THURSDAY, APRIL 2, 1908.

ELECTRICITY AND MATTER.

The Corpuscular Theory of Matter. By Prof. J. J. Thomson, F.R.S. Pp. vii + 172. (London: Archibald Constable and Co., Ltd., 1907.) Price 7*s.* 6*d.* net.

THE present volume is an expansion of six lectures delivered by Prof. J. J. Thomson in his capacity of professor at the Royal Institution. It is a simple and clear account of the development of the corpuscular, or, as some prefer to call it, the electronic, theory of matter to explain the passage of electricity through metals and gases. The last two chapters are devoted to consideration of the properties of model atoms built up of corpuscles, and the evidence in favour of the view that the number of the corpuscles in an atom is about the same as its atomic weight in terms of hydrogen.

The proof of the independent existence in matter of electrons of mass small compared with the atoms has supplied a great stimulus to the attack of that most important problem of physics, the connection between electricity and matter. This attack has been conducted both on experimental and theoretical lines, and while only a beginning has been made, yet the results already obtained have been instrumental in giving a much clearer and deeper insight into the conditions of the problem, and afford considerable justification for the hope of still greater advances in the immediate future. There has been a tendency in some quarters to view with alarm, if not with distrust, the philosophic speculations of the physicist, more particularly when dealing with the question of the constitution of the chemist's atom. It is apparently considered indelicate to pry too deeply into the mysteries of atomic structure, especially if mathematical analysis is the instrument of investigation. This attitude appears somewhat unreasonable to the average physicist, and arises largely from a misunderstanding of the relative place of theory and experiment in physical science. A student of the history of physical science cannot fail to be impressed by the notable part played by mathematical physics in the development of the subject, and there is no obvious reason why the cooperation between the two branches of the subject should not be as fruitful in the future. The physicist from his training is seldom content merely to describe phenomena, but seeks for some form of theory that will serve to give a general explanation of the facts and to show their relation with other branches of the subject. In dealing with such a complicated and intangible problem as the constitution of the atom, it is essential that theory should go hand in hand with experiment, for without some kind of theory the experimenter is in most cases as helpless as a ship without a rudder.

This attitude of the physicist is very well expressed by Prof. J. J. Thomson in the opening chapter. After mentioning the postulates on which the corpuscula theory of matter is based, he proceeds:—

"From the point of view of the physicist, a theory of matter is a policy rather than a creed; its object is to connect or coordinate apparently diverse phenomena, and above all to suggest, stimulate and direct experiment. It ought to furnish a compass which, if followed, will lead the observer further and further into previously unexplored regions. Whether these regions will be barren or fertile experience alone will decide; but at any rate, one who is guided in this way will travel onward in a definite direction, and will not wander aimlessly to and fro."

The working out of the logical consequences of a simple theory and the comparison of the deductions with experiment is eminently scientific, and of great importance to the specialist who is able to form a critical estimate of the adequacy of the theory. The danger of too free a use of hypothesis is not so much for the specialist as for the general reader who, from lack of expert knowledge or of time, is unable to form a critical judgment on the matter. In such a case there is a tendency to assume that a theory which may be admittedly tentative in character represents the final, accepted views on the subject.

Two of the most interesting chapters of the book are devoted to the application of the corpuscular theory to explain the passage of electricity through metals. In one chapter the theory developed is similar in general outlines to that originally advanced by the author and the late Prof. Drude. The corpuscles which are responsible for the passage of electricity through a conductor are supposed to be free from the molecules for a time sufficiently long for them to be in temperature equilibrium with the molecules of the metal. This implies that the corpuscles behave like a gas, and that temperature equilibrium is reached when the mean kinetic energy of the corpuscle has become equal to that of a molecule of a gas at the same temperature. The passage of the current is then supposed to result from the drift of these free charged corpuscles, brought about by the action of the external electric field applied to the conductor. This theory is shown to account in a satisfactory way for the connection between thermal and electric conductivities of metal, and with minor assumptions for the Peltier and Thomson effects. Prof. Thomson points out that this form of theory suffers from one very serious defect. In order to account for the conductivities observed in metals, it is necessary to assume the presence of such a large number of free corpuscles in the metal that the specific heat of these alone, quite independently of the atoms of the metal itself, is about ten times greater than that experimentally observed. The author in the next chapter develops another form of the theory which is free from this objection, and at the same time fits in with the facts to be explained equally well as the first theory. The second method supposes that the corpuscles are not free in the metal except for the time required to pass from one atom to another. They are pulled out of the atoms of the metals by the action of the

surrounding matter, and immediately pass into adjacent atoms. This view materially reduces the number of corpuscles required for the transfer of electricity. In both these forms of theory the atoms of the metal itself are supposed immobile, and to play no direct appreciable part in the transfer of the current.

