THURSDAY, MARCH 17, 1904.

NEW WORK IN THE MALAY ARCHIPELAGO.

Reisen in den Molukken, in Ambon, den Uliassern, Seran (Ceram) und Buru. Geologischer Theil. By Prof. K. Martin. Pp. x+296. (Leyden: Successors of E. J. Brill, 1903.)

EVER since Dr. A. R. Wallace revealed the organic treasures of the Malay Archipelago, zoologists have found in this or that island a rich and fascinating field. Following the path indicated by the master-pioneer, they have made these relics of equatorial land serve as a "public park" of philosophical zoology. The geologists, though often appealed to, have been forced to move more slowly, since the very vegetation which preserves the fauna has effectually concealed the junctions of the various types of rock. We have recently (NATURE, vol. lxvii. p. 506) had occasion to discuss the arduous researches of Molengraaff among the forests and water-ways of Borneo. Prof. Martin meets with similar difficulties in the smaller isles of the Moluccas. He remarks that the rivers are often known only by their mouths; and, while he walks across some of the central ridges, he can rarely study what lies to right or left. His maps show what lies along the shore, or on his traverses from coast to coast, and in the case of Buru (p. 215), an island larger than Kent, he has added a good deal to the previously known topography.

Work of this kind has naturally been spread over some years, and the first part of the volume is reprinted from that published in 1897. This might, we think, have been shown upon the title-page, so as to prepare the reader for comments and corrections inserted in the later portion. From p. 49 to p. 54, for example, considerable stress is laid on the recently volcanic character of Wawani, in Amboina, in which Wallace also believed. Prof. Kotô, of Tokio, criticised our author's conclusions so far back as 1899 (*Journ. Coll.* of Science, Tokio, vol. xi. p. 96), and on p. 281 of the present work the supposed evidence of an eruption in 1674 is withdrawn. Some modification of p. 64 also occurs, and the prolongation of the volcanic line of the Talaur Islands and Ternate into Amboina is rejected. So far as the relations of the lines of present eruption and of earth-folding are concerned, we are left, it seems, with Kotô's general map as our most recent guide.

In working out the specimens collected, Prof. Martin has had the help of Dr. Schroeder van der Kolk for the petrography, and of Dr. Rüst for the interesting radiolarian series. The book opens with a description of Amboina and its eastern neighbours, a region occupied more than once by England, and ceded again to Holland as recently as 1814. While largely composed of volcanic material, these islands have been raised above the sea in late Tertiary or Quaternary times. The cracks in the peridotites of Amboina contain modern sandstone with marine remains, while coral-limestone occurs high and dry inland. Even the natives (p. 37) have included this material, with its surface bored and roughened by solution-hollows, under the name "Karang," which they apply to the lower masses so familiar to them along the coast. Here and there only loose blocks remain to prove the former continuity of the reefs across their volcanic basis. "Karang" occurs in the peninsula of Leitimor at a height of 480 metres above the sea. In Saparua (p. 48) there is some evidence of an upward movement at the present day. The main uplift appears, indeed, to have occurred after the reefs had completely buried the earlier masses, since detritus from the latter is not found in the inland "karang."

Prof. Martin believes, moreover, that the eruptions along this east-and-west line were originally submarine, the rapid cooling of the lavas furnishing an unusual amount of glass. In this matter we find an interesting parallel with Mr. Guppy's conclusions as to the Fijis (NATURE, vol. lxix. p. 31). The volcanic rocks consist of various types of andesite and dacite, including at times patches of quartz, cordierite, and garnet, which Dr. Ferdinand von Wolff (p. 102), with great probability, considers to be derived from the cordierite-gneisses that occur among the basal rocks of the Moluccas. Prof. Martin points out (pp. 21 and 93) that the discovery of rolled blocks of gneiss and schist in any given island may be due merely to the carrying up of portions of the old ground in the volcanic masses that broke through it.

The author relies too much on the nature of his igneous rocks in assigning to them a geological age, especially when (p. 37) he determines a radiolarian limestone as Tertiary because it is later than "Neo-volcanic" lavas. This classification was, however, common at the time when he started on his labours. While adding greatly to our knowledge of these rocks, he is able to correct Wallace in regard to Buru, Tomahu, and some other islands, in which he is unable to recognise a volcanic character. Hot springs still arise in Nusalaut, accompanied by deposits of aragonite. The considerable extent of the author's researches is to be seen in Map iii., from Nusalaut to the west of Amboina, where his conjectures are distinguished by shading from the ground actually observed.

The second part of this handsome memoir deals with Seran (Ceram) and the little north-western island of Buano. Ichthyosaurus is already known from Seran, and Prof. Martin regards certain globigerina limestones and flinty deposits as Mesozoic (p. 141). The latter, rich in radiolaria, are probably representatives of Molengraaff's Danau series in Borneo, and also of deep-sea origin. The associated fragments of calcareous algæ may have come from shallower marine banks, and prove nothing as to the nearness of a shore (p. 138).

Besides these fossiliferous deposits, considerable interest attaches to the mica-schist and mica-slate which form the prevalent rocks of the hills of southern Seran, and which at times determine its surface features by their strike. Cordierite occurs both in the schist and in the associated gneiss. A massive "grauwacke" formation represents in part the interval between these rocks and the limestones.

The concluding section describes Buru, an island

lying at the west end of the tectonic line which curves about the Banda Sea. Here again radiolarian flint occurs, as nodules or thin beds in a massive limestone, unconformably overlying "grauwacke." Globigerina beds assist in assigning to this "Buru limestone" a true deep-sea character. Mesozoic molluscan species are known from the later limestones. Typical karang does not seem to have formed freely across the old crystalline rocks of Buru, which remain exposed over a wide area. A consideration of the coast-lines, and of the level nature of the karang formation, leads the author to conclude that the Moluccan region is one of fault blocks and vertical movements (p. 286) rather than of folding. He agrees with Verbeek and with most observers in the Indo-Pacific area that uplift and subsidence of adjacent land masses, and not the retreat of the waters, must be held accountable for the present relations of island-crest and ocean-floor.

A noteworthy feature of Prof. Martin's work is the frequent reference to the soils derived from various types of solid rock. This alone would show the careful spirit in which he has made his observations. As he freely remarks, detail after detail remains to be filled in; but his maps, drawn on a liberal scale, his sections, and the photographic landscapes, give the reader a clear insight into what his journeys have revealed. The Dutch Government, in assisting the publication of the results, has conferred a benefit on geographers as well as on geologists.

GRENVILLE A. J. COLE.

ANOTHER ATTACK UPON DARWINISM.

Mimicry, Selektion, Darwinismus. By M. C. Piepers, Dr. jur. utr. Pp. 452. (Leyden: Brill, 1903.)

THE theory that natural selection is an important if not an all sufficient explanation of the evolution of animals and plants has had to meet the attacks of a few serious and of many frivolous critics. To the former class belongs Dr. Piepers. We may not approve of his methods or agree with his conclusions, but his wide learning, his special knowledge of a single group of animals—the Lepidoptera—and his laborious efforts to disprove the current theories of evolution are sufficient to justify us in classifying him with the serious critics. Many will, doubtless, shrink from the task of reading with care the four hundred pages of closely written text, without illustration, with which his attack is framed and delivered, but every naturalist who has the courage to do so will find in it a great deal of instruction and—may we add without offence?—no little amusement. I would suggest to those who attempt the task to disregard, if possible, certain features of the work which disfigure the text.

The denunciation of modern theories with such expressions as the "mimicry humbug," the "heresies of modern biological science" and "phantasies"; the unmannerly denunciation of such naturalists as Weismann, Wallace, Bates and Poulton; the description of the unwholesome character of the English race which produced and encouraged a Darwin (p. 397), are unusual in a work of permanent scientific value. Nevertheless, the pages are filled with many facts bearing upon the theories of mimicry and protective resemblance which will certainly be of value to the serious student of natural history, whatever his preconceived ideas may be.

To quote one of the many interesting facts bearing upon the questions in dispute, we find on p. 22:—

"Ich habe selbst einen meiner javanischen Raupensucher, obwohl er das Thier selbst gefangen hatte, plötzlich erschreckt die Hand zurückziehen sehen, als eine Raupe von Hebomoia glaucippe L. die er mir zeigen wollte, ihre Schlangen-Mimicry annahm, und das wiewohl diese Raupe viel kleiner ist als die der Chaerocampa- und Parechidnia-Arten, die sich mehr der Grösse von kleinen Schlangen nähern, und deren Aehnlichkeit dadurch auch noch viel stärker ist."

It may seem incredible that a naturalist who has had the valuable experience of observing such interesting examples of mimicry as this can doubt the utility to the species of pronounced mimetic resemblance to poisonous or dangerous animals, but Dr. Piepers explains the resemblance in another way, and denies its protective value.

Some years ago Wasmann described a remarkable resemblance between an ant of the genus Eciton and a beetle which dwells in its nest belonging to the genus Mimeciton. If we deny, as Dr. Piepers does, that this is a true case of mimicry, it must be due either to an independent convergence of evolution (homeogenesis) or to a similarity in development caused by a similarity of external influences. But it is impossible to conceive that either of these explanations can account for such a close resemblance, even in the details of the antennæ, as this ant and this beetle exhibit. Surely, as Wasmann remarks, the old theory of special creation is more reasonable than either of these.

At the time the book was written, Dr. Piepers had probably not seen the very remarkable paper by Mr. Shelford on mimetic insects from Borneo and Singapore which was read before the Zoological Society in London on November 4, 1902. In this paper so many examples are given of insects and spiders that closely resemble other insects and spiders with which they associate that the theory of homeogenesis must be strained to the breaking point to account for them. There may be some justice in the remark that the experimental evidence is not sufficient to prove the theory of the origin of mimetic resemblance by natural selection; but what evidence of any kind can be brought to support the theory of homeogenesis, or the startling effects produced in mimicry by similar environments? Absolutely none. The impartial reader must be struck in reading these lengthy theses with the fact that singularly little experimental evidence is related in the text, and none that really supports the truth of any theory but that of natural selection. There is plenty of destructive criticism of current theories, there are many weighty objections and difficulties suggested, but if these succeed in destroying Darwinismus there is nothing left in the way of theory that has any basis of support. But there is a little evidence of a direct nature which our author has overlooked that supports the theory of natural selec-

tion. If he refers to the reports of the British Association for 1898 he will find that Poulton and his assistants have proved that the pupæ of *Vanessa urticae* are subject to a severe struggle for existence from birds at Oxford and the Isle of Wight, and that in this case the resemblance in colour of the pupæ to the surroundings is of prime importance in the struggle.

In the face of such evidence as this the statement on p. 386 that it is pure chance which of the seeds of a tree or which of the eggs of an animal survives requires some better proof than we have at present before it is acceptable. The evidence of Guy Marshall in his valuable papers on the bionomics of South African insects adds very materially to the support of the theory of natural selection, and naturalists may rest assured that, notwithstanding the vigour and the ability with which this, the latest, attack upon their trenches has been delivered, the defence of the theory of natural selection is still intact. SYDNEY J. HICKSON.

ASSAYING IN THE COLONIES.

Metallurgical Analysis and Assaying. By W. A. Macleod, B.A., B.Sc., A.O.S.M. (N.Z.), and Chas. Walker, F.C.S. Pp. xii+318; with 109 figures in the text. (London: Charles Griffin and Co., Ltd., 1903.) Price 12*s.* 6*d.* net.

THE aim of this work, as explained by the authors in the preface, is to provide a "graded course of work, leading from simple qualitative analysis up to the technical quantitative methods employed by the modern metallurgical chemist," and is intended to cover a period of three years' laboratory work.

The book is divided into three parts, of which part i., containing 50 pages, deals with qualitative analysis and the properties of gases, and part ii., containing 140 pages, deals mainly with quantitative analysis. Part iii., comprising 118 pages, is subdivided into two sections, the first treating of the ordinary methods of fire assaying, while the second gives an outline of the methods employed in some well-chosen examples of technical analyses.

The authors do not claim any originality of matter, but simply novelty in arrangement which is adapted to meet the requirements of students of schools of mines, "more especially of colonial schools of mines." This distinction between colonial and other schools of mines is difficult to understand, for the work which a qualified metallurgical chemist is required to undertake is independent of the locality in which he has received his training, and if the course of study is to be broad and efficient, a text-book which is suitable for one school of mines will be equally suitable for all. At any school of mines the students must be well grounded in the principles of assaying, so that they can understand, test, and practise any method that is subsequently presented to them.

It is obvious, for example, that the study of assaying should be preceded by a course in chemistry, but this can hardly be included amongst the duties of the instructor in assaying. It would be better that the chapters dealing with such subjects as glass working, the preparation and properties of gases, and elementary qualitative analysis should be omitted, and the matter left to the discretion of the professor of chemistry. Moreover, there are so many excellent text-books dealing with this part of the subject that it seems a pity that the authors should have sought to include it in this volume.

Part iii. has been carefully prepared, and the explanations are invariably clear and concise. Unfortunately, however, it suffers from want of space, and might well be expanded at the expense of some of the earlier chapters of the book. Thus the assay of tin ores is dealt with in a chapter of two pages, and that of lead ores occupies only three pages. Silver also receives three pages, and copper, sulphur, and mercury are dismissed in a short chapter of two pages. In spite of this enforced brevity, however, the authors have made the most of the space at their disposal, and the methods they describe are up to date and trustworthy. No pains have been spared in consulting and quoting from the work of recognised authorities on assaying, but it is doubtful whether the frequent reference to divergent opinions may not, in itself, constitute a source of danger. For example, the student who is told that the length of time required for the fusion of a tin assay by the cyanide method is variously estimated by different writers at from 3 to 30 minutes may be tempted to think that he also can vary the time of fusion within these limits, and still obtain satisfactory results. The importance of uniformity in working cannot be too strongly impressed upon the beginner.

The mistakes are remarkably few and unimportant, and the publication of this volume tends to prove that the teaching of metallurgical analysis and assaying in Australia rests in competent hands.

OUR BOOK SHELF.

The Direction of Hair in Animals and Man. By W. Kidd. Pp. xii+154; illustrated. (London: A. and C. Black, 1903.) Price 5*s.* net.

ALTHOUGH it is quite natural that every student should consider his own pet subject one of special importance, we cannot think that Dr. Kidd has sufficient justification for publishing a second work on the hair-slope of mammals, since the volume before us does not appear to carry the case materially further than was done in "Use-Inheritance." Indeed, since the author himself (p. 122) is fain to admit that hair-whorls, featherings, &c. (as he terms the various abnormalities in the direction of the hair) are variable, intrinsically unimportant, and even whimsical, we should have thought that enough had been made of them in the earlier work. If further evidence of their variability and slight morphological importance be considered necessary, we may refer to Prof. Ray Lankester's recent description of the condition existing in two specimens of the okapi, one of which shows a single and the other a double whorl on the forehead. If, however, the author and his publishers find the public sufficiently interested in the subject to absorb a second work, they have, from their own point of view, a sufficient justification for its issue.

Briefly stated, Dr. Kidd's theory appears to be as follows. In certain mammals, notably many long-bodied and short-limbed carnivores, and many rodents, marsu-

pials, marmosets and lemurs, the hair is found to be uniformly directed backwards from head to tail, and downwards from the flanks to the toes. From this presumed primitive condition there are numerous instances of reversal of the direction, accompanied by the aforesaid whorls and featherings at "critical" points, such points being correlated, in many instances at least, with subjacent centres of muscular activity.

Natural selection, it is urged, will not account for these diversities, and we must, therefore, fall back upon habit or use as the inducing cause. This being admitted, it follows, according to Dr. Kidd, that "use-inheritance" is a factor in nature, and consequently that the doctrine of "non-inheritance of acquired characters" is untrue.

The author concludes his argument by asserting that attempts to bring his facts within the domain of natural selection will be ineffectual; and that if any persons are induced to discredit his arguments by the assertion that as Weismann's doctrine holds good in other instances it ought to obtain in the present case, this is not science. With this we leave the case to the judgment of our readers.

We cannot, however, conclude without directing attention to the numerous "misprints" with which Dr. Kidd's work is disfigured, errors that might have been corrected by half-an-hour's visit to the British Museum. To take only the tables on pp. 153 and 154, we find the following errors, viz *jumela* for *jimela*, *Budonas* for *Budorcas*, *jenlaicus* for *jemlaicus*, *senegamus* for *senganus*, *Œpyceros* for *Æpyceros*, *sömmering* for *soemmerringi*, *madogna* for *Madoqua*, *nalabatus* for *ualabatus*, and *elephus* for *elaphus*. And there is an *erratum*-slip in which not one of these is noted! We may add that the author appears to be unaware of the existence of the name Böocercus for the bongo antelope.

R. L.

South African Flowering Plants. By Prof. G. Henslow. Pp. xii+300. (London: Longmans and Co., 1903.) Price 5*s*.

THIS book is intended to serve as a guide to students and teachers in South Africa who desire to become acquainted with the more important features of their native flora. Types of the principal orders are described, and instructions given for the practical examination of the different floral structures. The general choice of orders and genera is quite judicious; there are certain omissions, such as Asclepias and Schizoglossum in the Asclepiadeæ, and Helichrysum in the Compositæ, and the inclusion of a larger number of genera, even though only briefly described, would have been advantageous. But regarded as a whole, the systematic portion of the book should fulfil its purpose, and help towards a knowledge of the subject. The introductory chapters are not so satisfactory, for the general account of form and function is weak, occasionally incorrect, and the ecological discussion much too short to enable the reader to comprehend the very many striking peculiarities which characterise the flora of the country. And in the chapter on the structure of the flower the author has presented a dull and mechanical treatment of what might be made an extremely interesting subject if taken from the developmental point of view.

Die Bildnis-Photographie. Ein Wegweiser für Fachmänner und Liebhaber. By Fritz Loescher. Pp. xii+180; mit 98 Abbildungen. (Berlin: Gustav Schmidt, 1903.) Price 4.50 marks.

