look out for himself. He will thrive probably in spite of our attempts to educate him quite as much as because of them."

The President of the Board of Education has decided to appoint an advisory council for the Victoria and Albert Museum. The following persons have already consented to serve:—The Right Hon. Lord Reay (chairman), Mr. R. H. Benson, Mr. R. Blomfield, Sir Edward T. Cook, Mr. J. H. Fitzhenry, Mr. R. E. Fry, Mr. Frank Green, Lady Horner, Mr. Elijah Howarth, the Earl of Lytton, the Countess of Plymouth, Sir Isidore Spielmann, C.M.G. The council will be asked to advise the Board on questions of principle and policy arising from time to time, and to make an annual report on their proceedings to the Board, together with any observations on the condition and needs of the museum which they may think fit to make. It will be open to the council to constitute subcommittees on which persons who are specially qualified to advise on particular questions referred to the council may be invited by the Board to serve in addition to the ordinary members of the council.

The fourteenth of a series of articles which has been appearing in the Journal of the Department of Agricultural and Technical Instruction for Ireland has now been issued in pamphlet form. It is written by Mr. T. Clearkin, and is concerned with technical instruction in Larne. Larne differs from many small towns of Ireland, as it has various flourishing industries giving constant employment to a considerable number of skilled workers—men and women. Many of these industries have grown up within the last twenty years, *e.g.* the manufacture of aluminium, linen-weaving, and paper-making. The shipping industry, too, is of some importance, and the engineering and building trades give employment to a fair number of apprentices. The object of the municipal technical school which has now been established in Larne is to instruct in the scientific and artistic knowledge necessary for a thorough understanding of the several callings in which the inhabitants are already engaged.

The scheme of the competitive examination, held under the direction of the Civil Service Commissioners, for admission to the Indian Police Force is to be modified, by requiring candidates to take up English history and geography as a compulsory subject. The change will come into operation for the examination of 1914. There will then be four obligatory subjects which must be taken by all candidates, viz. English, elementary mathematics, French or German, and English history and geography. There are six optional subjects, of which candidates may take two; but, if one of the subjects selected is a modern language, it must be different from that taken as an obligatory subject. The optional subjects are intermediate mathematics, higher mathematics, German or French, Latin, Greek, and science (physics and chemistry). In addition, candidates may take up free-hand drawing. The maximum mark obtainable is the same for all subjects, except free-hand drawing, which carries only one-fifth of the mark in other subjects.

THE address delivered by Prof. Nicholas Murray Butler, president of the Columbia University, on the occasion of the dedication of the State Education Building at Albany, N.Y., last October, has been issued as a reprint from *The Educational Review* of New York. The subject of the address is the service of the university. The prime thought which underlies and gives purpose to the whole educational policy of New York from its very beginning, says Prof. Butler, is that educational progress is a unit, and that its supervision and control should be gathered into one single department of State education. Later in his address he provided an admirable definition of a university. He referred to it as "an institution where students adequately trained by previous study of the liberal arts and sciences are led into special fields of learning and research by teachers of high excellence and originality, and where, by the agency of libraries, museums, laboratories, and publications, knowledge is conserved, advanced, and disseminated. Teaching is only one function of a university, and perhaps the smallest one. Its chief function is the conservation, the advancement, and the dissemination of knowledge, the pushing out of that border line between the known and the unknown which constitutes the human horizon."