The important question of the type of radiation to be expected from a metal on the above theories is fully considered. Since the corpuscles are suddenly started and stopped, they must radiate energy in the form of thin pulses analogous to the pulses which are supposed to constitute the Röntgen rays. Lorentz has shown that if this radiation be analysed by means of Fourier's series, the amplitude of the long waves agrees closely with that deduced independently of such assumptions by means of the thermodynamical theory. Prof. Thomson, however, points out that the main radiation must consist of short waves analogous to very easily absorbed Röntgen rays. It would be of great interest and importance if the presence of such a type of radiation from metals could be experimentally detected. In another chapter the author explains the construction and properties of his well-known "model" atoms built up of rings of rotating corpuscles. No one can fail to admire the ingenuity displayed in the construction of such atoms, and in showing the remarkable way in which they imitate many of the known properties of the atom. On this hypothesis the properties of the atom are dependent on the number and arrangement of the negative corpuscles. The corresponding positive electricity, which is distributed throughout the volume of a sphere, merely serves as a cement to hold the atom together. This form of atom, while it has many advantages from the point of view of calculation, is somewhat artificial, for it implicitly assumes very peculiar properties for the positive electricity. To say that a positively charged body is one that has lost a negative corpuscle is not an explanation, but begs the question of the nature of positive electricity. The trend of modern views is to diminish in some directions the importance of the negative charge and to emphasise that of the positive. This is borne out by the author's estimates that the number of free corpuscles in an atom is about the same as its atomic weight in terms of hydrogen. Until we have a clearer idea of the nature of positive electricity we cannot hope to form a clear view of the constitution of the atom. The proof of the existence of a positive electron —the counterpart of the negative—if such exists, would be of enormous importance to theory and experiment. The problem of the nature of positive electricity is now very much to the fore, and it is to be hoped that we shall not have to wait too long for a solution.

Like all Prof. Thomson's books, the present volume is lucidly and simply written, while the mathematical analysis required for the development of the consequences of the theory is made as simple as possible. To all those interested in the latest views of the connection between electricity and matter this book will be very welcome. E. R.

CHARTING THE WORLD'S COMMERCE.

Atlas of the World's Commerce. Compiled from the Latest Official Returns at the Edinburgh Geographical Institute, and edited by J. G. Bartholomew. (London: G. Newnes, Ltd.) Twenty-two parts, each 6*d*. net.

MR. BARTHOLOMEW is a skilled hand at map-making, and in setting himself to chart the commerce of the world he has undertaken a gigantic task. With the aid of 176 large pages of coloured plates, containing more than 1000 maps and diagrams, he attempts to describe the products, imports, exports, commercial conditions and economic statistics of all the leading countries of the world, and he says quite justly that the successful accomplishment of such a work must throw much needed light on the solution of the great problem of international trade which we in British politics call "the fiscal question." His first object is to show whence we derive our food, drink, clothing, and all that we use in our daily lives. No better text could be chosen for the enlightenment of our politicians, whatever be their fiscal views, and indeed of all who would understand where England really stands in the world of commerce, and what are the essentials of her future as the central force of a great Empire.

The very immensity of Mr. Bartholomew's undertaking tends to lessen its topical value. For instance, the last three years have been momentous in their effect upon the sources of British food supply, and Mr. Bartholomew can be of little help to the man who would understand how far we are dependent upon foreign and how far upon colonial supplies, when he only carries us down to the year 1903. Canada, for instance, figures in Mr. Bartholomew's diagrams as yielding less than 86 million bushels of wheat. The produce of her western section alone was in 1906 considerably in excess of that figure. The fiscal controversy is especially associated with the food production of the newer countries, and the usefulness of Mr. Bartholomew's diagrams, so far as the fiscal controversy is concerned, goes little beyond the course of our dependence upon the older countries, such as the United States, Russia, &c. For his distribution of the chief sources of the British supply of wheat, Mr. Bartholomew brings us no further down than the 1901–3 average, from which we see that the Canadian percentage was 8·4 and the United States percentage 43·5. The limited usefulness of such figures is evident when it is noted that in 1906 the Canadian proportion was at least 12½ per cent. and the United States proportion 37 per cent. There may have been insuperable difficulties in carrying the averages down to a more recent period, but it is obvious that, in the absence of more recent figures, it is necessary to endorse with qualification Mr. Bartholomew's claim that in his new atlas "the whole fiscal question is clearly illustrated."