THE author confines himself solely to portrait photography in this book, and a very complete treatise he has given us on the subject. Commencing with a brief historical sketch of the early methods of portraiture from the daguerreotype to the silver bromide gelatine dry plate, on which he makes interesting comments, he then passes through the intermediate stages and describes the modern methods. The next chapter is devoted to the necessary instrumental equipment of a modern studio. This is followed by two chapters on portraiture in-doors and out-of-doors, another on working accessories, such as furniture, backgrounds, &c., and the last two on the production of the negative and positive.

Throughout the book the author has given a clear straightforward account of the various methods of procedure and has illustrated his remarks in a great number of cases by appropriate reproductions; in fact the illustrations form a distinctive feature of the book.

Those who make a speciality of portraiture and who can read German will, no doubt, find many useful wrinkles in these pages, for the author has taken advantage of the various methods practised in different countries and expounded them in their appropriate places.

Descriptive Chemistry. Parts i. and ii. By Lyman C. Newell, Ph.D. Pp. vi+488+135. (London: Heath and Co., 1904.) Prices 4*s*. 6*d*. and 1*s*. 6*d*.

ONE feels a certain amount of diffidence in reviewing a book which, either in the MS. or proof, has passed through the hands (so the preface states) of no less than eight distinguished American professors and teachers of chemistry, but the task is fortunately simplified by finding that the volume, with its small "experimental" companion, is written for teachers and not beginners.

One looks, therefore, more to the manner than to the matter of the book, but there is nothing in either the one or the other which seems to call for special comment. It is a conscientious, uninspired performance. It contains the usual information found in an elementary text-book presented in the usual form, with scraps of organic and physical chemistry, fragments of history, and a description of modern electrolytic processes. It is therefore well up to date, and as an *aide-mémoire* for the teacher is quite trustworthy, provided he expands and vitalises what is dull or unconvincing in the explanatory matter. The illustrations, though not numerous, are good. The picture of a platinum dish might be omitted as superfluous, and the illustration of calcite crystals might do very well for cleavage fragments, but does not represent the familiar forms of the mineral.

The American writers on elementary chemistry have not yet reached the level of their writers on nature-study, and the present volume seems to emphasise the fact that there is still room for a good chemistry for teachers.

J. B. C.

Onde hertziane e Telegrafo senza Fili. By Oreste Murani. Pp. 341; with 172 woodcuts. (Milan: Ulrico Hoepli, 1903.)

THIS is one of the Manueli Hoepli, and, in uniformity with other books of the same series, is of pocket size. In it Prof. Murani has endeavoured to bring some general knowledge as to the nature of wireless telegraphy within reach of those who start with no previous knowledge of electricity. Accordingly, we find in the earlier chapters figures of the proof-plane, the gold-leaf electroscope, the ice-pail, the frog's leg, the crown of cups and Ampère's swimmer, much as they used to figure in the text-books of our youth. The difference of the present book from these old handbooks is evident when we come to electric oscillations, Wehnelt interrupters, and ships with antennæ to their masts. The last two pages give a short biography of Mr. Marconi.

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.*]

Radio-tellurium.

IN an article in the issue of NATURE for February 11 Mr. F. Soddy gave some account of certain of the results of my investigations with regard to radio-tellurium. In this he criticised somewhat severely my choice of a name for the radio-active substance. He holds the substance investigated by me to be identical with polonium, and even goes farther than Madame Curie herself, who, in her recently published "Dissertation," characterises the use of a new name for the substance as premature.

In a paper published by me in the *Berichte der deutschen chemischen Gesellschaft* in September last, I have already given the reasons which have induced me to propose the name radio-tellurium "provisionally" (vorläufig). Mr. Soddy has not discussed these reasons, although he has had the opportunity of making himself acquainted with my communication before writing his criticism. As the question has once been raised before the readers of NATURE, however, it might be of advantage to discuss it here somewhat more fully.

Shortly after the discovery of polonium by M. and Madame Curie, Giesel found that this substance quickly lost its radio-activity, and he characterised it therefore as inducedly active bismuth. P. and S. Curie themselves had, indeed, shortly before the publication of my first paper on the subject, defined polonium as "une espèce de bismut actif." The observations of Giesel and the Curies differ from one another on two points. Giesel's polonium emitted α and β rays and lost its activity within a few weeks, while that of the Curies sent out only α rays, and lost the greater part of its activity only after the lapse of a few months. More recently Giesel has shown that bismuth by prolonged immersion in a solution of pure radium bromide can become permanently (?) active, and then emits only α rays.

Hence there exists with certainty an inducedly active bismuth giving out only α rays, and this might with accuracy be called polonium. There exists, further, a bismuth giving out α and β rays—Giesel's polonium. In this I have found traces of radio-tellurium, and I have shown that after the removal of the latter the remaining substance shows strong β and diminished α radiations. Finally, after the discovery of radio-tellurium, Madame Curie has purified her polonium by fractional precipitation of the subnitrate, and has ultimately arrived at a substance, of which she describes precipitates, the properties of which agree neither with those of bismuth nor with those of radio-tellurium. This substance she calls polonium. It can be seen from this brief summary that the idea associated with the name polonium is an extremely variable and indeterminate one.

In the investigation of bismuth separated from Joachimsthal pitchblende in an essentially different way from Madame Curie,[1] I found a small quantity of tellurium which was extraordinarily active. From one kilogram of bismuth I was able to separate only about a tenth of a gram of tellurium. This had not previously been found in the pitchblende.

Since the substance was distinguished from ordinary tellurium at first only by its radio-activity, I named it radio-tellurium "provisionally." To give a final name to it seemed to me to be premature. The example of polonium showed clearly enough the confusion arising from giving a permanent name to a thing before the thing itself has been accurately defined. Hence Madame Curie can least of all afford to reproach me with being too hasty in my naming.

The further investigation of radio-tellurium showed how necessary was my caution, for it proved that the substance consisted mainly of ordinary tellurium. It was possible, however, to separate, in a quantity amounting at most to a few tenths of 1 per cent., a radio-active substance of extremely high activity in proportion to its quantity. This substance, of which up to the present I possess only a few milligrams, I have named radio-tellurium "provisionally." Ought I, as Mr. Soddy seems to suggest, to call it also polonium, and so increase the present confusion?

Mr. Soddy appears to wish the justification for a new name to depend on the proof of the constancy of radio-activity of my substance. This suggestion of Mr. Soddy's was not necessary to induce me to pursue experiments in this direction. Such are already undertaken in the most accurate manner, but their results, which must be waited for, have not the least to do with the question of nomenclature. The name polonium does not denote a particular substance which has the property of losing its radio-activity with the course of time—who could at present be sure of the constancy of activity of radium?—but merely radio-active bismuth. So far as the constancy of the radio-tellurium emission is concerned, I may here cite the following experiment. A copper plate of about 8 square cm. surface, on which not more than a few hundredths of a milligram of the purest radio-tellurium have been precipitated, now, after nine months, radiates so powerfully that the phosphorescence of zinc blende and of barium platinocyanide can be made visible to an audience of several hundred people.

Mr. Soddy has thought fit towards the close of his article to attribute to certain German organic chemists the custom of "rechristening well-known bodies." In a way that can hardly be misunderstood, he insinuates that this may be traced to an endeavour to claim for themselves the discoveries of others.

This somewhat objectionable charge Mr. Soddy has in no way shown to be grounded. Polonium can, indeed, hardly be reckoned as one of the well-known bodies.

I can also the more easily refrain from answering this aspersion as I am aware that some of the most prominent English chemists have a quite different opinion of their German colleagues from that of Mr. Soddy. I would recommend in this direction a perusal of Prof. P. F. Frankland's address to the chemical section of the British Association in 1901.

W. MARCKWALD.

PROF. MARCKWALD'S communication will probably be welcomed by the scientific world on account of the opportunity it affords of settling finally the disputed question as to the nature of the body named by him "radio-tellurium." In my own mind, before I had read Prof. Marckwald's letter, a doubt still lingered as to the identity of the body with Madame Curie's polonium on account of the very definite statement made by Prof. Marckwald in his first communication on the subject that the activity of his body did not decay with the time. This to me was an insuperable difficulty in the way of considering the two bodies to be identical. The other reasons Prof. Marckwald has advanced—and it is not likely I should have ventured to express an opinion without having made myself acquainted with these reasons—seemed to arise out of a misconception on the part of Prof. Marckwald himself as to the nature of polonium. This point I hope to discuss later, but first I wish to deal with the, to me, important question of the constancy of the radio-activity of radio-tellurium. It is satisfactory to learn that accurate determinations are in progress. Everyone will understand that the results must be waited for. What I did not appreciate before reading Prof. Marckwald's letter was that his conclusion that the activity of radio-tellurium did not decay with time was merely an impression unsupported by actual measurements.

The experiment quoted, that a sample of radio-tellurium after nine months still illuminates a phosphorescent screen brightly, would seem to illustrate my point that Prof. Marckwald even now seems to be under a misapprehension as to the nature of polonium. After nine months, polonium, according to the work of its discoverer, would still possess at least one-half of its initial activity. I suppose no one would maintain that it is possible to remember over a period of nine months the various degrees of luminosity, produced by a radio-active preparation, with sufficient accuracy to be sure of a diminution by one-half of the initial luminosity during that interval. In two or three years the decay of activity of polonium should

[1] Madame Curie has recently published her method of separation. I separated the bismuth from the pitchblende by precipitating it as oxychloride by the addition of much water to the hydrochloric acid solution.

be obvious even with this rough test, but it certainly would not be sufficiently marked in nine months. We may therefore take it as settled that there is absolutely no evidence at the present time for supposing that radio-tellurium possesses a more constant radio-activity than polonium. If only this point has been made clear this correspondence may be considered to have justified itself.

According to Prof. Marckwald the idea associated with the term polonium is an extremely variable and indeterminate one. It seems to me that this is to put a wrong valuation on the work of its discoverer. Madame Curie gave the name to the hypothetical constituent of the bismuth separated from Joachimsthal pitchblende which caused its radio-activity. The radio-activity in question is distinct from that of any known radio-active substance, for it comprises only the emission of the α or non-penetrating type of radiation. Moreover, it slowly decays with time, and diminishes to half the initial value in about a year. Madame Curie has always been careful to point out that she has not succeeded in separating polonium from bismuth, or in obtaining any spectroscopic or other more direct proof of its existence. The name polonium applies to the body *causing this particular kind of radio-activity*. Hundreds of workers, I suppose, have obtained from the Société de Produits Chimique de Paris specimens of polonium prepared by Madame Curie's method, and have satisfied themselves by their own observations as to the character of its radio-activity. Now Prof. Marckwald has never claimed that he has isolated his body radio-tellurium, although he has been more fortunate than Madame Curie in effecting its concentration. Hence the name radio-tellurium applies also to the hypothetical constituent causing the radio-activity rather than to the preparation itself. Many, no doubt, have obtained also specimens of radio-tellurium from the firm of Dr. Sthamer, of Hamburg, and have compared its properties with those of polonium.

The meaning applied by Prof. Marckwald to the word polonium may be illustrated by these sentences quoted from his letter. "Shortly after the discovery of polonium Giesel found that this substance quickly lost its radio-activity. . . ." "Giesel's polonium emitted α and β rays and lost its activity within a few weeks." "In this (Giesel's polonium) I have found traces of radio-tellurium, and I have shown that after the removal of the latter the remaining substance shows strong β and diminished α radiation."

The question at issue is therefore a very simple one. Is Prof. Marckwald justified in applying Madame Curie's name to Prof. Giesel's preparation? "Giesel's polonium," according to Prof. Marckwald's statement, is a mixture of two radio-active constituents:—(1) radio-tellurium, (2) a constituent giving β as well as α rays. The latter, since it can neither have been polonium nor radio-tellurium, need not be further considered in the present discussion. It *may* be something new and interesting, but, on the other hand, there is nothing to show that it was not merely a trace of radium present as an impurity. In either case it does not concern us, and two bodies only, Madame Curie's polonium and Prof. Marckwald's radio-tellurium, need be further considered. Both are obtained from the same variety of pitchblende, both are distinguished from all the other radio-elements by the fact that they only give α rays, and both possess at least a considerable fraction of their initial activity after the lapse of one year. Now Prof. Marckwald used the same[1] raw material as Madame Curie, namely, the bismuth extracted from the Joachimsthal pitchblende. Since he states that his method separated *all* the active constituent we may feel certain (1) that radio-tellurium must certainly contain polonium; (2) that as it gives no β rays it contains none other of the known radio-active elements; (3) that as the radio-active properties of the two preparations are indistinguishable the active constituent of Prof. Marckwald's preparation is the same as that of Madame Curie's preparation, and therefore by every recognised canon should be termed polonium.

Prof. Marckwald's work has shown that there are present on a maximum estimate 4 milligrams of the active constituent in two tons of pitchblende, or in 8 kilograms of the bismuth salt separated from it. Hence what possible bearing can such a small trace of substance have upon the analytical reactions of the relatively vast bulk of the raw material? In laying stress on these reactions he frequently seems to apply the term polonium to Madame Curie's preparation rather than to its radio-active constituent.

The same criticism might be applied to the following sentence, to be found in his most recent communication (*Berichte*, 1903, p. 2665). "Whether this Curie's polonium does not perhaps contain also some radio-tellurium is a question which must be left to the discoverers of polonium."

With regard to the view expressed that polonium is merely radio-active bismuth, or inducedly active bismuth, in support of which an opinion once expressed by Madame Curie is quoted, the answer, of course, is that Prof. Marckwald's own subsequent work has shown otherwise. By the experiment of depositing on a stick of pure bismuth the whole of the polonium present in a solution, he makes it evident that the latter cannot be bismuth. Those who are acquainted with the work of Rutherford in 1900 on "induced" activity know that the whole conception of radio-active induction has been built up on a simple misconception of the phenomena it is designed to explain. The conception had its origin in the belief that the *rays* from a radio-active substance could excite radio-activity in otherwise inactive matter, which was not in accordance with the facts known at the time it was put forward.

Giesel repeated the identical experiment of Prof. Marckwald with a solution of pure radium, and found that a stick of bismuth after immersion becomes permanently (?) active and then only emits α rays, and Prof. Marckwald, in spite of his own work, concludes that there exists with certainty an inducedly active bismuth giving only α rays, which might with accuracy be termed polonium. He, however, omitted to state that Giesel obtained the identical result if a stick of platinum or palladium were immersed in the radium solution. Hence it might be argued that there exist an inducedly active platinum and an inducedly active palladium, both of which might with accuracy be termed polonium. The alchemists considered that they had turned iron into copper by means of a solution of blue vitriol, until it was pointed out that the latter substance contains copper. It has never been shown that any of the effects of the so-called "radio-active induction" are really due to the conversion of an inactive element into radio-active matter. From the existing evidence to the contrary, it would seem more reasonable to suppose that they admit of a similar interpretation to that now adopted to explain the cuprification of iron.

FREDERICK SODDY.

[1] The point raised in the footnote to Prof. Marckwald's letter is, I take it, a side-issue. He brings forward no evidence that the bismuth separated from the pitchblende by sulphuretted hydrogen (Curie) is different in its radio-active properties from that separated by himself as oxychloride, nor any reason for supposing that the active constituent in the two cases might be expected to be different. It is true that his bismuth contained a minute proportion of ordinary inactive tellurium, which was probably almost or quite absent in Madame Curie's preparation. This fact he made use of as the basis of his elegant method of concentrating the active constituent, and he seems to have at first confused the difference of behaviour of the two raw materials to differences in the chemical nature of the active constituents rather than to the fortuitous presence of a trace of tellurium. But his own later experiments (*Berichte*, 1903, p. 2663) show that when the tellurium is removed from the solution his methods of precipitating the active constituent completely fail, but again work perfectly if a few tenths of a milligram of ordinary telluric acid in aqueous solution are added.

Dependence of the Ionisation, produced by Röntgen Rays, upon the Type of the Rays.

MR. EVE, in his letter in NATURE of March 10 (p. 436), shows that the relative amount of ionisation produced by Röntgen rays in different gases depends upon the "hardness" or penetrating power of the rays. I have lately been investigating this question of the dependence of the relative ionisation upon the type of rays, and an abstract of a preliminary paper on the subject appeared in a report of the proceedings of the Cambridge Philosophical Society in the number of NATURE issued on February 18 (p. 383). These experiments, along with later ones, show that the relative ionisation in different gases depends upon the type of rays used. I used a balance method, balancing the ionisation in each gas against that in air. The pressure of the gas in the Röntgen ray bulb was varied, thereby varying the "hardness" of the rays, and it was found that in the case of gases in which the ionisation is greater than in air the ionisation in these gases decreases relatively to that in air

as the rays become harder. This result is in agreement with that given by Mr. Eve. I find also that in hydrogen, in which the ionisation is much less than in air, the ionisation increases relatively to that in air with the increase of hardness of the rays.

The experiments are not quite completed yet, but it is hoped to publish a full account of them shortly.

R. K. McCLUNG.

Cavendish Laboratory, Cambridge, March 12.

Polarisation in Röntgen Rays.

IN a paper on secondary radiation from gases subject to X-rays (*Phil. Mag.* [6] v., p. 685, 1903), I described experiments which led to the conclusion that this radiation is due to what may be called a scattering of the primary X-rays by the corpuscles (or electrons) constituting the molecules of the gas. More recently I have found that from light solids which emit a secondary radiation differing little from the primary, the energy of this radiation follows accurately the same law as was found for gases, so that the energy of secondary radiation from gases or light solids situated in a beam of Röntgen radiation of definite intensity is proportional merely to the quantity of matter through which the radiation passes. Experimental evidence points to a similar conclusion even when metals which emit a secondary radiation differing enormously from the primary are used as radiators, though I have as yet only shown that the order of magnitude is the same in these cases. The conclusion as to the origin of this radiation is therefore equally applicable to light solids, and probably to the heavier metals.

As explained by Prof. J. J. Thomson ("Conduction of Electricity through Gases," p. 268), on the hypothesis that Röntgen rays consist of a succession of electromagnetic pulses in the ether, each ion in the medium has its motion accelerated by the intense electric fields in these pulses, and consequently is the origin of a secondary radiation, which is most intense in the direction perpendicular to that of acceleration of the ion, and vanishes in the direction of that acceleration. The direction of electric intensity at a point in a secondary pulse is perpendicular to the line joining this point and the origin of the pulse, and is in the plane passing through the direction of acceleration of the ion.