THE following advanced lectures in scientific subjects have been arranged for the present term by the University of London. Unless otherwise stated, admission is free without ticket. Detailed information will be found in *The London University Gazette* of January 1:—"The Illustration of Botanical Papers," Mr. T. G. Hill; "The Morphology of Gnetales," Prof. Margaret Benson; "The Theory of the Solid State," Prof. W. Nernst, professor of physical chemistry and director of the Institute of Physical Chemistry in the University of Berlin; "The Growth in Length of the Vertebrate Embryo," Mr. Richard Assheton; "Recent Work on the Bionomic Value of Colour in Animals, especially Insects," Prof. E. B. Poulton, F.R.S.; "Meteorology in Relation to the Navigation of the Air," Dr. W. N. Shaw, F.R.S. (in this case application for tickets of admission should be made at the Meteorological Office); "The Relations of Electrolytes to Living Tissues," Mr. G. R. Mines. (These lectures are for advanced students of the University and others interested in physiology. Any member of a London school of medicine, whether an undergraduate of the University or not, is entitled to admission to this course.) "The Protozoa," Prof. E. A. Minchin, F.R.S. (The course is open free to all members of the University, to all medical men or registered medical students, and to other persons, on application to the academic registrar.) "Some Hitherto Neglected Sources of Error in Mine-surveying and their Elimination or Reduction by Improvements in Instruments or Methods," Mr. L. H. Cooke. Six lectures in connection with the Francis Galton Laboratory for National Eugenics will be given at University College on Tuesday evenings, at 8 p.m., beginning on February 11. Admission to this course is free, but by non-transferable ticket, applications for which should be sent to the secretary of University College.

SOCIETIES AND ACADEMIES.

MANCHESTER.

Literary and Philosophical Society, December 10, 1912.—Prof. F. E. Weiss, president, in the chair.—T. A. **Coward** exhibited a fossil, barrel-shaped pith of a cycadean stem with small portions of the surrounding wood, with superficial markings due to the medullary rays, from a brickfield near Timperley.—T. A. **Coward**: Coloured photograph of a specimen of the Baikal or Formosan teal, *Anas formosa*, shot at Wirral a short time ago.—A. **Holt** and J. E. **Myers**: The constitution of the phosphoric acids and some of their alkali salts. There appear to be but two varieties of metaphosphoric acid and two corresponding series of salts. These salts are derived from mono- and tri-metaphosphoric acids. The tri-acid is vitreous; the mono-acid can only be obtained in solution. The monometaphosphates of the alkalies are readily soluble in water, and are prepared either by neutralising the mono-acid or by devitrifying the glass obtained by the action of heat on microcosmic salt. This is in direct contradiction to the customary statements of text-books. The more complex metaphosphates are probably double salts.—Miss P. C. **Esdaile**: The scientific results of the salmon scale research at Manchester University. The results obtained by an examination of scales from nearly 1700 fish from the Wye indicate some relation between the length of time spent in the river and in the sea. In the majority of cases, when the young fish has stayed for a considerable time in the river it has remained for a comparatively short while in the sea, and *vice versâ*. Grilse and small spring fish with a comparatively short sea-life are longer for their weight than large summer or large spring fish, and also show much more variation. Only seventy-eight of the fish had spawning marks on their scales. It was observed that fish which one year spawned as spring fish may spawn again as summer fish, and *vice versâ*. The results indicate that the scales do not provide any evidence to support the belief that spring and summer salmon represent two distinct races.—Dr. J. R. **Ashworth**: Note on the mean magnetic moment and energy of a vibrating magnet. By a mathematical investigation the author showed that the behaviour of a magnet making oscillations of large amplitude in a uniform field resembles that of a diamagnetic substance. When, however, it oscillates under the influence of a similar neighbouring magnet its behaviour has a resemblance to that of a ferromagnetic substance under the influence of heat, and the phenomenon of recalescence could in some degree be imitated under like conditions.

BOOKS RECEIVED.

Memoirs of the Geological Survey, Scotland. The Geology of Ben Wyvis, &c. By Dr. B. N. Peach and others. With petrological contributions by Dr. J. S. Flett. Pp. x+189+xii plates. (Edinburgh: H.M.S.O.; London: E. Stanford, Ltd.) 4*s*.

Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India (New Series). No. 54, Studies on the Mouth Parts and Sucking Apparatus in the Blood-sucking Diptera. No. 1, *Philaematomyia insignis*, Austen. By Captain F. W. Cragg. Pp. 3+17+iv plates. (Calcutta: Superintendent Government Printing, India.) 1*s*. 3*d*.

Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India (New Series.) No. 55, The Structure of *Haematopota pluvialis*, Meigen. By Captain F. W. Cragg. Pp. 3+35+vii plates. (Calcutta: Superintendent Government Printing, India.) 1*s*. 9*d*.

Scientific Memoirs by Officers of the Medical and Sanitary Departments of the Government of India (New Series). No. 56, Malaria in the Andamans. By Major S. R. Christophers. Pp. 4+48. (Calcutta: Superintendent Government Printing, India.) 1*s*. 4*d*.

The Fauna of British India, including Ceylon and Burma: Diptera Nematocera (excluding Chironomidæ and Culicidæ). By E. Brunetti. Pp. xxix+581+xii plates. (London: Taylor and Francis.) 20s.

Les Progrès Récents de l'Astronomie. By Prof. P. Stroobant. Pp. 173+iv plates. (Brussels: Hayez.)

Technical Electricity. By Prof. H. T. Davidge and R. W. Hutchinson. Fourth Impression. (Third Edition.) Pp. xii+590. (London: W. B. Clive.) 5s. 6d.

Notes on Chemical Research. By W. P. Dreaper. Pp. x+68. (London: J. and A. Churchill.) 2s. 6d. net.

Who's Who in Science. International, 1913. Edited by H. H. Stephenson. Pp. xvi+572. (London: J. and A. Churchill.) 8s. net.

The Dynamic Foundations of Knowledge. By A. Philip. Pp. xii+318. (London: Kegan Paul and Co., Ltd.) 6s. net.

Industrial and Manufacturing Chemistry. Organic. By Dr. G. Martin and others. Pp. xii+726+plates. (London: Crosby Lockwood and Son.) 21s. net.

Die neue Tierpsychologie. By G. Bohn. German edition by Dr. R. Thesing. Pp. viii+183. (Leipzig: Veit and Co.) 3 marks.

Memoirs of the Geological Survey. England and Wales. Explanation of Sheet 299. The Geology of the Country around Winchester and Stockbridge. By H. J. D. White. Pp. 89. (London: H.M.S.O.; E. Stanford, Ltd.) 1s. 6d.

Das Auge von Palaemon Squilla. By Dr. E. Trojan. Pp. 54+vi plates. (Vienna: A. Hölder.)

Memoirs of the Geological Survey. Scotland. The Oil-shales of the Lothians. Parts i., ii., iii. By R. G. Carruthers and others. Pp. xii+199+2 plates+map. (Edinburgh: H.M.S.O.; London: E. Stanford, Ltd.) 2s. 6d.

Catalogue of the Photographic Collection at the Forest Research Institute, Dehra Dun, India. Pp. iii+245. (Calcutta: Superintendent Government Printing, India.)

Memoirs of the Queensland Museum. Vol. i. Edited by Dr. R. Hamlyn-Harris. Pp. 216+16 plates. (Brisbane: A. J. Cumming.)

DIARY OF SOCIETIES.

THURSDAY, JANUARY 9.

CONCRETE INSTITUTE, at 7.30.—Concrete in its Legal Aspect: W. Valentine Ball.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—The Design of Apparatus for Improving the Power Factor of A. C. Systems: Prof. Miles Walker.

MATHEMATICAL SOCIETY, at 5.30.—The Reduction of Ideal Numbers: W. E. H. Berwick.—Proofs of Certain General Theorems Relating to Orders of Coincidence: J. C. Fields.

FRIDAY, JANUARY 10.

ROYAL ASTRONOMICAL SOCIETY, at 5.—Observations of Comet 1912*a* (Gale): J. Tebbutt.—The Periodic Errors in the Right Ascensions of the Standard Catalogues: S. S. Hough.—Sun-spots and Terrestrial Magnetic Phenomena, 1898–1911. The Greater Magnetic Storms. II.: Rev. A. L. Cortie.—Observations of the Satellite of Neptune from Photographs taken between 1909, November 22, and 1910, April 15: Royal Observatory, Greenwich.—*Probable Papers*: The Motions and Distances of the Bright Stars of the Types B—B5 (Stellar Motions, No. 4): H. C. Plummer.—The Short Period Variable SU Draconis: C. Martin and H. C. Plummer.