We may note one other respect in which the topical usefulness of Mr. Bartholomew's investigations is limited, and it is a vital one. In dealing with the import and export trade of the United Kingdom

(p. 33), the imports are lumped together with no allowance for the fact that in some cases large proportions are re-exported, and therefore, except from the point of view of the shipper, the gross totals throw no light on the industry of the country, in fact they can only mislead. The importance of this allowance for re-exports is shown in the textile group. Thus, of the 52,400,000*l.* worth of imports of cotton, no less than 7,000,000*l.* worth was re-exported, and of the wool imports of 26,600,000*l.* no less than 11,200,000*l.* If Mr. Bartholomew had these calculations in mind, he would hardly have ventured upon the conclusion he draws in a note to this diagram in the following words :—

"It is at once evident that articles of food greatly preponderate, the value amounting indeed to 40 per cent. of the total. Raw material accounts for more than 28 per cent., of which 16½ represent textile fibres."

But we would not leave Mr. Bartholomew's atlas without a recognition of the enormous labour it must have involved, and of its successes in several directions. The maps are excellent, and the table of the commodities of commerce and the gazetteer of countries and ports of the world have obvious uses.

MASONRY AND CONCRETE ARCHES.

Symmetrical Masonry Arches. By M. A. Howe. Pp. x+170. (New York: John Wiley and Sons; London: Chapman and Hall, Ltd., 1906.) Price 10*s.* 6*d.* net.

THE author's object in this text-book has been to present in a simple and direct form a method which can be employed in the design of masonry arches according to the elastic theory. He points out that since such arches are built of materials and under conditions which are more or less uncertain in character, the use of rigidly accurate formulæ is not necessary.

The first portion of the book consists of two chapters, in which the various formulæ which are required in the design of such arches are deduced, and then several examples are worked out in detail to illustrate the application of the formulæ. Independent formulæ are obtained for the effects of bending, axial thrust, and temperature; these formulæ are then combined, but the author points out that as the effect of axial stress is small, except in very flat arches, it may in general be neglected in obtaining a combined formula. For symmetrical arches fixed at the ends, the following conditions must be satisfied, viz., the central angle and the relative elevations at the supports must each remain unchanged, and the length of span must remain constant; Mr. Howe is therefore able to obtain three equations involving the three unknown quantities—moment, vertical reaction, and horizontal thrust at the supports of the arch. He then proceeds to deal with a number of special cases of loading, and discusses fully the temperature effects; graphical representations are frequently used to show the results obtained by analysis.

The last part of this portion of the book is devoted first to a discussion of the trustworthiness of the elastic theory when applied to ribs composed of natural stone voussoirs, and to plain and reinforced concrete ribs (the author comes to the conclusion that the theory may be used with confidence so long as no tensile stresses occur); and secondly to a collection of empirical formulæ for the thickness of the ring at the crown and at the supports in stone arches, and for the thickness of the abutments. The examples of the applications of the formulæ, which are fully worked out, cover the following cases:—(1) An arch for a single-track railway bridge of 60-feet span and a rise of 8 feet, the arch ring to be constructed of granite; (2) an arch with a clear span of 50 feet and a rise of 10 feet, constructed of reinforced concrete (in both cases the maximum stresses produced by dead load, live load, and changes of temperature are computed); (3) the author takes again the data employed in the second example, and gives an ingenious and much shorter method for working out the values of the horizontal reactions and bending moments at different sections of the arch. In the fourth chapter, dimensioned illustrations are given of a few typical arches, and, in the form of an appendix, data have been brought together for 500 arch bridges of masonry, plain concrete, and reinforced concrete. The data in this appendix will be of considerable service to engineers who may be called upon to design arch bridges of one or other of these materials. T. H. B.

OUR BOOK SHELF.