If, then, a secondary beam be studied, the direction of propagation of which is perpendicular to that of the primary, it will on this theory be plane polarised, the direction of electric intensity being parallel to the pulse front in the primary beam.

If the primary beam be plane polarised, then the secondary radiation from the charged corpuscles or electrons has a maximum intensity in a direction perpendicular to that of electric displacement in the primary beam, and zero intensity in the direction of electric displacement. Prof. Wilberforce first suggested to me the idea of producing a plane polarised beam by a secondary radiator, and of testing the polarisation by a tertiary radiator.

The secondary radiation from gases is, however, much too feeble to attempt the measurement of a tertiary. From solids I think it will be possible, and hope shortly to make experiments on this.

It occurred to me, however, that as Röntgen radiation is produced in a bulb by a directed stream of electrons, there is probably at the antikathode a greater acceleration along the line of propagation of the kathode rays than in a direction at right angles; consequently, if a beam of X-rays proceeding in a direction perpendicular to that of the kathode stream be studied, it should show greater electric intensity parallel to the stream than in a direction at right angles.

I therefore used such a beam as the primary radiation, and studied by means of an electroscope the intensity of secondary radiation proceeding from a sheet of paper in a direction perpendicular to that of propagation of the primary beam.

By turning the bulb round the axis of the primary beam studied, the intensity of this beam was not altered, but the intensity of the secondary beam was found to reach a maximum when the direction of the kathode stream was perpendicular to that of propagation of the secondary beam, and a minimum when these two were parallel.

In one series of experiments the intensity of secondary radiation in a direction perpendicular to that of the primary beam was compared with that in a direction making a small angle with the axis of the primary beam. The latter, according to theory, should not vary with the position of the X-ray bulb.

In a second series of experiments the intensity of secondary radiation in a direction perpendicular to the axis of the primary beam was compared with that of a small portion of the primary beam itself, when the bulb was in different positions.

Lastly, the intensity of secondary radiation was measured in two directions perpendicular to that of propagation of the primary radiation and perpendicular to each other, while the intensity of the primary beam was measured by a third electroscope.

The three methods gave similar results.

In the last case, as the bulb was turned round as described, one secondary beam reached a maximum of intensity when that at right angles attained a minimum. When the bulb was turned through a right angle the former produced a minimum of ionisation while the latter produced a maximum.

Two bulbs were used and the sizes of the apertures were varied, but the results were similar in all cases.

The variation of intensity of the secondary beam amounted to about 15 per cent. of its value, but this, of course, does not represent the true difference, as beams of considerable cross section were studied, consequently secondary rays making a considerable angle with the normal to the direction of propagation of the primary rays were admitted into the electroscope.

The experiments are being continued.

These results, however, are in agreement with the theory, and I think show conclusively that the X-radiation proceeding from a bulb is partially polarised.

CHARLES G. BARKLA.

University of Liverpool, March 10.

The British Government and Marine Biology.

IN a note in your issue of February 25 announcing the appointment of Mr. James Hornell, who, it is stated, acted as Prof. Herdman's assistant during the Ceylon pearl oyster investigation, to the post of marine biologist to the Government of Ceylon and inspector of the pearl banks, it is said that "the appointment is of interest as showing how in the recognition of science some of our colonies are in advance of the mother country. We have no 'marine biologist to the Government' here."

Now although the latter statement may be verbally accurate, it appears to me to be misleading, and one would seem to be justified in supposing that it has been made without full knowledge of the facts.

At the present time the British Government is committed to an expenditure of 42,000*l.*, to be spread over a period of three years, for the purpose of carrying out the British portion of the international fishery investigations, the programme of which, conceived in an eminently scientific spirit, has been drawn up by an international council comprising amongst its members some of the most distinguished of European marine biologists. In addition to this the Government has made for a number of years, and still continues to make, a grant of 1000*l.* a year to the Marine Biological Association, the declared object of which is the promotion of both scientific and economic marine biology; public money has been spent on scientific fishery investigations in both Scotland and Ireland, and the Government has quite recently appointed Dr. A. T. Masterman, a well known and capable marine biologist, to the post of inspector of fisheries.

To decline to acknowledge what is already being done is surely not the way to obtain increased support for scientific investigations in the future.

E. J. ALLEN.

Marine Laboratory, Plymouth.

THE brief statement contained in the note was quite correct, and although it might be expanded and illustrated, it needs no qualification. We were well aware of all the facts stated by Dr. Allen.

The fact that the British Government has given a considerable grant for a limited and short period in order to meet part of the expense of an international fishery investigation does not, unfortunately, enable us to claim that we have a "marine biologist to the Government." The Government gives various grants to enable special pieces of scientific work to be carried out, but that does not constitute the recipients Government officials.

Dr. Allen reminds us that a marine biologist has been recently appointed inspector of fisheries. Fortunately that is no new thing. The list in the past includes Huxley and Frank Buckland, and we hope that all our inspectors of fisheries are competent biologists—but they are H.M.'s "Inspectors of Fisheries."

The Government grant to the Marine Biological Association goes to no Government official. The cover of the current number of the *Journal* of the Marine Biological Association announces that "The Association owes its existence and its present satisfactory condition to a combination of scientific naturalists, and of gentlemen who, from philanthropic or practical reasons, are specially interested in the great sea-fisheries of the United Kingdom." This is no Government institution.

One of the conditions attached to the annual grant from the Treasury was that space at the Plymouth Laboratory should be placed at the disposal of any competent investigator deputed to carry out investigations into fishery questions. None of the Government fishery departments (England, Scotland, Ireland) have, however, availed themselves of this condition. Where, then, is the "Government marine biologist"? THE WRITER OF THE NOTE.

Learned and Unlearned Societies.

MR. BASSET'S letter (p. 437) is of importance in giving authoritative evidence of what goes on behind the scenes. It was only a matter of suspicion with me that the benevolent rejectors sometimes knew even less about the subjects of the papers than the authors themselves. But the remedy proposed by Mr. Basset is, I fear, a very unsatisfactory one. Just the same sort of thing can and does occur elsewhere. The only right and proper course seems to be that indicated by Mr. Buchanan. It would be enormously to the advantage of an old-established institution, and to its members, even though there might sometimes be some counteraction by the admission of poor matter. But it is not necessary to repeat here Mr. Buchanan's argument, which was very strong and full of common sense. OLIVER HEAVISIDE.

March 13.

A Plea for Good English.

I BELIEVE the phrase that "language was given us to conceal our thoughts" only holds good in diplomacy, and it may therefore be reasonably expected that a professor of science should endeavour to teach his pupils to express themselves in clear, concise and literary English. The German language lends itself to a process known as word-building, and for aught I know to the contrary, the word "Schwefelkohlenstoff" may be good, literary German. But this process is altogether foreign to the genius of the English language, and I cannot imagine a more barbaric or misleading conglomeration of verbiage than the phrase "chalk-stuff-gas." Chalk is popularly associated with lime, or, to speak more accurately, with calcium, and to call a substance "chalk-stuff-gas" which does not contain an atom of calcium appears to me a misuse of language, especially as CO_2 can be prepared in various ways without using any substance containing calcium, or what is popularly known as "chalk" or "lime." It seems to me that it would be difficult to invent a more suitable phrase than "carbon dioxide," since it expresses in terse and pointed language the chemical composition of the gas.

Alassio, March 9. A. B. BASSET.

Zoological Nomenclature.

ON p. 200 of your issue of December 31, 1903, just arrived, in a review by "W. T. B." I note an allusion to my "curious illustrations of zoological nomenclature," and it is stated that my "new name" (which, by the way, was proposed in 1899!) "is given to a genus the type of which appears, according to the rules of Linnæus himself, to be also the type of the Linnæan genus Cimex."

Where, sir, are these "rules of Linnæus himself" in which the fixation of types is set forth? I was under the impression that we were indebted to Fabricius for these indispensable aids to zoological nomenclature, and I would be grateful for the reference to Linnæus.

Your reviewer's remark on Cimex contains an error; "lectularius" is not and cannot be the type of Cimex, Linn., (1) because it does not conform to the description of that genus as set forth by the founder. Moreover, if the type be worked out historically, "lectularius" is equally invalid; the first discerptor was Fabricius, who, in a perfectly straightforward manner, removed our species from Cimex to form a part of his new genus Acanthia. This effectively prevents lectularius from ever appearing as the type of Cimex, and it is a fact well known to the students of the Rhynchota.

Further, lest it might be thought that the proper generic name of lectularius is Acanthia, let me mention that in 1797 Latreille restricted the latter to "littoralis" and its congeners, and "lectularius" was again shut out, the way that, so far as my knowledge then went, I was justified in proposing a new name. However, since then I have acquired a somewhat rare book, the "Hemiptera Sueciæ" (1829), the authorship of which is usually ascribed to Fallén, but is mentioned as Johannes Petersson for p. 141, where "Clinocoris" is proposed, and I willingly, and, indeed, inevitably, retire in favour of this for the unfortunate and so long homeless "bed-bug." My previous ignorance of this was shared apparently by everyone since the first announcement of the name (as applied to lectularius).

With regard to the "curious illustrations of zoological nomenclature," I would refer "W. T. B." to the witty and able "Zoological Nomenclature. Remarks on the Proposed International Code," by T. R. R. Stebbing, in the *Zoologist* for October 15, 1898, 2, pp. 423–8. As the reverend karkinologist remarks, "no possible harm is done if we do leave to the polished scholar some little occasion for chuckling over us untutored sons of science."

G. W. KIRKALDY.

Department of Agriculture, Honolulu, H.I., January 26.

MR. KIRKALDY'S remarks about the type of the Linnæan genus Cimex are a quibble, to which it is sufficient reply to point out that in the passage which he quotes and attempts to ridicule it was not stated that *Cimex lectularius* was made the type of the genus by Linnæus.

Although the selection of one species of each genus as the type is of later date than Linnæus, several of the Linnæan genera are clearly founded on a particular species in each case. Thus, to take familiar forms, Equus is named from the horse, and it is therefore correct to say that *E. caballus* is the type of the Linnæan genus Equus. Similarly *Bos taurus* is the type of Bos, and *Canis familiaris* of Canis. Similar cases are rare amongst invertebrate animals, but Cimex is an exception, for the generic name was taken from a species in the Linnæan genus that was called Cimex in classical Latin. The only species that can be clearly identified with the Latin name appears to be *C. lectularius*, Linn.

This, however, has been disputed—what opinion has not?—by a few amongst the very many writers who have treated the question of Cimex and Acanthia, so another reason may be given for regarding *C. lectularius* as the type of Cimex. The rule of Linnæus, quoted below, was that if a genus be divided, the commonest and best known species should be retained under the original generic name. There can be no question that *C. lectularius* is by far the best known species of the genus.

The "rules of Linnæus himself" were printed in his "Philosophia Botanica," and quoted by Agassiz in the introduction to the "Nomenclator Zoologicus." These rules have always been regarded as authoritative by both botanists and zoologists, and should in any case be consulted when Linnæan genera and species are concerned. The two following rules apply in the present case:—

242. *Nomen genericum* Antiquum *antiquo generi convenit.*

246. *Si genus receptum, secundum jus naturae et artis*

in plura dirimi *debet, tum nomen antea* commune *manebit* vulgatissimæ *et officinali plantae.*

It must be evident that when Fabricius removed *Cimex lectularius* from Cimex and placed it in a new genus Acanthia, he disregarded the rules of Linnæus, and his classification in this instance was rejected by Latreille and by many later writers. What would be thought of a naturalist who proposed to remove the dog from the Linnæan genus Canis, and to retain that generic name for the hyæna, which was included in the genus by Linnæus? According to Mr. Kirkaldy's contention this is the nomenclature we should be bound to adopt by the "rule of priority" if the individual who proposed the absurdity happened to be the first to divide the original genus.

Mr. Kirkaldy has not pointed out in what respect *C. lectularius* does not conform to the description of the genus Cimex as set forth by the founder. He probably refers to the mention of four wings amongst the generic characters, *C. lectularius* being apterous or nearly so. The objection is invalid in view of the facts already stated, and of the inclusion of the species in the genus by Linnæus, who prominently recorded the absence of wings in this case.

The subordinate question as to the type of Acanthia has been discussed *ad nauseam*. Anyone who feels interested in the matter will find a full history by Reuter in the *Wiener Entomologische Zeitung*, vol. i., 1882, p. 301. By an argument rather different from that above given, Reuter came to the same conclusion as to the type of Cimex. Mr. Kirkaldy's last proposal, to use Clinocoris for *C. lectularius*, is a curious illustration of his method. Clinocoris was suggested in the "Hemiptera Sueciæ" as a name to be substituted for the Fabrician Acanthia, because "*forsan convenientius judicabitur nomen Clinocoris.*" But this substitution of one name for another on the score of convenience is absolutely in defiance of the "rule of priority."

W. T. B.

Spawning of the Plaice.

THE plaice (*Pleuronectes platessa*) in the open-air pond at the Port Erin Biological Station started spawning on March 3, and those at the Piel (Lancashire) Sea-Fish Hatchery (under cover) on March 1. This is about a week earlier than last year (March 9). It would be interesting to know how this record compares with that of fish in the sea. At the time of writing I have no returns that will give the information for the Irish Sea, though I hope to know later. Probably the officials of the International Investigation will be able to speak of the condition in the North Sea, and those of the Plymouth Biological Station in regard to the English Channel. W. A. HERDMAN.

Liverpool, March 8.

Preliminary Measurement of the Short Wave-lengths discovered by Schumann.

FOR the past few years the writer has been engaged in an attempt to measure the short wave-lengths discovered by Dr. Victor Schumann, and very recently the attempt has proved successful.

Working in an atmosphere of hydrogen with a concave grating ruled on speculum metal, an "end-on" tube filled with hydrogen gives numerous lines below the aluminium group at 1854 Ångström units.

The shortest of these wave-lengths so far observed by the writer has a value 1206 Ångström units. Thus the measurable spectrum has been extended by 648 units.

It is interesting to note that, contrary to expectation, speculum metal is able to reflect these very short wave-lengths to a considerable degree.

The writer has in preparation a complete list of the new wave-lengths. He has also good hopes of still further extending the spectrum. THEODORE LYMAN.

Jefferson Physical Laboratory, Harvard University, February 29.

Women and Sanitary Science.

IN your issue of February 11 a reference was made to a recent report of the Subcommittee on Technical Instruction for Women appointed by the Technical Education Board of the London County Council, quoting one of the recommendations of the committee that "Classes be established for the training of women in hygiene and sanitation with a view to their taking up the occupation of sanitary, workshop or public health inspectors, or of rent collectors."

May I urge in this connection the great importance of all training in hygiene and sanitation being thoroughly scientific in character and based upon practical teaching in chemistry, physics, physiology, and bacteriology?

"Hygiene," to quote Dr. T. M. Legge, H.M. Medical Inspector of Factories, "is not a science in itself, but is the meeting point where several exact sciences widely distinct from each other meet and yield up that element they possess which can be of practical use in the prevention of disease and the preservation of health."

At every turn the inspector or health worker is brought face to face with facts which can only be appreciated in their true light by a person who has had some considerable scientific training, and the greater their scientific knowledge the more enlightened and efficient will their work be.

Bedford College in 1895 established a scientific course in hygiene for women. While amply providing for the necessary practical demonstrations in hygiene proper, we continue to attach great importance to laboratory work in chemistry, physics, physiology, and bacteriology, as we believe the latter to be essential to a thorough teaching of hygiene, and necessary if women are to have a first-hand knowledge of the subject and become intelligent and effective workers. ETHEL HURLBATT.

Bedford College for Women, York Place, Baker Street, W.

Aërial Tubers on the Potato.

I DO not know whether the appearance of tubers on the stems of potatoes as well as underground is a frequent occurrence, but last season I noticed several plants presenting this appearance. One of the plants had a large number of underground tubers as well as those appearing above ground. The abnormal tubers were purple in colour; each one had several "eyes," and one or two minute green leaves showed in each "eye." The garden is a very stiff clay. The season was very wet as the potatoes were maturing; in fact, the ground was too soft to allow of digging at the proper time. My explanation is that the great quantity of water on the ground destroyed the balance between producing power in the leaves and storage power in the normal tubers, and that the surplus production deposited itself in the stems, which at the selected spots became modified tubers. W. TRAYLEN.

Guildford, Western Australia, January 28.

THE appearance of tubers on the haulm in the axils of the leaves is not uncommon, and as the bud and the tuber are homologous, the circumstance is only what might be expected.

In this country it is generally considered that some injury to the subterranean part of the plant, as by the spade or fork, or perhaps by wire worm or other destructive insect, is the inducing cause of the production of aërial tubers. I am, however, not aware whether this has been demonstrably proved. M. T. M.

March 8.

THE CEYLON PEARL FISHERIES AND THEIR ADMINISTRATION.[1]

A VERY remarkable feature of the Ceylon pearl fisheries has been their uncertainty and intermittent character. Thus only thirty-six fisheries took place during the nineteenth century, or, put in another way, for just half a century the fishery banks lay barren. These blank years sometimes followed one another in dreary succession, as may be seen from the fact that for seventeen years—from 1837 to 1854—and again for nine years—from 1864 to 1873—practically no fishing was done. For a decade before the investigation embodied in this report was begun the beds lay

[1] "Report to the Government of Ceylon on the Pearl Oyster Fisheries of the Gulf of Manaar." By W. A. Herdman, D.Sc., F.R.S., &c. Part Pp. xii+307. (London: Royal Society, 1903.)

tenantless. Occasional breaks of five years or less account for the remainder of these years of famine. But this apparently inexplicable state of affairs is by no means of modern date; for centuries these fat and lean seasons have been the despair of those interested in the collection of these gems.

All kinds of theories, or rather speculations, have been promulgated, but the mystery remained, until now, as impenetrable as ever. Undoubtedly, then, the immense importance and value of these fisheries called for some effort on the part of the Government, not only to attempt a solution, but also to find a remedy for these years of failure. To this end the Colonial Office, acting on the advice of Prof. E. Ray Lankester, invited Prof. Herdman to examine the records on this subject and to report to them. As a result of this report Prof. Herdman was induced by the Government to make a personal inspection of the pearl banks. Taking with him Mr. Hornell as his scientific assistant, he accordingly set out for Ceylon, and instituted a thorough examination of the whole question, the results of which are set out, in part, in the volume before us. Without doubt the task that lay before these investigators was no light one, and it is equally certain that it has been admirably fulfilled. As the pages of this volume show, the expedition has not only been abundantly fruitful in scientific results, but it has achieved the purpose for which it was dispatched.