MONDAY, JANUARY 13.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Journeys in North-east Greenland: Einar Mikkelsen.

TUESDAY, JANUARY 14.

ROYAL INSTITUTION, at 3.—The Heredity of Sex and Some Cognate Problems: Prof. W. Bateson.

ILLUMINATING ENGINEERING SOCIETY, at 8.—Acetylene Lighting: C. Hoddle.—Petrol Air Gas Lighting: E. Scott Snell.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Bridging Operations Conducted Under Military Conditions: Capt. C. E. Pym Sankey, R.E.

WEDNESDAY, JANUARY 15.

ROYAL SOCIETY OF ARTS, at 8.—The Present Condition and Future Prospects of the British Sea-Fisheries: Dr. J. Travis Jenkins.

ROYAL METEOROLOGICAL SOCIETY, at 7.30.—Annual General Meeting.—The Snowfall of the United States: C. F. Brooks.

AERONAUTICAL SOCIETY, at 8.30.—Stresses and Stress Diagrams Relative to Aeroplane Structure: F. Handley Page.

ENTOMOLOGICAL SOCIETY, at 8.—Annual Meeting.

ROYAL MICROSCOPICAL SOCIETY, at 8.—Presidential Address: *Bdellus immortalis*: H. G. Plimmer.

THURSDAY, JANUARY 16.

ROYAL SOCIETY, at 4.30.—*Probable Papers*: The Effect of Junctions on the Propagation of Electric Waves along Conductors: Lord Rayleigh.—The Influence of Chemical Constitution upon Interfacial Tension and upon the Formation of Composite Surfaces: W. B. Hardy.—Duration of Luminosity of Electric Discharge in Gases and Vapours: Hon. R. J. Strutt.—Some Electrical and Chemical Effects of the Explosion of Azoimide: Rev. P. J. Kirkby and J. E. Marsh.—Negative After-images with Pure Spectral Colours: Dr. G. J. Burch.—Factors Affecting the Measurement of Absorption Bands: H. Hartridge.—A New Method of Measuring the Torque produced by a Beam of Light in Oblique Refraction through a Glass Plate: Dr. G. Barlow.—The Positive Ionisation produced by Platinum and by certain Salts when Heated: Dr. F. Horton.—The Refraction and Dispersion of the Halogens, Halogen Acids, Ozone, Steam Oxides of Nitrogen and Ammonia; and the Causes of the Failure of the Additive Law: Clive Cuthbertson and Maude Cuthbertson.—Liquid Measurement by Drops: R. Donald.—The New Theory of Integration: Prof. W. H. Young.

ROYAL INSTITUTION, at 3.—Birds of the Hill Country: Seton Gordon.

LINNEAN SOCIETY, at 8.—A Visit to Madagascar in Search of Subfossil Lemuroids: The Hon. P. Methuen.—Les Caridines des Seychelles, avec des Observations sur leurs Variations: Prof. E. L. Bouvier.—Psychodidæ of the Seychelles; Ephemeridæ of the Seychelles: The Rev. A. E. Eaton.—Odonata of the Seychelles: H. Campion.—A New Land Leech from the Seychelles: W. A. Harding.—Some New British Plants: G. C. Druce.

ROYAL SOCIETY OF ARTS, at 4.30.—Agricultural Progress in Western India: G. F. Keatinge.

INSTITUTION OF MINING AND METALLURGY, at 8.—Specification of a Precision-Theodolite (for Workings on Lodes of Medium Inclination and Narrow or Medium Thickness): L. H. Cooke.

FRIDAY, JANUARY 17.

ROYAL INSTITUTION, at 9.—Further Applications of the Method of Positive Rays: Sir J. J. Thomson.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Indicators: J. G. Stewart.

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