Das Kausalitätsprinzip der Biologie. By Dr. Friedrich Strecker. Pp. viii+153. (Leipzig: W. Engelmann, 1907.) Price 3 marks.

VON BAER said that the chief end of biology was to refer the formative forces of organisms to the general forces and vital directions (Lebensrichtungen) of the Kosmos. According to the mechanists this is rapidly being done; according to the neo-vitalists this is not being done at all, for the characteristic activities of living creatures cannot be described in the formulæ of physicochemical happenings, and there is in the organism an autonomous regulative force or entelechy. Biologists oscillate between these two positions, or dogmatically entrench themselves in either of them, very much as philosophers did in regard to empiricism and rationalism before Kant's critique showed a better way. Dr. Strecker seeks to be a daysman between the two biological schools, laying his hands upon them both, pointing out that there is truth on both sides, but that there is a third outlook which dominates both. For the practical methods and analytic results of the "Entwicklungsmechaniker," such as Roux, the author has an appreciative respect; his criticism is epistemological rather than biological; he does not think that there is any hope of rationally interpreting organisms in mechanistic formulæ. For the neo-vitalists he has also much that is good to say, for they at least do not give a false simplicity to the facts of life; on the other hand, he does not hold with an "entelechy," which seems to be an ingenuous way of bundling all the difficulties into one term, and saying "there's an end of it." The fact is that the mechanists and the vitalists are tarred with the same stick, they are *ekgenetic*, they seek to interpret results which have come to be, instead of concentrating attention on the process of becoming, which is the

engenetic method. In the inorganic world we have to do with passive *things*, with an externally conditioned series of sequences; in the world of organisms we have to do with *creative agents*, with an internal activity, like that of our own psychical life, with engenetic doings, not with ekgenetic occurrences. The only way to get at the gist of the organism, its internal creativeness, is as we get at our own internal life—engenetically. Man crowns the evolution series, his most distinctive feature is his psychical experience, and it is in the light of this that we must try to read the secret of the dominating, correlating, regulating principle in the life of organisms. This, at least, is what we understand this exceedingly abstract treatise to mean. J. A. T.

Pharmakognostisches Praktikum. By Dr. Ludwig Koch and Dr. Ernst Gilg. Pp. viii+272; illustrated. (Berlin: Gebrüder Borntraeger, 1907.) Price 6.80 marks.

IT appears that the recent edition of the German Pharmacopœia has placed additional responsibility upon the German pharmacist, and he is now required to be practically cognisant with the microscopical characteristics of the medicinal plants in their entire as well as in their powdered form. The book before us deals with the above subject, and is intended to be used as a laboratory handbook for pharmaceutical students.

The initial chapter is devoted to the methods of preparing microscopical specimens of the respective plants and their powders, and staining them appropriately. In addition, the adequate magnification for drawing and photographing the respective objects is fully dealt with. The microscopical characteristics of all the official medicinal plants, or rather the parts of them which are official, are fully described, and following upon such description is an account of the microscopical appearance presented by the powdered drug. The order followed in the book corresponds to the part of the plant which is official; for instance, the cortices are all considered together, the rhizomes together, the roots together, and so forth. The whole subject is treated in great detail, and abundant illustrations are scattered through the text of the microscopic appearance of the respective preparations. The volume commences with a table of contents and concludes with a register, from which latter it appears that no fewer than eighty drugs are described.

Die Pendulations-theorie. By Dr. Heinrich Simroth. Pp. xii+564; maps. (Leipzig: K. Grethleius, 1907.) Price 12 marks.

TAKING as his basis Dr. Paul Reibisch's "Ein Gestaltungsprinzip der Erde" (1901), supplemented by Mr. D. Kreichgauer's "Die Äquatorfrage in der Geologie" (1902), the author of the curious volume before us discusses the effects which would, in his opinion, be produced on the animal life of the globe by secular changes in the direction of the polar axis. Mr. Kreichgauer, it seems, is of opinion that in the course of geological time the two poles have actually changed places, and also that during such oscillations huge "wobbles" or waves have been produced in the earth's crust in the intervening latitudes. These "wobbles," if we understand him rightly, the author believes have produced marked effects on the distribution of animal life, having, so to speak, "shaken" the various groups into particular positions. The distribution of all the chief groups is discussed according to the new theory, and in many cases illustrated by maps.