A complete survey of the whole sea bottom of the pearl fisheries area has now been made, partly by sounding and dredging and partly by the aid of divers. In some cases even, Mr. Hornell himself descended in a European diving dress. By this survey a thorough knowledge has been gained, not only of the nature of the ground best suited for the growth of the pearl oyster, but also of the dangers by which this animal is beset.

Flourishing beds may be depleted by the ravages of boring sponges, boring molluscs, starfishes, internal parasites, and fishes, though the destruction wrought by these is generally slight compared with the wholesale destruction caused by shifting sands due to currents, or churned up by the south-west monsoon. By way of illustrating the vast scale of catastrophes of this kind, an instance—one of several—may be selected here. One bed examined in March, extending over an area of sixteen square miles, was covered with enormous quantities of young oysters "so closely packed that the bank must have held not less than about a hundred thousand million." Early in November of the same year this spot was revisited, when this vast host was found to have vanished, having been buried in the sand or swept down the deep declivity outside the bed.

The loss which results from overcrowding is, on some beds, almost as wholesale. If, however, Prof. Herdman's suggestions are carried out, this enormous waste will in future be prevented by the simple expedient of transplanting to sheltered spots affording suitable conditions for growth and infection. Nature has often to be assisted in the preparation of these spots by the process known as "culching," that is, scattering the floor of the bed with rock, loose coral, and so on, to afford the necessary anchorage for the byssus of the young oyster.

What havoc may be caused by starfishes can be gathered from the fact that a bank examined in March, 1902, lodged a crop of oysters estimated at $5\frac{3}{4}$ millions; by March, 1903, they had nearly gone!

Over-fishing is another source of danger, though in future, if Prof. Herdman's plan of transplanting is judiciously carried out, this need not be feared. In many places, it has been discovered, fishing may be carried on by dredging instead of by diving, though there are many places where the nature of the bottom will still compel the services of the native diver.

On the question of the formation of pearls this book contains much of great interest, and yet fuller details are promised in the next volume. Only in extremely rare cases did these investigators find that the nucleus of a pearl is formed by a grain of sand. Boring sponges and burrowing worms cause the formation of pearls or pearly excrescences on the inner surface of the shell by the irritation which they set up. Pearls of a peculiar kind are found in the muscular tissues, usually the levators of the foot. These also have no organic nuclei, but seem to start as minute calcareous concretions, and may be extraordinarily abundant.

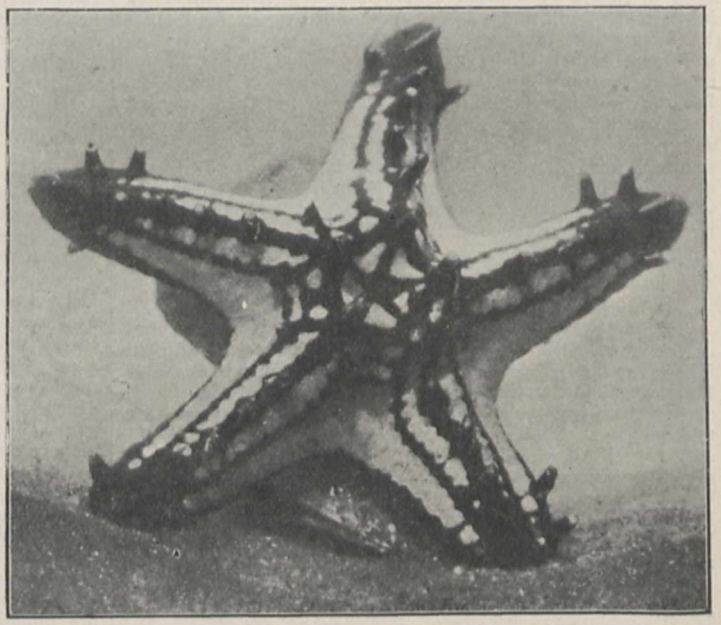


FIG. 1.—*Pentaceros lincki*, DeBl., lying on a large pearl oyster, half natural size. From a photograph by J. Hornell.

Thus, at the insertion of one of the levator muscles 23 small pearls were detected with the naked eye, whilst under the microscope 170 more tiny spherules were found. But the best "orient" or "cyst" pearls are those which occur in the mantle "or in the thick white lateral part over the stomach and liver, or even, secondarily, free in a cavity of the body." Caused by the secretion of concentric layers of nacre around the dead body of a parasite—generally that of a platyhelminthean larva—these pearls attain their greatest size in oysters of from three and a half to five years of age.

This parasite has an interesting history. Commencing life as a free-swimming embryo, it, in favourable circumstances, finds an entrance between the open valves of the oyster shell, or is drawn in by inhalent currents. The entry once gained, the next step is to bore into the tissues of the host, and here it undergoes the early stages of its growth. If the fates are propitious the host is eaten, and the developing worm escapes uninjured from the body of its first into that

of its second host—a file-fish (Balistes). If the life-history is to be completed, the file-fish must in turn be swallowed by one of the large elasmobranchs, within the body of which the final adult stage is reached, and from thence escape the free-swimming embryos to renew the cycle. In these cases, however, where all runs smoothly—for the parasite—no pearls are formed. On the other hand, when the oyster escapes the file-fish, the larval parasite, unable to complete its development, dies, and becomes encapsuled by the pearly nacre deposited by the living tissues of the oyster upon the source of irritation.

Throughout his report Prof. Herdman bestows unstinted praise on the work of his assistant, Mr. Hornell, and there can be no doubt but that it is most thoroughly deserved, for much work of the highest importance was entrusted to him, and he in every case proved worthy of the trust. We are therefore glad that Prof. Herdman's wish has been fulfilled—

FIG. 2.—Valuation sample of pearl oysters from the Cheval Paar, being brought on board the *Kangasameeparawee* from the inspection boats. From a photograph by J. Hornell.

that Mr. Hornell should be asked to continue his observations as marine biologist at the Galle Laboratory—for he will now be able to render "signal service to the pearl, sponge, trepang and other marine fisheries of the Colony."

In concluding this notice we must not omit to mention that a series of separate reports has been prepared by various specialists on material collected during this investigation. Seven of these reports are included in the present volume, and others are to follow. The first of these deals with the geology of the sea-bottom, and describes the formation of the peculiar bottom essential to the presence and well-being of the pearl oyster. Mrs. Gepp, in an account of the algæ collected, describes the hitherto unknown fructification of a species of Halimeda.

The remaining reports are zoological, and describe the Gephyrea, Chitons, Holothurians, Cephalochorda, and Copepoda. Mr. Tatersall's report on Amphioxus will be read with great interest. No less than seven of the eleven species known occur around Ceylon. "The tables at the end of the report show how extremely variable the species of the group are, and the more extended our knowledge of this group becomes the less do the species appear to be separated." The report on the Copepoda, by Messrs. Thomson and Scott, is by far the largest of these supplementary reports, and embraces descriptions of no less than 283 species, of which 76 are new to science.

Further description of this most valuable book we cannot give. It must be read to be appreciated. The vast wealth of information contained in Prof. Herdman's report on the pearl oyster alone demanded far more space than we have been enabled to afford it. Enough, however, has probably been said to show that the commission was not only completely justified, but has resulted in a rich harvest of facts which appeal not merely to those interested in the pearl fisheries or to students of mollusca, but to the biologist the world over.

The volume is well bound, well printed, and profusely illustrated. W. P. P.

THE CAMPAIGN AGAINST MALARIA.[1]

THE unhealthiness of many tropical countries is largely due to the prevalence of malarial diseases. The discovery that a particular kind of mosquito is the definitive host of the malaria parasite paved the way for a method of prevention based upon the destruction of the malaria-bearing mosquitoes, which, so far as present knowledge goes, all belong to the genus Anopheles. At first the measures of prevention were individual rather than general, and included the destruction of mosquitoes in and about the house, and their exclusion by nets and wire gauze. But through the labours of Major Ronald Ross on the west coast of Africa, and of the Americans in Cuba and elsewhere, it has been shown that much may be done to free a whole town from mosquitoes, thereby diminishing the incidence of malaria.

The report under review details the measures initiated in India by the members of the Royal Society's Malaria Commission to test the efficacy of mosquito destruction in the prevention of malaria. The station selected was Mian-Mir, a cantonment near Lahore, the garrison of which consists of about 3900 officers and men, British and native, and of 600 native followers. Situated in a plain with an average rainfall of about 20 inches, little of the surface water can drain away, especially as the subsoil is exceedingly impervious, so that after one or two hours' rain the locality becomes flooded. In addition there are numerous brick-work surface drains, which become filled and form excellent breeding-places for the Anopheles until dried up by the sun. Owing to these conditions, Mian-Mir is one of the most unhealthy cantonments in India, the mean annual admission rate for ague among European troops averaging 663 per 1000. Six species of Anopheles were found to be present, of which *A. Rossii* was the most abundant, the numbers reaching a maximum in September and October.

The methods of prevention adopted were (1) the cleaning of irrigation water courses, smoothing their sides, and where possible lining with brick and cement; (2) drying out and cleaning branch water courses every ten days; (3) treatment of water courses with kerosene oil; (4) draining small collections of stagnant water;

[1] "The First Report of the Anti-malarial Operations at Mian-Mir, 1901–1903." By Capt. S. P. James, I.M.S. (*Scientific Memoirs* of the Government of India, No. 6. Calcutta, 1903.)

(5) constant attention to collections of water in gardens of houses and bungalows. In addition the segregation of Europeans was carried out to a limited degree, removing them from the vicinity of infected natives, treatment of all infected persons with quinine and the prophylactic use of quinine, the troops being paraded twice a week for this purpose. The results obtained were a distinct but not great diminution in the number of Anopheles present in the houses, and a diminution in the admission rate for ague to 269 per 1000, the lowest rate on record (1902 happened to be, however, an exceptionally healthy year). Captain James concludes that mosquito destruction, even though not obviously reducing the number of Anopheles, brings about a decrease in the amount of malaria, but is difficult to carry out and is expensive; apparently the campaign against the mosquitoes at Mian-Mir was not nearly so successful as that in Lagos. He attributes great value to the other measures, viz. the continued and systematic treatment with quinine of the native children, who are undoubtedly the chief source of infection, and the prophylactic use of quinine.

R. T. HEWLETT.

M. HENRY PERROTIN.

THE cause of astronomical science in France has been deprived of another of its ablest advocates by the lamented death of M. Perrotin, the director of the observatory at Nice. For more than twenty years M. Perrotin has watched over the growth and directed the energies of that institution. It was his good fortune, through the munificence of M. Bischoffsheim, to be able to erect and arrange a well equipped observatory to his own design, unhampered by legacies from former benefactors or directors. How the work grew under his hand astronomers have long since recognised and appreciated. As each instrument was completed it was immediately devoted to some special purpose. The meridian instrument was employed to determine the difference of longitude between Paris and the observatory, and to complete the chain Paris-Nice-Milan long before the observatory was in working order as a whole. The fifteen-inch equatorial was at work on double stars, planetary markings, comets, &c., before the large instrument of thirty inches aperture, under the mammoth "floating dome," could be devoted to the more rigorous scrutiny of faint and difficult objects.

It is scarcely necessary here to direct attention to the industry that marked the career of the first director of the Nice Observatory, or to the value of the researches produced by the staff under his guidance and encouragement. The work of M. Thollon on the solar spectrum may serve as a specimen in the department of spectroscopy. The discovery of many minor planets shows the care with which the photographic plates were taken and scrutinised. More particularly as the work of M. Perrotin, personally, should be mentioned his discussion of the inequalities in the orbit of Vesta, a research to which he devoted much time, interrupted as it must frequently have been by the care of the establishment under his charge. As an observer he was indefatigable, and devoted much time to the study of the faint markings on Venus, on Mars, and on Uranus. Aware that he was working at the extreme limit of visibility, and knowing the tendency for self-deception to creep in and impair the value of such delicate observations, he sought opportunities of making similar measures and records with different instruments, and under varied conditions, in order to remove, so far as possible, the evils of bias and partiality from the results of his researches. Excessive and painstaking care marked his efforts to secure rigorous accuracy.

Apart from his astronomical work, properly so called, in the department of physics, he added another determination to those that have been made on the velocity of light, which we recall here mainly to show the varied character of his researches and the energy which he displayed in whatever he undertook. His life was a busy one, and he did not spare himself. The great monument that he has left behind is the magnificent observatory at Mont Gros, and his greatest service to science is perhaps the activity which he inspired in those by whom he was surrounded. At the comparatively early age of fifty-eight he has succumbed, but he leaves behind him a memory that will be long treasured by all those whose fortune it has been to assist him in earning the reputation that the young observatory at Nice has already won.

NOTES.

THE Croonian lecture of the Royal Society will be delivered on March 24, the subject being "The Chemical Regulation of the Secretory Process," by Prof. E. H. Starling, F.R.S., and Dr. W. M. Bayliss, F.R.S. The Bakerian lecture will be delivered during May by Prof. E. Rutherford, F.R.S., of Montreal, on "The Succession of Changes in Radio-active Substances."

THE annual inspection of the National Physical Laboratory by the General Board will be held to-morrow, March 18.

PROF. OSTWALD will deliver the Faraday lecture of the Chemical Society on April 19 in the theatre of the Royal Institution.

PROF. AGASSIZ has been elected a foreign associate of the Paris Academy of Sciences in succession to Sir George Stokes; and Prof. E. Warming, Copenhagen, has been elected a correspondant of the academy.

SIR ARTHUR RÜCKER will deliver the academic address at the close of the present session at the University College of North Wales, Bangor.

DR. ROBERT LUTHER has been appointed professor of physical chemistry at the University of Leipzig.

THE deaths are announced of Dr. Wilhelm Schnell, professor of mechanics and synthetic geometry at the Technical School of Carlsruhe, and of Dr. von Pallich, assistant in physics and director of the meteorological station at the University of Graz.

THE Belgian Royal Academy has awarded its gold medal of 1000 francs to M. Marc de Selys-Longchamps for his memoir on the development of a Phoronis. The Théophile Gluge prize for physiology has been awarded to Dr. P. Nolf, of the University of Liège.

THE following have been elected associates of the Belgian Royal Academy (Classe des Sciences):—Profs. George Howard Darwin (England), Corrado Segre (Turin), Wilhelm Roux (Halle-sur-Saale), and M. Michel Lévy, of the French Geological Survey.

THE foundation of Schnyder von Wartensee offers, says *Science*, its prize of about 140*l.* for an essay on the climate of Switzerland during the last thirty-seven years. Essays, which may be in English, should be sent before September 30, 1906, to the library at Zurich.

A REUTER message from Rome reports that at 5.30 a.m. on March 10 a very violent earthquake shock, followed by four others, was felt at Magliano di Marsi. On the same

day two earthquake shocks were felt in the neighbourhood of Botzen, in the southern Tyrol, in consequence of which a large landslip occurred.

THE council of the Society of Arts will proceed to consider the award of the Albert medal for 1904 early in May next, and members of the society are invited to forward to the secretary, on or before April 2, the names of such men of high distinction as they may think worthy of this honour. The medal was struck to reward "distinguished merit in promoting arts, manufactures, and commerce."

A REUTER message from St. Petersburg states that a scientific expedition, organised by the Russian Ministry of Finance, will leave there for Abyssinia within the next few days. The expedition will be under the leadership of M. Kournakoff, mining engineer, and its object will be to explore the auriferous districts near the source of the White Nile.

THE following are among the lecture arrangements at the Royal Institution, after Easter:—Prof. L. C. Miall, three lectures on the transformations of animals; Mr. L. Fletcher, three lectures on meteorites; Mr. H. F. Newall, two lectures on the solar corona; Prof. Dewar, three lectures on dissociation; Mr. H. G. Wells, two lectures on literature and the State; and Sir W. Martin Conway, two lectures on Spitzbergen in the seventeenth century. The Friday evening meetings will be resumed on April 15, when Monsignor the Count vay de Vaya and Luskod will deliver a discourse on Korea and the Koreans. Succeeding discourses will probably be given by Dr. P. Chalmers Mitchell, Prof. E. Rutherford, H.S.H. the Prince of Monaco, Prof. S. Arrhenius, and other gentlemen.

WE hear from Stockholm of the death of the well-known zoologist, Prof. Fredrik Adam Smitt, which took place on February 19. Born on May 9, 1839, at Halmstad, he took his doctor's degree at Upsala in 1863, and became docent in zoology at that university. While in this position he joined Torell and Nordenskjöld in their expedition to Spitsbergen in 1861, went with Nordenskjöld's expedition to Beeren Island and Spitsbergen in 1868, and accompanied the frigate *Josefine* on her voyage to the Azores, England and North America in 1869. On the death of Prof. Sundevall in 1871, Smitt, though only thirty-two years old, was appointed to succeed him as professor and intendant at the natural history museum of the State. Smitt wrote several papers on marine Invertebrata, notably Bryozoa, but it is for his work on fish that he is best known, especially for his critical list of the Salmonidæ in the State museum. Of late years he paid much attention to the gobies. His scientific knowledge was freely bestowed in attempts to help the Swedish fisheries.

AT the annual meeting of the Association of Chambers of Commerce last week, it was resolved that the Government should be urged to grant early facilities for the passage of the Bill for compulsory adoption of metric weights and measures throughout the United Kingdom. A resolution was approved supporting the motion recently adopted by the Royal Society with regard to the position of science in higher education, and directing attention, in view of the competition with other countries, to the vital importance of a knowledge of science being recognised as an essential part of general education. After a discussion on Patent Law, it was agreed that "this association, whilst welcoming the instalment of reform secured by the Patent Law Amendment Act of 1902, is of opinion that further amendment is needed in order to secure the forfeiture of all foreign owned patents for inventions and designs workable in this country, which are not so worked within a reasonable limit of time."

IN the House of Lords on Tuesday Lord Barnard directed attention to the report of the Departmental Committee on British Forestry, and asked the President of the Board of Agriculture and Fisheries whether the Government proposed to take any, and, if so, what, steps to give effect to the recommendations of that committee on the subject of education, instruction, and training in forestry. In reply, the Earl of Onslow said that the Board of Agriculture proposed to act on the recommendations of the departmental committee. On Mr. Stafford Howard's initiative the first steps in that direction had already been taken. Without any assistance from the Treasury a school of forestry had already been established by the Commissioners of Woods and Forests in the Forest of Dean. Again, through the agency and assistance of the Office of Woods and Forests, the Scottish Office had entered into communication with certain Scottish landowners to secure suitable areas for planting. The Treasury had been approached by the Board of Agriculture, and had promised assistance in the foundation of at least two forestry schools in England. Where these schools would be established he could not yet say; but applications had been received from many colleges, and from the University of Cambridge. He had been considering whether the University of Cambridge should not have the first claim to the attachment of a school of forestry; but no decision could be arrived at until the Secretary of State for India had decided what was to be the future of Coopers Hill College. His desire was to establish the two schools in different localities—one for the training of young men who were likely to become landowners or land agents, and the other for woodmen. The former he should prefer to see attached to one of the great universities.

THE Survey Department of the Ministry of Public Works at Cairo has published its meteorological report for the year 1901. It includes hourly meteorological observations at Abbassia Observatory, with seismological and magnetic observations, monthly and yearly means at a number of second order and climatological stations, and ten years' means, 1891–1900, for Wadi-Halfa. Most of the stations send telegraphic reports, from which a daily weather report is prepared and circulated, including data from several Mediterranean stations.

THE Danish Meteorological Institute has issued, as in previous years, an abstract from its nautical-meteorological year-book showing the state of the ice in the Arctic seas during 1903. The conditions are shown on five charts, for the months April to August, and the particulars are discussed in Danish and English text. The conclusions drawn are (1) that about the normal amount of sea-ice from the Polar Sea entered the temperate seas; (2) that the Labrador current brought an unusual number of icebergs with it in 1903; (3) that there is no indication that the appearance of icebergs east of Newfoundland will be more frequent than usual in the year 1904.

THE activity of the Faraday Society has given a fresh impetus to our contemporary the *Electro-chemist and Metallurgist*, which is now the official organ of the society. The current number contains a report of the proceedings at the February meeting, at which M. Hollard's interesting paper on the electrolytic separation of metals was discussed, and a paper by Dr. Perkin on the electrolytic analysis of gold. There are also a large number of notes on

electrochemical matters, including a particularly full account of recent advances in battery work.

THE *U.S. Monthly Weather Review* announces that the Government of the Argentine Republic has determined to give a permanent character to the first-class meteorological and magnetic observatory on the island of Año Nuevo, situated in the vicinity of Staten Island, in latitude 54° 39′ south (Fig. 1). The observatory was established in order that the Republic might cooperate with the International Antarctic Expedition. It is equipped with a complete instrumental outfit, such as is appropriate to a station of the first order, and the results obtained during the International Antarctic Expedition, as also of the observations for the year 1903, will shortly be published. This observatory, as well as the one soon to be established at Bahia Blanca, will form a part of the proposed network of observ-

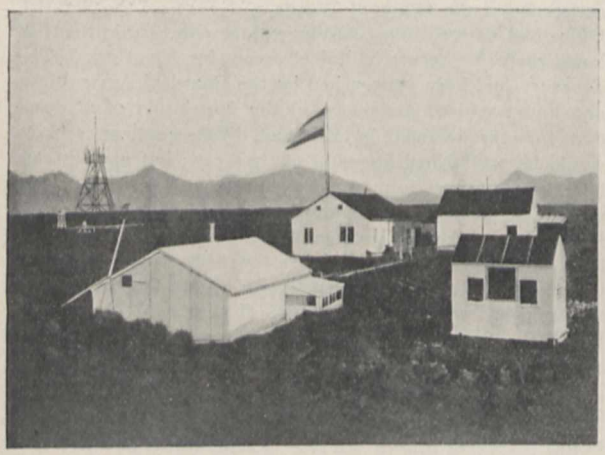


FIG. 1.—Meteorological and Magnetic Observatory of the Argentine Republic on the Island of Año Nuevo.

atories on the Atlantic coast of the Argentine Republic. All correspondence should be addressed Observatory of Año Nuevo, Ministry of the Marine, Buenos Ayres.

WE have received a copy of the fifth edition of "Jelinek's Psychrometer-Tafeln" (Leipzig). The original name is presumably retained in deference to the former eminent chief of the Austrian Meteorological Service, who first compiled them. They were mostly recomputed by Dr. J. Hann, who also made several important additions to them. The new edition has been revised by Dr. J. M. Pernter, the present chief of the Austrian Service, who has added some elaborate tables for obtaining by inspection the vapour tension from the relative humidity values given by de Saussure's hair-hygrometer. He has also added to the foot of the psychrometric tables the corrections to the ordinary values due to conditions of calm and strong wind. We also find short tables for deducing the vapour tension at various altitudes up to 3000 metres. The tables are naturally much more comprehensive than those usually adopted in this country; they give the values for every tenth of a degree from −30° to 40° of the Centigrade thermometer. A list of the works relating to the dry and wet bulb hygrometer and to the hair-hygrometer is a useful addition to this valuable publication.

IN the University of Colorado *Studies*, Dr. Arnold Emch contributes a short note on the *p*-discriminant of ordinary differential equations, and discusses d'Arboux's proof that this discriminant in general represents the cusp-locus of the curves. In a second note the same writer discusses Newton's five types of plane cubics, and shows how to transform them by Steiner's method.

WE have had an opportunity of examining and testing an induction coil fitted with the Charpentier-Gaiffe patent platinum interrupter, sent to us by the Medical Supply Association, 228 Gray's Inn Road, and we find its performance fully equal to what is claimed for it. With two four-volt cells the full 10-inch spark was obtained with ease, and there was every indication that the interrupter was capable of working regularly for comparatively long periods without attention. In place of the iron hammer and spring of the old form, there is a light rigid strip of metal, faced with iron, resting by gravity on its lower edge in a shallow groove, and pulled downwards by an adjustable spiral spring. One of the platinums is carried by a flexible strip and remains in contact with a fixed platinum until separated by a blow from the hammer, the rapid motion of which produces a very sudden break. The intensity and frequency of the discharge can be readily varied by the adjustments of the platinums and hammer. The arrangement seems to make the most of a given battery power, and will therefore be specially appreciated by those to whom portability is an important consideration. Coils fitted with the new interrupter are supplied by the Medical Supply Association.

WE have received a paper on pulse and rhythm, contributed to the *Popular Science Monthly* by Mary Hallock-Greenewalt. In it the author endeavours to trace a connection between rhythm in music and the beats of the human pulse. In illustration a table is given of the metronome markings of the different movements of twelve of Beethoven's sonatas. Nineteen movements are set to rhythms of 72 or 76 beats per minute, rates exactly equal to those of a normal healthy pulse, and all the other markings range from just a little under 60 to 92, these limits representing the maximum range of pulse-action.

THE Johns Hopkins Hospital *Bulletin* for January (vol. xv. No. 154) contains Prof. Osler's address on the occasion of the opening of the new buildings of the medical faculty of the University of Toronto. It is entitled "The Master Word in Medicine," this being *work*. Miss Rowley, M.D., writes on some unusual forms of the malaria parasite.

THE United States Public Health and Marine Service has published a brief report by Dr. Howard on the geographical distribution of the yellow fever mosquito. After recording the localities in which the *Stegomyia fasciata* has been met with, he concludes that this species may be expected to occur in all regions the climate of which is not too dry between the parallels of latitude 38° north and 38° south, and in which the sum of the daily mean temperatures above 6° C. or 43° F. amounts to 10,000° C. or 18,000° F. for the year.

THE conquest of the Philippines by the United States has been followed by the establishment of a Government laboratory at Manila, which is already doing excellent work. The latest report is one on the subject of rinderpest in cattle, by Dr. James Jobling. No treatment seems to be of any benefit when once an animal has contracted the disease, but several methods of preventive inoculation may be successfully employed and are detailed, *e.g.* the injection of the bile of an animal dead of the disease, or of the blood of a "salted" animal, *i.e.* one that has recovered.

THE *Journal of Hygiene* (vol. iv. No. 1) contains several interesting papers. Dr. Bulloch and Mr. Macleod discuss

the chemical constitution of the tubercle bacillus. They find that it contains a large percentage of fatty substances, and that the "acid-fast" substance is an alcohol. Dr. Edington writes on a malarial form of South African horse sickness, and Dr. Bashford on immunity. Drs. Boycott and Haldane give a second instalment of their article on ankylostomiasis, and Dr. Durham discusses beri-beri in Malayia and in Christmas Island, which he visited as commissioner of the London School of Tropical Medicine.

IN 1902 Major Ross, at the invitation of the Suez Canal Company, proceeded to Ismailia in order to advise upon a method to rid the town of mosquitoes, and as the result of his advice a series of measures was instituted to accomplish this. These consisted in filling in marsh land, a weekly flushing and cleansing of drainage channels, and, about the houses, petroleum treatment of drains and waste water that does not soak away. Prof. Boyce has recently made a tour of inspection, and reports that as a result of this anti-mosquito campaign, the mosquitoes in Ismailia are no more abundant than in Paris. Malaria also has much diminished, from 1555 cases in 1902 to only 209 cases in 1903. The expenditure to accomplish such results has not been great, 4400*l.* in the initial cleansing operations, and an annual outlay of 720*l.* (Liverpool School of Tropical Medicine, *Mem.* xii.).

IN a paper read before the Royal Institute of British Architects, Prof. Clowes discusses the application of the biological method of sewage treatment to the sewage of Christ's Hospital at Horsham. The plant consists of closed septic tanks into which the sewage flows by gravitation, from whence the effluent is distributed over the surface of coke beds, the liquid remaining in the bed for two hours and then passing away as the purified effluent through drainage channels in the bottom of the beds. No hitch whatever has occurred in the working of the plant, and on one occasion only has smell been detected, the cause being stagnation during a lengthy vacation. Attention is specially directed to this occurrence and to its cause, as it probably explains why similar installations for the treatment of sewage from isolated buildings have become offensive. The solid matter is absolutely disposed of in the septic tank; the number of bacteria in the effluent is 32 per cent. less than in the crude sewage, and the effluent will support fish life.

AN interesting and useful account of the present position and prospects of the Panama Canal is to be found in an illustrated article in the February number of the *National Geographic Magazine*, by the Hon. Wm. H. Burr, of the Isthmian Canal Commission, entitled "The Republic of Panama."

THE December (1903) number of *La Géographie* contains two papers of geological interest. M. Émile Chaix-Du Bois writes on "Le pont des Orelles (Bellegarde, Ain)," giving a careful study, with a number of excellent illustrations, of a remarkable example of the effects of erosive action of running water. MM. Jean Brunhes and Louis Gobet give an account of the "glacier excursion" of the ninth International Geological Congress, which includes a valuable synthetic summary of the observations and theories of Prof. Penck.

DR. R. REINHARD contributes an interesting paper to the *Deutsche Geographische Blätter* on the geographical conditions affecting the positions and development of the large German sea-ports. The port of Bremen is specially dealt with, but the discussion includes Hamburg, Kiel, Lübeck, Stettin, Danzig, and Königsberg. The study of the effects of the introduction of modern methods of transport by land and sea, and of the increased power of modern engineering to overcome local disadvantages, is of considerable geographical value.

AN excellent summary of what is known about the occurrence of gold in Great Britain and Ireland has been written by Mr. J. Malcolm Maclaren (*Trans.* Inst. Mining Engineers, vol. xxv.). The earliest records of the discovery of gold are mentioned, and particulars are given of its occurrence in Cornwall, Devon, Cumberland and elsewhere in England; in Carmarthenshire and in the important district of Merionethshire in Wales; in the Leadhills district and at Kildonan in Scotland; and in several localities in Ireland. The paper is illustrated with sketch maps and numerous pictorial photographic views, and is accompanied by a bibliography of the subject.

DR. G. J. HINDE contributes to the *Journal* of the Royal Microscopical Society (February) an important article on the structure and affinities of the genus Porosphæra. The genus was established for certain small rounded fossils commonly met with in the Chalk, and referred by old authors to Foraminifera, sponges, and Polyzoa. Dr. Hinde shows that the organism is clearly a calcisponge. Several species are figured and described, and their zonal range and distribution in the English Chalk are recorded.

A STRATIGRAPHICAL interest attaches to a short paper by Messrs. Steinmann, Hoek, and von Bistram, who have been travelling together in south-eastern Bolivia (*Centralblatt für Mineralogie*, &c.). A series of red sandstones, gypsiferous clays, limestones, and dolomites, easily taken for Permian or Triassic beds, is shown to contain a marine band near Miraflores, possibly of Jurassic, but more probably of Cretaceous age. This supports the view that the corresponding petroleum beds in Argentina are Cretaceous. Extended traces of glacial phenomena, including enormous moraines of southern Alpine type, are noted in the mountains east of Potosi, down to heights of 4000 metres.

A PAPER by Dr. G. Steinmann on *Tetraploporella Remeši* (*Beiträge zur Paläontologie und Geologie Österreich-Ungarns und des Orients*, Bd. xv., 1903, p. 45) will be of interest to botanists as well as to palæontologists. This new genus, from the Tithonian, is ascribed to the Dasycladaceæ, with Dactylopora, Diplopora, &c., and resembles a highly calcareous Bornetella. Incidentally, the much discussed genera Cyclocrinus and Receptaculites are considered, and the author doubts if they can be referred to the calcareous algæ.

THE secretary has sent us a copy of the report of the Anti-Bearing-Rein Association for the second half of 1903, from which it appears that no efforts are spared by that body to continue the crusade against inflicting unnecessary discomfort and pain on draught horses of all classes.

THE report for the year 1903 shows that the Yorkshire Naturalists' Union is still in debt (something more than 100*l.*) to its treasurer, a part of the deficit being due to that useful publication, the *Naturalist*, upon which there was a loss of 22*l.* A county of the size and wealth of Yorkshire ought surely to be able to keep the balance of the association on the right side.

THE March number of the *Field Naturalists' Quarterly* contains a long article, by Mr. R. H. Wallace, on the now well-worn subject of the place of "nature-study" in education. Certain of the suggested schemes of work in connec-

tion with spring flowers savour, to our thinking, somewhat too much of the methods of the faddist and of the crank. The editor, Dr. G. Leighton, continues his "Reptile Studies," dealing in this instance with the distribution of the British species. Perhaps, however, the most generally interesting article in the issue is one by Mr. W. H. Legge on Ringmer, a favourite Sussex resort of Gilbert White.

WE have received four parts of the *Proceedings* of the U.S. National Museum (Nos. 1361, 1362, 1363, and 1367), all devoted to invertebrates. In the first, Mr. C. F. Baker points out the remarkable fact that while in the United States fleas nearly allied to the human *Pulex irritans* infest such animals as the dog, cat and rabbit, in Mexico and South America species even more nearly related to the former are found on rats, mice, and other small rodents. Hence there is a great probability, in the latter instance, of the communication of serious diseases to human beings by these insects. In No. 1367 Mr. J. E. Benedict points out the probability that the enormously elongated antennulæ of crustaceans of the genera Albunea and Lepidopa, which are furnished with hair-like fringes, are for the purpose of preventing the sand in the water from reaching the mouth.

THE report of the Liverpool Marine Biology Committee for 1903 contains an account of the first year's working of the new biological station at Port Erin, in the Isle of Man. From a financial point of view it is satisfactory to learn that the aquarium is very popular with tourists, and that a substantial sum was received from their gate-money. During the year very successful progress has been made with the experiment of hatching and rearing lobsters, and some remarkable hauls of plankton and the discovery of several rare and interesting animals have been made. Special interest attaches to the hatching of a number of cuttlefish eggs, the commencement of the process taking place after a sojourn of eighty days in the tank. The committee has to deplore the loss of its energetic and talented secretary, Mr. I. C. Thompson, of whom a memoir appears in the report, at the comparatively early age of sixty. A considerable portion of the report is devoted to a pronouncement of the general aims of biological study and the urgent need of further efforts in this direction in Britain. The writer is of opinion that as the older naturalists pass away their place is not taken by younger men, and he deplores that such a state of affairs should exist, even locally.

ACCORDING to Mr. Southwell's report on sealing and whaling for the past year (the twenty-third of the series), published in the February number of the *Zoologist*, the trade in seal skins and seal oil has become specially lucrative on account of the marked rise in prices, and the demand in America. In seal-oil the price has advanced from 18*l.* per tun (some years ago) to 28*l.*, while skins which were then worth half a crown now realise 3*s.* 6*d.* each. Sealing will, therefore, undoubtedly be on the increase, but, as Mr. Southwell remarks, this means a black lookout for the seals themselves, and it may be hoped that measures will be taken in time to prevent anything approaching extermination. The year's catch of right whales was small, but several were seen which, owing to the bad weather and heavy ice, could not be pursued. Owing to scarcity of whales and other causes, the Norwegian fin-whale catch has been comparatively only small, the two Ronas Voe companies having captured only 126 head. If it be true that in 1902 the Norwegian fleets accounted for no less than 2500, the scarcity of these whales is no matter for wonder, and ere long they must be well-nigh exterminated. Mr. Southwell alludes to the appearance last summer of a large school of sperm-whales in the seas between Iceland and Norway, of which an account has already appeared in the *Field*.

WE have received a copy of the first part of "Documents Scientifiques de la Mission Saharienne: Mission Foureau-Lamy d'Alger au Congo par Le Tchad," by M. F. Foureau, the leader of the expedition. The work is being published by Messrs. Masson and Co., of Paris, for the French Geographical Society, and is to consist of several parts, forming together a volume of from 800 to 1000 pages. The present fasciculus includes an introduction and two sections, dealing respectively with astronomical and meteorological observations. In his prefatory remarks M. Foureau details the steps which preceded the expedition of 1898, with which the present work is concerned, and gives interesting particulars of nine journeys of exploration in the Sahara he had undertaken before that date. Our notice of the scientific work accomplished must be deferred until all the parts of M. Foureau's volume have been received.

PLATE XI. of the January number of the *Emu*, herewith reproduced on a smaller scale, illustrates the "play-ground" of one of the species of bower-bird, *Scenopaeus dentirostris* (Fig. 1). The original photograph was taken by Mr. E. M. Cornwall, who states that the area was situated

FIG. 1.—"Play-ground" of the Tooth-billed Bower-bird. (From the *Emu*.)

among a tangle of "lawyer-palms, in which a gap had to be made for the camera. The play-ground, which was of considerable size, had been cleared of dead leaves, and was kept scrupulously clean; but at the date of the visit a number of large fresh leaves were strewn over it, apparently as ornaments. "In the morning," according to Mr. Cornwall, "all the birds were noticed low down amongst the scrub, quite close to the play-ground, whilst towards sundown they were invariably perched high up amongst the topmost branches of the trees, but still in the immediate neighbourhood."

A SOMEWHAT remarkable process of oxidation is described by Dr. Geisow in the *Berichte*. It was noticed some years ago by Blank and Finkenbeiner that when formaldehyde was oxidised in alkaline solution by means of hydrogen peroxide an inflammable gas was liberated which appeared to be hydrogen. An investigation of the course of the oxidation in neutral and acid solution has shown that under these conditions no formic acid is produced, and that the sole products of the oxidation are carbon dioxide and hydrogen, which are produced quantitatively according to the equation $CH_2O_2+H_2O_2=CO_2+H_2O+H_2$.

SOME interest attaches to the preparation of optically active hydrocarbons of the benzene series as described by Messrs. Klages and Sautter in the *Berichte*. A dextrorotatory hexenylbenzene, $C_6H_5.CH:CH.CH(CH_3).C_2H_5$, having $[\alpha]_D+50°3$, was prepared by condensing amyl iodide with benzaldehyde by Grignard's magnesium method, and this was reduced to a hexylbenzene,

$$C_6H_5.CH_2.CH_2.CH(CH_3).C_2H_5,$$

which gave $[\alpha]_D+17°2$. The latter compound behaves in a normal manner as a homologue of benzene, and it should, therefore, be possible to prepare from it optically active derivatives of all the most important types.

THE additions to the Zoological Society's Gardens during the past week include a Snow Leopard (*Felis uncia*) from Tibet, presented by Major Cox; a Lesser White-nosed Monkey (*Cercopithecus petaurista*) from West Africa, presented by Mrs. Gower; a Mozambique Monkey (*Cercopithecus pygerythrus*) from East Africa, a Yellow Baboon (*Papio cynocephala*) from Africa, a Green Monkey (*Cercopithecus callitrichus*) from West Africa, a Ring-tailed Lemur (*Lemur catta*) from Madagascar, a Common Rat Kangaroo (*Potorous tridactylus*) from Australia, a Lesser Vasa Parrot (*Coracopsis nigra*) from Madagascar, a Blossom-headed Parrakeet (*Palaeornis cyanocephala*), two Larger Tree Ducks (*Dendrocygna major*) from India, deposited; two Himalayan Pheasants (*Lophophorus impeyanus*) from the Himalayas, purchased.

OUR ASTRONOMICAL COLUMN.

A SIX YEAR PERIOD FOR THE POLAR MOTION.—Writing to the *Astronomische Nachrichten* (No. 3932), Mr. H. Kimura, of the International Latitude Station, Mizusawa, states that he has found that the x and y curves of the polar motion return to the same phase (not amplitude) every six years. This is shown very clearly on the curves accompanying the note.

The latest maximum deviations of the instantaneous pole occurred in 1891 and 1897, whilst the minima deviations were in 1894 and 1900.

The actual x and y curves obtained from the observations may be fairly represented by calculated curves derived from the combinations of two periods of 438 days and 365 days respectively.

During his researches on this subject Mr. Kimura has discovered that there are important systematic variations of purely local character which are as yet unaccounted for.

DOUBLE STAR OBSERVATIONS.—During his absence on leave from the Hong Kong Observatory, Prof. Doberck has observed 280 double stars, mostly taken from the Struve catalogues. The name, coordinates, position angle, and distance of each pair are given in a list published in Nos. 3830 and 3831 of the *Astronomische Nachrichten* as a continuation of the previous list which appeared in Nos. 3860 and 3861. In cases where there are more than two components in any one system, the angles and distances between each pair are given. The observations were made at Copenhagen.

CORRECTIONS TO THE BERLINER JAHRBUCH FUNDAMENTAL CATALOGUE.—In Nos. 3927, 3928 and 3929 of the *Astronomische Nachrichten*, Dr. A. Auwers publishes the results of his discussion of the observations, made between 1750 and 1900, of the 622 stars of the Astronomische Gesellschaft Fundamental Catalogues, which were published in the *Berliner Jahrbuch* in 1883. After a lengthy discussion of the reduction of the observations, Dr. Auwers gives a table showing the total corrections to the places for 1875, and then discusses several multiple systems, for each of which he gives the elements he has computed. In a second table he compares the corrections and the hundred-year proper motions given in his tables with those given by Boss, for each five degrees of declination and right ascension.

COOPERATION IN SOLAR OBSERVATIONS.—In No. 1 (1904) of the *Memorie della Societa degli Spettroscopisti Italiani* Prof. Ricco discusses the modern methods of studying solar phenomena, and points out the vital importance of obtaining as full a record as possible of all the changes which take place in the sun. He also describes the results obtained by Prof. Hale with the spectroheliograph, and directs attention to the important connections which have recently been shown to exist between solar and meteorological changes.

A STUDY OF THE RADIO-ACTIVITY OF CERTAIN MINERALS AND MINERAL WATERS.[1]

PART I.

A CONSIDERABLE number of minerals are known in varying degrees to be radio-active. Lists have been given by M. and Madame Curie ("Thèse présentée à la Faculté des Sciences," Paris, p. 19) and by Sir W. Crookes (Roy. Soc. *Proc.*, vol. lxvi. p. 411). Except in the case of pitchblende, little has been done to determine the nature of the radio-active constituents, or to decide whether any hitherto unknown radio-active body is present.

To obtain complete information on these subjects, the only method available would be completely to analyse the mineral, and examine every precipitate and filtrate for radio-activity. This process is, of course, very tedious, and the results have to be interpreted with care, since traces of radio-active elements may often be carried down in the groups to which they do not properly belong, and thus cause confusion. A much easier method is to heat the crude mineral, and to examine the rate of decay of the emanation which it gives off. Each emanation has a characteristic time constant of decay, and by determining this we can identify it.

The method is, of course, useless for testing the presence or absence of radio-active elements such as uranium [2] which do not give off a characteristic emanation. But the great facility with which it may be applied to a small quantity of material, and the definiteness of the results, are great merits.

In any case when a material suspected to contain radium is obtainable in abundance, it is better to test for the presence of emanation than to look for activity in the solid. For but little of the solid material can be advantageously used in the test. Thick layers give no larger effect than thin ones, since the upper layers absorb the radiation from the lower. But the emanation can be extracted from any desired bulk of material, and the effect proportionately increased. If carbonic acid or any other gas is evolved at the same time in inconvenient quantities, it can be absorbed with a suitable reagent, and the emanation contained in it thereby concentrated.

The present paper gives the results of an examination of certain radio-active materials by this method.

No new emanation has been recognised. The results have in all cases been attributable to thorium and radium.

If any emanation decidedly more permanent than that of radium existed in the evolved gas, the method could not fail to detect it. For in every case the activity of the gas was watched until it became comparable with the very small activity due to the walls of the vessel. If a more durable emanation had been present even in small quantities, the proportion of it present would have increased relatively to the radium emanation, and its presence would have become apparent towards the end by a diminished rate of decay.

Small quantities of an emanation less durable than that of radium might have escaped detection. For they would have been masked by the much greater quantity of the latter.

By measuring the rate of leak due to the accumulated

[1] By Hon. R. J. Strutt, Fellow of Trinity College, Cambridge. Read before the Royal Society, March 10.

[2] I have found a distinct, though feeble, emanation from recrystallised uranium nitrate, having a rate of decay equal to that of the radium emanation. Whether this is really due to uranium, or to traces of radium, which the uranium still contains, must be left for the present an open question.

emanation from a weighed amount, the proportion of radium present may be estimated. A comparison with the leak due to the emanation of a known weight of radium must of course be made. For this purpose it would be best to weigh out, say, a milligramme of radium bromide, dissolve it in a litre of water, and evaporate a small measured quantity of the solution in a suitable tube. In this way the effect due to a standard quantity could be determined.

The method of experimenting was as follows:—

The powdered mineral was placed in a hard glass combustion tube, drawn out and sealed at one end, connected to a mercury gas-holder at the other. The mineral was heated to redness, and the gaseous products collected in the gas-holder. When the evolution of gas had ceased, the point was broken off, and air drawn into the gas-holder up to a standard volume.

For measuring the electrical effects an electroscope was used. This was exhausted, and the gas extracted from the mineral, together with the air, which had been used to make up its volume to a sufficient amount, was admitted. After a few hours, enough for the deposited activity to attain its full value, the rate of leak was read. The day and hour were noted, and the gas was pumped out into a test-tube and stored over mercury. After a sufficient time had elapsed it was again introduced into the apparatus by means of a syphon gas pipette[1] and the rate of leak again measured. In the meantime the apparatus had been available for making measurements with other gases.

In some cases the emanation was initially so strong that it could not be conveniently investigated. In such cases a portion of the gas was diluted with air for measuring the rate of decay at first. The concentrated material was kept until, by lapse of time, it had become weak enough to be conveniently used. Its activity was followed until it had become too small for measurement.

With this preface the results for the various minerals tried may be given in the form of a table. The rates of leak are given in scale divisions per hour. When air alone filled the apparatus, the rate of leak was 2·25 sc. div. per hour. This was in each case subtracted.

Mineral	Locality	Quantity taken in grammes	Rate of leak due to emanation (sc. div. per hour)	Rate of leak per 100 grammes	Time in days taken by the emanation to fall to half its initial value
Samarskite .	N. Carolina, U.S.A. .	20	20,600	103,000	3·48
Fergusonite .	Norway?	7	4,280	61,000	3·80
Pitchblende .	Cornwall	40	11,900	29,800	3·50
Malacone . .	Hitteroe, Norway .	20	1,440	7.200	3·81
Monazite . .	Norway	51	2,060	4,000	3·50
,, . .	N. Carolina	82	37	45	3·81
,, . .	Brazil	54	11	24	3·80
Zircon . . .	N. Carolina	60	24·6	41	4·05

All the minerals give radium emanation, though in very varying quantity.

These tests were not started quickly enough to give information as to the presence of a very quickly decaying emanation. This was tested for independently.

The mineral malacone is of peculiar interest, because it has been found to contain argon as well as helium (Ramsay and Travers, Roy. Soc. *Proc.*, vol. lxiv. p. 131). Helium is formed by the degeneration of radium, and it is reasonable to assume that the other kindred gases have had a similar origin. It was hoped, therefore, that malacone might contain some new radio-active element. It is still possible that it does so, but, if so, this substance gives no emanation distinct from that of radium.

The meteorite of Augusta, co. Virginia, has also been found to contain argon and helium. But no emanation at all could be obtained from 20 grammes of it.

The minerals were all tested for thorium emanation by drawing air over them in the cold; the only one in the above list that gives it is the Norwegian monazite, and even this does not yield it very abundantly. A crystal of thorite, however, kindly lent me by Prof. Lewis, was found to give torrents of thorium emanation. Air drawn over it in the cold possesses strong discharging power. It was not permissible to heat the specimen, which might have injured it, so that the presence or absence of radium emanation in thorite could not be investigated.

There can be no doubt that the other specimens of monazite contained thorium, for they were given me by the late Mr. W. Shapleigh, who was connected with the thorium industry, and used these varieties of monazite for preparing thoria. They were, moreover, markedly radio-active, while the amount of radium emanation obtained from them was so small that their activity could not be mainly due to radium. They probably contain the thorium in what Rutherford and Soddy call the de-emanated condition, that is, the thorium emanation, though formed, is not able to escape.

It is a remarkable fact that these varieties of monazite, though they contain practically no radium, yield helium in fair quantity. There are several explanations possible. The radium originally present may have almost completely decayed into helium, and any other products which it may yield; or it may be that thorium, as well as radium, yields helium by its decomposition; or, lastly, the helium may not, in this instance, have been generated by radio-active changes at all.

It is interesting to know whether the minerals retain all the radium emanation which they generate when heat is not used to expel it. Two cases were examined. One hundred and fourteen grammes of powdered samarskite were kept for three weeks in a sealed glass tube. The air was pumped out and tested. It was found to contain about 1/150th part of the emanation, which could have been extracted by heat.

A similar experiment with malacone showed that about one-fiftieth of its emanation was able to escape in the cold.

It appears, therefore, that these minerals retain nearly all their emanation. The same is probably true of the helium produced by the emanation. Samarskite which had been heated to redness was found to retain its emanation in the cold about as well as before.

PART II.

I happened to possess a small sample of a red deposit, coloured by iron, which is left by the water of the King's Spring, at Bath. It occurred to me that it might be worth while to test this for radio-activity. The result was to show that the deposit was markedly active. On leaving it in the testing vessel (which was closed airtight) for a few days, the activity was found to increase to several times its initial value. This shows that the deposit gives off an emanation freely, even without heat.

Experiments were then made to test the rate of decay of this emanation. It proved to be identical with the rate of decay of the emanation of radium.[1] The activity is wholly due to that element.

This deposit was collected inside the King's Well itself, where the hot water issues from the ground. Other deposits are left in the tanks and pipes. They are less active than that collected near the source.

Deposits from another of the hot springs at Bath, that known as the Old Royal Spring, have also been tested. These were found to be active also. In this case there was no opportunity of collecting the deposit at the well head itself, but it was found that the deposit left in the channel near the source was more active than that in the tanks further from it.

It was interesting to determine whether the water itself contained any radium in solution. There could be little doubt that there must be traces left in solution, after the deposit had settled out. But, since the Bath water contains

[1] The methods of manipulation used in storing and transferring the gases without loss were those described in Dr. Travers's book, "The Study of Gases."

[1] In the first experiment made, I obtained a small residual leak when the radium emanation had decayed. This was attributed to a new emanation, of greater durability. But I have failed to repeat the experiment, and am forced to conclude that the leak was due to a failure of the quartz insulation, owing to the presence of moisture. It is very difficult to understand how this can have happened, for the gas was passed through drying tubes. When the rate of leak was tested with air in the apparatus, it had always a perfectly definite and constant small value.

abundance of sulphates, and since radium sulphate is one of the most insoluble salts known, there could not be more than the merest traces present. The sulphate of barium is very much less soluble than that of strontium, and presumably the sulphate of radium is much less soluble still. Barium sulphate requires half a million times its weight of water to dissolve it; radium sulphate perhaps several hundred million times its own weight.

About 10 litres of the Bath water were evaporated to dryness. The resulting saline residue was sealed up in a hard glass tube, and left for about a fortnight to generate a stock of emanation. On heating, a distinct emanation was obtained, giving several times the rate of leak that air did. A deposit, similar to that from the Bath water, but black in colour, can be collected from the source of the hot springs of Buxton. It has been analysed by Dr. J. C. Thresh (*Proc.* Chem. Soc., January 17, 1882), and I am indebted to his kindness for a specimen of it. This deposit was found to contain radium also, the proportion present being not very different from what was found in the case of some of the Bath deposits.

The following table gives the quantitative data for these emanations from these deposits. The rates of leak are on the same scale as those in the preceding table.

Material	Quantity taken in grammes	Rate of leak due to emanation (sc. div. per hour)	Rate of leak due to emanation from 100 grammes	Time in days taken by the emanation to fall to half its initial value
King's Spring, Bath—				
Deposit from inside of well . .	10	250	2,500	3·60
,, ,, tank	12	78·2	650	—
Saline residue from water . . .	18	12·4	69	—
Old Royal Spring, Bath—				
Deposit from channel near well .	10	63·5	635	—
,, ,, bottom of tank . .	15	60	400	—
Hard deposit from sides of tank .	25	43	173	3·58
Buxton deposit	26	356	1,370	3·81

It will be seen that the richest of the deposits is some thirty-six times more active than the salt obtained by evaporating the water.

Although the agreement in the rate of decay of the emanation seemed sufficient to prove that the activity was really due to radium, yet it was thought desirable to show that the chemical properties of the active constituent were in agreement with this conclusion. Two hundred grammes of the richest deposit were treated with dilute sulphuric acid. The activity was all in the insoluble residue, which was dirty white in colour, and amounted to about half the entire quantity of deposit. The residue was boiled with strong sodium carbonate solution. This was washed away, and the mass extracted with hydrochloric acid. The hydrochloric acid solution gave a slight precipitate with sulphuric acid. This precipitate was collected, and found to be strongly active, so that there is every reason to conclude that the activity of the deposit is due to the presence of radium.

The presence of radium in the Bath water and deposits is of special interest because of the occurrence of helium in the gas which rises with the spring (Rayleigh, Roy. Soc. *Proc.*, vol. lx. p. 56). There can be little doubt that the helium owes its origin to the same store of radium that supplies the water.

It is interesting to estimate the quantity of radium annually delivered by the spring. Part of this is in the deposit, part in the water. But the annual yield of deposit does not exceed a few hundredweight at the most; and although it is much richer in radium than the dissolved salt, the quantity of the latter is so enormously greater that the deposit may be neglected. According to the estimate of Sir A. C. Ramsay, the late director of the Geological Survey, the salt annually delivered by the spring would be equivalent in volume to a column 9 feet in diameter and 140 feet high. Taking the density to be twice that of water, this would weigh about 500,000 kilogrammes.

Now the saline residue gives about 1/1500th part of the quantity of emanation that samarskite gives. Let us assume that the latter contains one-millionth part of radium, which is, I think, an outside estimate. At that rate, the annual delivery of radium by the spring amounts to about one-third gramme. The volume of gas which the spring delivered is about 100 cubic feet per day (Williamson, British Association Reports, 1865, p. 380). About 1/1000th part of this is helium, so that about 3 litres of helium are given off daily, or about 1000 litres per annum. The proportion of helium to radium thus indicated is of the same order as in the radio-active minerals, though somewhat larger. This is in accordance with the view that the spring draws its supplies from the disintegration of such minerals.

In obtaining the various materials from the Bath springs, I have had the great advantage of Mr. Sydenham's help. His knowledge of everything connected with the springs has been of great assistance.

In addition to the Bath and Buxton waters I have examined several others.

A sample of the Cheltenham saline water, and also a deposit left in the pipes, was kindly sent me by Mr. G. Ballinger. But no emanation could be obtained, either from the dissolved salts or from the deposit.

The boiler crust from a domestic hot water pipe, Terling, Essex, was examined, but the result was again negative.

THE MINING OF NON-METALLIC MINERALS.[1]

THE four Cantor lectures delivered before the Society of Arts last year by Mr. Brough, and now published as a pamphlet, form a fitting sequel to the course which he gave in 1900 upon metalliferous deposits. The title "non-metallic minerals" must be taken in the popular and not in the strictly scientific sense, and is intended to include all the useful minerals which are not employed as sources of the common metals. Mr. Brough classifies these minerals into four groups, viz. coal and bitumens, salts, stone and precious stones.

FIG. 1.—Magnesite Quarry, Salem, India.

[1] By Mr. Bennett H. Brough. Pp. 48 and 15 figures. (*Journal* of the Society of Arts, December 25, 1903, January 1, 8, 15, 1904.)

The progress of the world during the last half-century becomes strikingly evident if one reflects how very different the lectures would have been if the course had been delivered fifty years ago. Apart from the enormous expansion of the coal trade, various great industries have arisen due to the working of minerals which were unknown, or little used, at the time of the Great Exhibition of 1851. It is only necessary to refer to the petroleum of Russia and the United States, the potash salts of Germany, the borates of California, the nitrate of soda of Chili, and the phosphates of various countries.

The provision of a cheap and convenient illuminant like petroleum may seem a small matter to the present generation of town-dwellers accustomed to the electric light or to Welsbach burners; but those whose memories go back to the days of the guttering "dip" and its snuffers can realise what petroleum has done for the winter evenings of our villages and those of distant lands; and, of course, petroleum has many other uses.

Mr. Brough has not confined his lectures to a mere compilation of published information. His own extensive travels enable him to give descriptions of various workings which he himself has visited, and, in addition, he has been able to obtain accounts from competent observers on the spot, and to illustrate them by reproductions of photographs. We learn from the accompanying figure, reproduced from Mr. Brough's paper, that magnesite is quarried in a primitive fashion at Salem, which lies half-way between Madras and Beypore. The stone is carried away on the heads of women to the mills. The Indian magnesite is exceedingly pure, and therefore admirably adapted for the manufacture of fire-bricks.

The last lecture contains not only many interesting details concerning gem-mining, but also affords useful information concerning the sources of thoria, now in demand for the manufacture of incandescent mantles.

The addition of a complete index considerably enhances the value of the pamphlet.

OBSERVATIONS OF THE PLANET JUPITER.

JUPITER has now approached so near to the sun as to be invisible for all practical purposes, and observers must wait until the mornings of next June before telescopic work can be renewed with prospective success.

The study of his surface markings during the past nine months has evolved some interesting facts which will prove useful for comparison with those obtained in preceding years. It is from the continued study of Jovian features during many successive oppositions that we may hope to learn something more definite as to the nature of the curious phenomena operating on his surface.

Essentially different in its aspect and character from the more durable lineaments observed on Mars, the scenery of Jupiter consists of variable bands of light and dark material circulating round the great planet at dissimilar periods. Apparently we see nothing of Jupiter's real surface formations; the belts and zones exhibited in our telescopes represent vapours spun into parallels of latitude by the rapid rotatory motion of the globe beneath.

The study of Jupiter is chiefly directed towards determining the rate of motion of the various currents and to noting the more active regions and forms and tints of the principal features. During the last half of 1903 the red spot appeared to be a little plainer than during the few previous oppositions, and it exhibited a decided retardation of velocity, its rotation period being 9h. 55m. 41·6s., as in the last few years of the nineteenth century.

The equatorial spots, of which there were about twenty-eight fairly conspicuous examples presented, gave a rate of 9h. 50m. 27·9s., agreeing very closely with the mean value for the previous six years.

The south temperate spots travel from year to year at a very uniform rate of motion, and this was further exemplified in 1903, the mean period of nine spots being 9h. 55m. 18·5s.

The north temperate spots moved more slowly than any others on the disc, the rotation of nine objects in this region averaging 9h. 55m. 54·3s.

A number of large dusky spots were seen in high northern latitudes in 1903. Some of these in about lat. +55° were carefully watched, and their periods were found nearly conformable with the period of the red spot.

A few irregular markings were observed in the region of the north and south poles, but owing to the bad definition usually prevailing, a sufficient number of observations of them could not be secured. During the last five months of 1903 the weather conditions were usually bad, and very delicate planetary features were obliterated on the very unsteady, indistinct images. Between 1903 May 26 and 1904 February 21 I examined Jupiter on 109 nights, the definition being noted as "bad" or "very bad" on 58 nights, while it was recorded as "good" or "very good" on 30 nights only. In all, 1388 transit times of various spots were secured, and the rotation periods of seventy different objects determined. W. F. DENNING.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The degree of Doctor of Science, *honoris causa*, is to be conferred on Dr. Wilhelm Ostwald, professor of chemistry in the University of Leipzig.

Mr. H. Y. Oldham, King's, has been appointed to the readership in geography for a period of five years, under the new conditions.

Mr. F. Horton, B.A., St. John's, has been elected to the Allen studentship of 250*l.* for research in experimental physics.

THE Senate of Aberdeen University has agreed to confer the degree of Doctor of Laws upon Sir George Watt, the officer in charge of the Industrial Museum at Calcutta, and Prof. Wyndham R. Dunstan, F.R.S., director of the Imperial Institute.

THE Senate of Glasgow University has resolved to confer the honorary degree of Doctor of Laws on Mr. G. F. Deacon, civil engineer, London; Dr. W. Stirling, Brackenbury professor of physiology and histology at Owens College, University of Manchester; and Sir William Taylor, Director-General of the Army Medical Service.

AN examination in biological chemistry will be held at the laboratories of the Institute of Chemistry in October next. The examination will extend over four days, and may be theoretical, practical, written and oral. The syllabus will include biological chemistry, with special reference to the chemistry and bacteriology of foods, water, sewage and effluents, and to the practical applications of biological chemistry to industries.

THE Board of Education has approved the draft scheme for the Education Committee for London, submitted by the County Council. The education authority for the metropolis will thus not include members co-opted on account of special knowledge or experience of educational problems. The letter from the Board of Education contains the remark that "In expressing their approval, the Board must not be understood to accede without regret to the desire of your Council to limit the Committee so closely to members of their own body."

A REUTER message from Calcutta states that the Indian Government has issued the text of a resolution of some length dealing with Lord Curzon's scheme for the reform of education. From this it appears that after an exhaustive history of the subject, the Government states that the existing methods require sweeping changes, and goes on to announce that competitive examinations for the public services will be abolished and a system of selection of candidates on probation substituted. "Examinations," it is added, "have harmfully dominated the education system." The Government admits that primary education has been neglected, while secondary education has increased in a striking manner. The college curriculum will be generally raised, the Government assisting deserving colleges. Teachers will be specially trained, and the Education Department will be given four extra officers to assist the present

directors. Questions relating to commercial, technical, artistic, and agricultural training are fully discussed in the resolution.

A NEW building, called Palmer Hall, which has been opened at Colorado College, Colorado, has cost more than 50,000*l.*, and is to be devoted chiefly to the scientific departments. The dedicatory address was delivered by the president of Stanford University, Dr. D. S. Jordan, who in the course of his remarks said:—"As the university ideal of England is one of personal culture, that of Germany is one of personal knowledge. An educated German may lack culture—of this there are many conspicuous examples, just as in England a cultured gentleman may lack exactness of knowledge on all points. In America, a new ideal is arising as a result of the creative needs of our strenuous and complex times. We value education for what can be made of it. Our idea is personal effectiveness. We care less and less for surface culture, less and less for mere erudition. We ask of each man not what he knows, but what he can do with his knowledge. This ideal of education has its dangers. It may lead us to sacrifice permanent values for temporary success. It may tend to tolerate boorishness and shallowness, if they present the appearance of temporary achievement. But the fact remains, the value of science lies in its relation to human conduct. The value of knowledge lies in the use we can make of it. As each thought of the mind tends to work itself out in action, so does each accession of human knowledge find its end in fitting men to live saner and stronger lives. We may, therefore, rest content with the ideal of effectiveness."

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, February 18.—"Note on the Formation of Solids at Low Temperatures, particularly with regard to Solid Hydrogen." By Morris W. **Travers,** D.Sc., Professor of Chemistry at University College, Bristol. Communicated by Sir W. Ramsay, K.C.B., F.R.S.

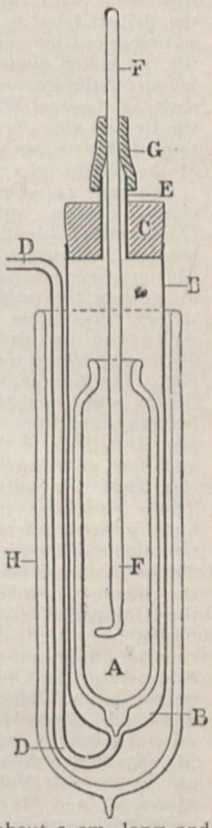
In the year 1902 Dr. Jaquerod and the author carried out some experiments on liquid and solid hydrogen with the view of determining its vapour pressure on the scales of the constant-volume helium and hydrogen thermometers. They found that hydrogen remained liquid down to 14°·2 (He scale), the lowest temperature to which they could reduce a large mass of the liquid by means of the pump at their disposal. When, however, a small quantity of liquid hydrogen, cooled to 14°·2 in a glass tube immersed in the liquid contained in the large vacuum vessel, was allowed to evaporate under reduced pressure, it solidified when the pressure fell to 49 or 50 mm. of mercury. This pressure corresponds to a temperature of 14°·1 on the helium scale. The presence of the solid was determined by mechanical means, and it was not possible to observe its appearance.[1]

Dewar gives the melting point of hydrogen at about 15° absolute, and the melting pressure at 55 mm. of mercury. He describes its appearance as that of "frozen foam," or as "clear transparent ice."[2]

It appeared to the author worth while to carry out a few experiments to try to determine whether solid hydrogen formed definite crystal, or, indeed, whether the glassy substance was a true solid or merely a highly viscous fluid. The following is an instance in which both such changes occur.

If an organic liquid, such as ethyl acetoacetate, is cooled slowly to the temperature of liquid air it is converted into crystalline solid, the formation of the crystals commencing when the liquid is cooled to about −150° C., usually at several points on the side of the vessel, and spreading rapidly throughout the mass. If, on the other hand, the liquid is cooled very rapidly, a hard glassy substance is formed, and though crystals may begin to appear, they will only do so locally, as the velocity of crystallisation decreases rapidly as the viscosity of the liquid increases. The glassy substance is really a liquid of high viscosity; it is formed with perfect continuity from the normal liquid state, and should differ from the solid (crystalline) form in its physical properties. Such a substance might, for convenience, be called a pseudo-solid.

In the investigation of solid hydrogen the apparatus shown in the accompanying figure was employed. The liquid hydrogen was introduced into a small clear-glass vacuum-vessel 15 cm. long and 4 cm. in internal diameter. This vessel was placed inside a glass tube BB, which communicated with an exhaust pump through a tube DD sealed to it, and was closed by a rubber stopper C. A short glass tube E, 6 mm. in diameter, passed through the stopper, and through it passed the stirring rod FF. To allow of free rotating motion to the stirrer, and to make the apparatus gas-tight, a short piece of rubber tube G was passed over the end of the tube E and was wired to F. The lower part of the apparatus was contained within the vacuum vessel H, which contained a small quantity of liquid air.



When the liquid hydrogen was made to boil *in vacuo*, its temperature fell, but the liquid did not appear to become more viscous. At length films of a colourless glassy substance formed at the surface, and broke away as the bubbles rose. After a short time the vessel became filled with these flakes, and while in this condition stirring, by giving the top of the rod F a rotatory motion, did not appear to indicate that the portion which remained liquid had undergone any considerable increase in viscosity. After a time the mass contained so much solid that it became pasty, and finally the whole of it appeared fairly homogeneous.

The solid evaporated fairly rapidly, so that after about ten minutes only a hollow cylinder of it, about 3 cm. long and 2·5 cm. in diameter, remained. This had the appearance of a film of ice which had partly thawed, consisting of clear granules connected by thinner and less transparent portions of solid. No crystals were observed on either of the three occasions on which the experiments were carried out. An attempt was made to examine the solid in the field of a polariscope, but it was unsuccessful.

Though there is no direct evidence of the formation of crystalline hydrogen, the author's experiments lead to the belief that solid hydrogen is a crystalline substance and not a pseudo-solid. The sharpness with which the solid hydrogen is formed, and the constancy of the apparent melting pressure, are distinct evidence in favour of this conclusion, though it must be allowed that the rate of change in viscosity, when the temperatures are measured on the Centigrade scale, will probably appear to be more rapid at low temperatures than at high temperatures.

The whole question of the formation of solids at very low temperatures is of great interest both from a physical and from a biological standpoint. It is quite possible that if living organisms were cooled only to temperatures at which physical changes, such as crystallisation, take place with measurable velocity, the process would be fatal, whereas if they once were cooled to the temperature of liquid air, no such change could take place within finite time, and the organism would survive.[1]

These experiments were made in connection with some investigations which were being carried out at University College, London, with the assistance of a grant from the Royal Society. As the author is at present unable to continue the work, he has decided to publish this note.

[1] *Phil. Trans.*, A, vol. cc., p. 170.

[2] British Association, Presidential Address, 1902. See also paper on "Solid Hydrogen," Brit. Assoc. Report, 1899, reprinted in NATURE; also Roy. Inst. *Proc.*, 1900.

[1] Experimental results are given by Macfadyen, Roy. Soc. *Proc.*, vol. lxvi., 1900, pp. 180, 339, 488; Swithinbank, Roy. Soc. *Proc.*, vol. lxviii., 1901, p. 502.

Geological Society, February 19.—Annual general meeting.—Sir Archibald Geikie, F.R.S., vice-president, in the chair.—After the presentation of the annual awards, the chairman proceeded to read the anniversary address that he had prepared, giving first of all obituary notices of several fellows deceased since the last annual meeting. He then dealt with the bearing of the evidence furnished by the British Isles as to the problem whether in the so-called secular elevation and subsidence of land it is the land or the sea which moves. The conclusion thus reached was in favour of the generally accepted view that changes of level, such as those of Pleistocene and post-Pleistocene time, in the British area, have been primarily due, not to any oscillation of the surface of the ocean, but directly to movements of the terrestrial crust.

February 24.—Dr. J. E. Marr, F.R.S., president, in the chair.—Eocene and later formations surrounding the Dardanelles: Lieut.-Colonel T. **English,** late R.E. Our present knowledge of the older rocks, upon which the Tertiary beds surrounding the Dardanelles rest, only suffices to indicate the positions of the outcrops of a succession of schists, crystalline limestones, granites, and serpentines, which can be traced from the Ægean district into the Marmora, where they formed an archipelago in the Eocene Sea. The Eocene deposits surrounding these old rocks commence with sandstones, conglomerates, and clays, which become calcareous and nummulitic upward, and are about 2000 feet thick in the aggregate. They are succeeded by 3000 feet of lacustrine sandstones, clays, and schists, interstratified with volcanic rocks, and containing coal-seams. These beds have yielded Anthracotherium, plant remains, and *Corbicula semistriata* at the coal-horizon, which is near the middle of the series. They are widely spread in southern Thrace, and are cut off to the eastward by the falling-in of the Marmora sea-bed. The author has traced them along the Gallipoli Peninsula to Imbros Island; Lemnos and Samothrake are partly composed of similar beds, and he considers that all these deposits represent the uppermost Eocene and the Oligocene, and that the coal-seams belong to the latter. The paper is accompanied by three appendices, one on the rock-specimens, by Dr. J. S. Flett; one on the collection of Tertiary and post-Tertiary fossils, by Mr. R. Bullen Newton; and a third, by Mr. R. Holland, on species of Nummulites.—The Derby earthquakes of March 24 and May 3, 1903: Dr. Charles **Davison.** The undoubted earthquakes of this series were four in number. The first and strongest occurred on March 24, 1903, at 1.30 p.m., and was felt over an area of about 12,000 square miles, its centre coinciding with the village of Kniveton, near Ashbourne. The shock consisted of two distinct parts, separated by an interval of about three seconds, which coalesced, however, within a narrow rectilinear band running centrally across the disturbed area at right angles to the longer axes of the isoseismal lines. The isacoustic lines (or lines of equal sound-audibility) are very elongated curves, distorted along the rectilinear band. The earthquake, it is concluded, was caused by simultaneous slips within two detached foci situated along a fault-surface running from north 33° east to south 33° west, hading to the north-west, and passing close to the village of Hognaston. The strongest after-shock occurred on May 3, its focus lying along the same fault, for the most part between the two foci of the principal earthquake, but much nearer the surface. The principal earthquake was registered by an Omori horizontal pendulum at Birmingham, by a Milne seismograph at Bidston (near Birkenhead), and by a Wiechert pendulum at Göttingen (502 miles from the epicentre). The larger waves travelled with a velocity of 2·9 kilometres per second.

Chemical Society, March 3.—Dr. W. A. Tilden, F.R.S., president, in the chair.—The following papers were read:—Chemical dynamics of the alkyl iodides: Miss K. A. **Burke** and F. G. **Donnan.** The authors have determined the velocity of the reaction between silver nitrate and various alkyl iodides in alcoholic solution, and have compared the results so obtained with those observed by previous workers using other reactions of the alkyl haloids.—Separation of β-crotonic acid from α-crotonic acid: R. S. **Morrell** and A. E. **Bellars.** This separation was effected by recrystallisation of the quinine salts of the mixed acids.—Contribution to the knowledge of the β-diketones: S. **Ruhemann** and E. R. **Watson.**—Purification of water by continuous fractional distillation: W. R. **Bousfield.** The apparatus consists of a copper boiler provided with a series of "baffle plates" to prevent "spraying," leading to a condenser consisting of a series of test-tubes cooled by adjustable streams of water at different temperatures. The distilled water which drips from the coldest portions of the condenser is sufficiently pure to be used in electrical conductivity experiments.—Freezing point curves of dynamic isomerides. Ammonium thiocyanate and thiocarbamide: A. **Findlay.** The freezing point curve consists of two branches meeting at the eutectic point 104·3.—Constitution of phenolphthalein: A. G. **Green** and A. G. **Perkin.**—δ-Ketohexahydrobenzoic acid: W. H. **Perkin,** jun.—Photochemically active chlorine: C. H. **Burgess** and D. L. **Chapman.**—The union of hydrogen and chlorine, part viii., the action of temperature on the period of induction: J. W. **Mellor.** It is shown that the period of induction shortens with increase of temperature up to 38°; above this point the temperature effect is obscured, probably by the influence of the water vapour present.—The union of hydrogen and chlorine, part ix., further experiments on the action of light on chlorine: J. W. **Mellor.** It is shown that the greater chemical activity of "insolated" chlorine is closely related with the presence of water vapour.—Additive compounds of unsaturated cyclic ketones with hydrogen cyanide: A. C. O. **Hann** and A. **Lapworth.** A description of the additive compounds obtained from carvone and pulegone.—Formation of periodides in organic solvents: H. M. **Dawson.** A study of the potassium periodides formed by the solution of potassium iodide and iodine in organic aromatic and aliphatic solvents.—The action of sodium hypochlorite on the aromatic sulphonamides: H. S. **Raper,** J. T. **Thompson** and J. B. **Cohen.** A description of the compounds obtained.

Linnean Society, March 3.—Prof. S. H. Vines, F.R.S., president, in the chair.—Mr. L. A. **Boodle** exhibited photographic lantern-slides demonstrating the formation of secondary wood in certain regions of the stem of *Psilotum triquetrum.*—List of the Carices of Malaya: C. B. **Clarke,** F.R.S. After defining his meaning of the term Malaya, the author explained that he had been obliged to confine his remarks to the material existing at Kew, with certain additional specimens lent by Dr. Zahlbruckner, of Vienna, who had sent over some of the types of Zollinger's collections. The British Museum herbarium could not be utilised, owing to the impracticability of comparing the specimens belonging to the two institutions. In all, fifty-four species are here enumerated, of which thirty-six, including the eleven here characterised as new, belong to the subgenus Caricandra, a natural group essentially tropical and difficult to diagnose as to species, all possessing a trifid style, with a terminal spike male in the upper portion and female at the base.—On some species of the genus Palæmon, Fabr., from Tahiti, Shanghai, New Guinea, and West Africa: Dr. J. G. **de Man.**—The species discussed are distributed by the author over three subgenera. Relative measurements and minute details of various specimens are explained and illustrated by drawings, to show the amount of variation possible among examples undoubtedly belonging to a single species, and on the other hand to offer materials for deciding whether forms from two or more widely separated localities should be accepted as specifically identical.

Mathematical Society, March 10.—Dr. E. W. Hobson, vice-president, and temporarily Prof. Elliott, vice-president, in the chair.—The following papers were communicated:—On inner limiting sets of points in a linear interval: Dr. E. W. **Hobson.** Every point of an inner limiting set may be enclosed in a sequence of intervals of breadths tending to zero in such a way that those limiting points of the set which do not belong to the set are not, in the limit, interior points of any of the intervals. The cardinal number of the points of an inner limiting set is known to be either that of the natural numbers or that of the continuum. It is shown in the paper that the necessary and sufficient condition that an enumerable set may be an inner limiting set is that it contains no component which is dense in itself. The most general character of an inner limiting set which is unenumerable is also determined. The importance of the

theory in connection with functions of real variables is explained.—On the unique expression of a quantic of any order in any number of variables with an application to binary perpetuants: P. W. **Wood.** The paper contains a new proof that the minimum weight of an irreducible perpetuant of degree δ is $2^{\delta-1}-1$.—(1) The derivation of generalised Bessel coefficients from a function analogous to the exponential; (2) transformation of generalised Legendre functions: Rev. F. H. **Jackson.** In a series of papers the author has shown how functions defined by known power series may be generalised by replacing the numbers $1, 2, \ldots n$ in the coefficients by the numbers $f_1, f_2, \ldots f_n$ of a chosen sequence. The two papers now communicated trace various analogies between Bessel functions and Legendre functions and the functions that are derived from them by this process.—The singularities of functions defined by power series: H. M. **Macdonald.**—Illustrations of modes of decay of vibratory motions: Prof. A. E. H. **Love.** The ordinary processes for determining the rate of decay of vibratory motion by transmission of waves through the surrounding medium afford a good approximation when the rate in question is slow, but they are inadequate for determining the motion of the medium. It is shown that when a sphere vibrates in air the slightly damped harmonic wave, with nearly the period of the vibrator, must be accompanied in its passage through the air by one or more subsidiary waves, of exponential or rapidly damped harmonic type, which serve to establish the front of the advancing wave. When electrical oscillations are set up on a spherical conductor, the waves that travel through the æther are analogous to the subsidiary waves in the sound problem. Corresponding with any surface harmonic distribution of the initial charge a system of such waves advances into the initial electrostatic field of the distribution, and all the waves of the system must coexist in order that the wave-front may advance. The wave-motions cannot be propagated independently. As the front of the composite system of waves advances the electrostatic energy of the initial field is converted into electromagnetic energy, which is accumulated in a narrow region at the front of the advancing wave.

EDINBURGH.

Royal Society, February 1.—Lord Kelvin, president, in the chair.—The **President** read a paper on deep-water two-dimensional waves produced by any given initiating disturbance, which was in continuation of a paper on the front and rear of a free procession of waves in deep water, read seventeen years ago. In that paper a question had been raised and a solution given in symbols which still, however, awaited tabulation or graphical calculation. The problem of the surface motion of waves in very deep water had long been solved, but the problem of waves circling out in all directions from the surface disturbance produced by the falling of a stone into the water was a far more difficult problem, which nothing known in mathematics enabled the mathematician to calculate. In the present paper Lord Kelvin gave the solution of an analogous though simpler problem. Given a certain definitely specified initial disturbance fitted to generate two-dimensional wave motion, the results showed the genesis of waves from a condition in which there was nothing undulating whatever.—Dr. G. A. **Berry** read a paper on the relation of visual efficiency to visual acuity, being a consideration of the data for determining in general the relative loss of efficiency caused by accidents which lead to different degrees of interference with sight. The object was to get some basis for calculating the amount of compensation which should be allowed by the Workman's Compensation Act when sight had been damaged to various extent by accident, and thus avoid the frequent litigation to which such accidents now give rise. The data for establishing a visual efficiency scale were somewhat arbitrary, but basing on certain principles, the author deduced the following expression for the efficiency:—

$$E=\frac{m+1-\frac{V+V'}{2}-\frac{V-V'}{V+V'}\left(1-\frac{V+V'}{2}\right)}{m-1+2/(V+V')}$$

where V, V′ were the visual acuities of the better and worse eyes respectively, and m a number such that the fraction $m/(m+1)$ represented the reduction in sight due to complete loss in one eye with retention of full sight in the other. Tables of efficiency were given for different values of m, also maximum and minimum curves for $m=3$.

February 15.—Dr. Horne in the chair.—Dr. T. J. **Jehu** read a paper on the Glacial deposits of northern Pembrokeshire, in which full descriptions were given of (1) the lower Boulder-clay; (2) the sands and gravels; (3) the upper Boulder-clay and rubbly drift. Boulders from the south of Scotland and the north-west of Ireland were found, showing that the northern ice-sheet had covered the whole of north Pembrokeshire. The results led to a clearer view than had been possible hitherto as to limits of the various ice sheets which glaciated that region.—In a communication on sea temperature and solar radiation, Prof. C. G. **Knott** discussed some of the data furnished by the elaborate observations of temperature at various depths in the Mediterranean Sea made by the staff of the Austrian warship *Pola*. It was shown that direct solar radiation was not appreciable to depths greater than 15 metres, and that the vertical distribution of temperature within the upper layers was largely conditioned by convection or diffusion of material. An estimate was made of the amount of solar heat which gets into the water every day and leaves it at night, and it was found that about two-thirds of the available solar energy incident on the surface of the waters was so entrapped and set free. The processes by which this diurnal influx and efflux of heat took place were discussed in some detail.

PARIS.

Academy of Sciences, March 7.—M. Mascart in the chair.—The president announced the death of M. Fouqué, member of the section of mineralogy.—Researches on the gaseous exchanges between the atmosphere and plants deprived of their roots, and kept in the dark: M. **Berthelot.** The gases given off during the maturing of hay were measured, together with the rise of temperature. Neither methane nor ammonia were given off, the gases containing carbon dioxide, oxygen, and nitrogen only.—On the rhizomes and roots of the fossil ferns and of the Cycadofilices: M. **Grand'Eury.**—On the formation of glycuronic acid in the blood: R. **Lepine** and M. **Boulud.** The authors have shown in a previous paper that glycuronic acid is present in the liver, and now give experimental evidence that the lævorotatory power of certain extracts of blood from the hepatic veins is due to derivatives of this acid.—M. Agassiz was elected a foreign associate in the place of the late Sir George Gabriel Stokes, and M. Warming a correspondant in the section of botany in the place of M. Agardh.—The dielectric cohesion of argon and its mixtures: E. **Bouty.** Argon is characterised by the smallness of its dielectric cohesion, which is even less than that of hydrogen. Minute traces of foreign gases produce a remarkable increase in the cohesion, this increase being much greater than would be indicated by the law of mixtures.—The general law of magnetofriction: H. **Pellat.** In an intense magnetic field the particles in motion, the kathode rays, undergo an action analogous to an anisotropic friction, which is large in a direction perpendicular to the lines of force, but almost nothing in the direction of these lines.—Experimental proofs of the laws of anomalous propagation of light along the axis of an optical instrument: G. **Sagnac.**—An elementary demonstration of the phase rule: C. **Raveau.**—The different conditions of a spark fractionated by blowing: J. **Lemoine** and L. **Chapeau.** When a stream of sparks is allowed to pass over a spark gap for some time, there is an abrupt change in the nature of the discharge. This is due to the spontaneous oxidation of the brass, the formation of oxide causing a lower explosive potential than with polished brass balls.—The action of certain chemical and osmotic phenomena on phosphorescence: M. **Lambert.**—On europium: G. **Urbain** and H. **Lacombe.** The authors have applied their method of crystallisation with magnesium and bismuth nitrates to the separation of europium (Demarçay) from monazite sand. The sand contains only about 0·002 per cent. of this oxide, which forms a sulphate $Eu_2(SO_4)_3.8H_2O$. The atomic weight was found to be 151·8.—The action of carbon dioxide upon the metal ammoniums: Étienne **Rengade.** Carbon dioxide reacts with sodium-ammonium and potassium-ammonium. Below $-50°$ C. the alkaline carbamate and hydrogen are the sole products. At a higher temperature

some formate is also produced.—A general method for the preparation of anhydrous chlorides: C. **Matignon** and F. **Bourion.** A mixture of chlorine and sulphur chloride reacts with metallic oxides at moderately low temperatures, giving an anhydrous chloride. Details are given of the preparation of the chlorides of silicon, aluminium, thorium, praseodidymium, neodidymium and samarium.—On the phenylurethanes of the sugars: L. **Maquenne** and W. **Goodwin.**—On allyl- and propenyl-alkyl ketones: E. E. **Blaise.** In the allyl-alkyl-ketones, migration of the ethylene linkage occurs with extreme facility, and details are given of the various ways in which this may be effected.—The combination of saccharose with some metallic salts: D. **Gauthier.**—On the development of annual oil-containing plants: G. **André.**—On the development of the perithecium in the Ascomycetes: P. A. **Dangeard.**—On the perpetuation of the mildew of the vine: Gy **de Istvanffi.** The author has been able to prove the presence of the mycelium in a latent state in several organs of the vine during the winter months.—Faults and folds: H. **Douvillé.**—On the chemical composition of the crystalline strata of the Belledonne Chain: Pierre **Termier** and André **Leclère.**—The action of the *n*-rays upon the sense of hearing: Augustin **Charpentier.** The sensibility of the ear is increased when acted upon by the *n*-rays.—The physiological action of the n_1-rays of Blondlot: Augustin **Charpentier.** M. Blondlot has recently described a new species of rays possessing physical properties which are the inverse of the *n*-rays previously studied. These rays also produce the inverse effects on the nervous system; thus they diminish the intensity of the sensation of smell, whereas the *n*-rays increase it.—On the relations of the colouring matter of subrenal extract with tyrosine: Gab. **Bertrand.**—The oxidation of formic acid by extracts of animal tissues in presence of hydrogen peroxide: F. **Battelli.**—The action of artificial oxydases upon the tetanic toxin: Aug. **Lumière,** L. **Lumière** and J. **Chevrottier.**

DIARY OF SOCIETIES.

THURSDAY, MARCH 17.

ROYAL SOCIETY, at 4.30.—Physical Constants at Low Temperatures. (1) The Densities of Solid Oxygen, Nitrogen, Hydrogen, &c: Prof. J. Dewar, F.R.S.—The Specific Heats of Metals, and the Relation of Specific Heat to Atomic Weight. Part III.: Prof. W. A. Tilden, F.R.S.—On the Construction of some Mercury Standards of Resistance, with a determination of the Temperature Coefficient of Resistance of Mercury: F. E. Smith.—On the Effect of a Magnetic Field on the Rate of Subsidence of Torsional Oscillations in Wires of Nickel and Iron, and the Changes produced by Drawing and Annealing: Prof. A. Gray, F.R.S., and A. Wood.—On a Criterion which may serve to test various Theories of Inheritance: Prof. K. Pearson, F.R.S.

LINNEAN SOCIETY, at 8.—On the Bryozoa from Franz Josef Land: A. W. Waters.—Natural-Colour Photographs of Living Insects and Flowers: F. Enock.

AERONAUTICAL SOCIETY, at 8.—Experiments with Aërial Screw Propellers: Major B. F. S. Baden-Powell.—The Beedle Airship: W. Beedle.—Mechanical Flight: Thomas Moy.

INSTITUTION OF MINING AND METALLURGY, at 8.—Annual General Meeting. Followed by Discussion on "The Equipment of Laboratories for Advanced Teaching and Research in the Mineral Industries."

FRIDAY, MARCH 18.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.—Compound Locomotives in France: M. Edouard Sauvage.

EPIDEMIOLOGICAL SOCIETY, at 8.30.—The Epidemiology of Enteric Fever and Cholera in Hamburg: Dr. Reincke.

SATURDAY, MARCH 19.

ROYAL INSTITUTION, at 3.—The Life and Work of Stokes: Lord Rayleigh.

MONDAY, MARCH 21.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—The Swedish Antarctic Expedition: Dr. Otto Nordenskjöld.

FARADAY SOCIETY, at 8.—The Electrolytic Analysis of Gold: Dr. F. Mollwo Perkin and W. C. Prebble.—Thin Film Electrolysis with an Application to Printing: Chas. R. Darling. (With Experiments.)

SOCIETY OF ARTS, at 8.—Recent Advances in Electro-Chemistry: Bertram Blount. (Cantor Lecture, III.)

SOCIETY FOR PSYCHICAL RESEARCH, at 8.30.—A Case of Multiple Personality: Dr. A. Wilson.

TUESDAY, MARCH 22.

ROYAL INSTITUTION, at 5.—The Doctrine of Heaven and Hell in Ancient Egypt and the Books of the Underworld: Dr. E. A. Wallis Budge.

SOCIETY OF ARTS, at 4.30.—Cotton Growing in the British Empire: Alfred Emmott, M.P.

INSTITUTION OF CIVIL ENGINEERS, at 8.—*Discussion*: The Barrage across the Nile at Asyut: G. H. Stephens, C.M.G.—The Use of Cement Grout at the Delta Barrage in Egypt: Sir R. H. Brown, K.C.M.G.—*Papers*: Lowering the Sill of the Ramsden Dock, Barrow-in-Furness: L. H. Savile.—Burntisland Harbour; Construction of the East Dock: R. Henderson.

MINERALOGICAL SOCIETY, at 8.—(1) Irregularly Developed Crystals of Zircon (Specific Gravity 4·0) from Ceylon: (2) Notes on "Feather-ore"; identity of "Domingite" ("Warrenite") with Jamesonite: L. J. Spencer.—The Connection between the Atom Arrangements of certain Allied Carbon Compounds: W. Barlow.—On the Construction and Use of the Moriometer: H. Smith.—(1) Note Relative to the History of the Caperr Meteorite; (2) On the Meteoric Irons of Bethany, Lion River, Springbok River and Great Fish River, South Africa: L. Fletcher, F.R.S.

WEDNESDAY, MARCH 23.

GEOLOGICAL SOCIETY, at 8.—On the Discovery of Human Remains beneath the Stalagmite Floor of Gough's Cavern, near Cheddar: H. N. Davies.—On the Moine Gneisses of the East Central Highlands and their Position in the Highland Sequence: G. Barrow.

THURSDAY, MARCH 24.

ROYAL SOCIETY, at 4.30.—Croonian Lecture, on the Chemical Regulation of the Secretory Process: Prof. E. H. Starling, F.R.S., and Dr. W. M. Bayliss, F.R.S.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—Direct Reading Measuring Instruments for Switchboard Use: K. Edgcumbe and F. Punga.

FRIDAY, MARCH 25.

ROYAL INSTITUTION, at 9.—Liquid Hydrogen Calorimetry: Prof. Dewar, F.R.S.

PHYSICAL SOCIETY, at 5.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The Relative Advantages of Continuous and Alternating Current for Traction Purposes: J. M. Kennedy.

SATURDAY, MARCH 26.

ROYAL INSTITUTION, at 3.—The Life and Work of Stokes: Lord Rayleigh.

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