Without in any way committing ourselves to an opinion on the author's views, it may be pointed out that several of these maps are inaccurate. The one illustrating the distribution of ichthyosaurs (p. 249) ignores, for instance, the fact that remains of these reptiles have been obtained from more than one locality in Africa, which is left a blank in the map in question. This being so, it is difficult to see what value attaches to Dr. Simroth's conclusions in this and several other cases. R. L.

The Minimising of Maurice, being the Adventures of a very small Boy among very small Things. By Rev. S. N. Sedgwick. Pp. ix+150. (London: Elliot Stock, 1907.) Price 5*s.* net.

A WORD to "grown-ups" which prefaces this volume asserts "there are quite a lot of things in it *which only children are able to understand*"—the italics are not ours. There are "baby" language, indifferent verse, and talking animals in great profusion, but, despite all these, we are very doubtful as to whether the book will really appeal to children. The illustrations are good, and these at least will set young readers questioning and observing. We should have preferred a simple account in good literary English of the forms of animal life introduced, and so would most of the children we know.

Les Progrès de la Photographie astronomique. By Prof. P. Stroobant. Pp. 34; illustrated. (Brussels: M. Hayez, 112 rue de Louvain, 1907.)

THIS thirty-four page extract from *l'Annuaire astronomique de l'Observatoire royal de Belgique pour* 1908 is typical of those services which Prof. Stroobant is continually rendering to contemporary astronomy. It contains in a concise and lucid form descriptions of the methods by which photography renders such valuable services to astronomical research. The photography of regions, such as nebulæ, the discovery of minor planets and satellites by the photographical method, the investigation of the physical peculiarities of comets and of the solar photosphere, the observations of variable stars and of proper motions are all dealt with in turn, and in each case the text is illustrated by excellent reproductions of actual photographs. Duplicate, detachable plates, for use in a stereoscope, are included in order to illustrate the value of Prof. Wolf's stereocomparator method for the detection of small proper motions and of variations in magnitude. W. E. R.

(1) *I laterizi.* By Ing. G Revere. Pp. x+298; 134 figures. Price 3.50 lire.

(2) *La Tecnologia delle Saldature autogene dei Metalli.* By Prof. S. Ragno. Pp. iii+129. (Milan: Ulrico Hoepli, 1907.) Price 2 lire.

THESE are recent additions to the "Manueli Hoepli," a collection which numbered 900 of these small pocket-books on April 1, 1907. Mr. Revere's book deals with brickwork. It opens with general and historical information, and then deals in succession with the selection and extraction of the clay, its subsequent preparation, brick-making machinery, the drying process, and finally the brick kiln. The need of such a book has arisen through the great development that has taken place in the brick industry in recent years, notably in Italy, where improved machinery has been largely introduced.

Prof. Ragno's manual deals with the soldering and welding of metals. Five methods are distinguished, namely, the electric, oxy-hydrogen, oxy-acetylene, oxy-gas, and aluminium methods. The advantages of these methods are discussed. Two appendices deal respectively with the cutting of metals by means of an oxygen jet and the methods of producing oxygen commercially.

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.]*

Mendelian Characters among Shorthorns.

I HAVE just come upon a phenomenon which, although it may be interesting to naturalists, may be alarming to breeders of Shorthorn cattle. It is that the roan Shorthorn is a hybrid, and must remain so for ever.

The data on which this statement is based are to be found in a paper on the inheritance of coat-colour in cattle, by Miss A. Barrington and Prof. Karl Pearson, published in *Biometrika* for March, 1906.

For the purposes of their paper these authors, having examined in the Shorthorn Herd-book the pedigrees of more than 2000 calves, noted the colours of these and their parents, and analysed and tabulated the figures found. They divided the sires and dams according to the colours under which they are registered, and then made an analysis of the colours of the calves produced. There are five different colours registered, viz. red, red and little white, red and white, roan, and white. A sire of any one of these colours may be bred with a dam of any one of them. Miss Barrington and Prof. Pearson made an analysis of the colours of the calves produced by bulls of all the five colours when bred with cows of every one of the same five colours. For instance, they found that by mating 514 roan bulls with 514 roan cows there had been produced eighty-six red calves, thirty-one red with little white calves, thirty-five red and white calves, 278 roan calves, and eighty-four white calves.

These cases at a first glance give rise to no Mendelian suggestion. No more does the full collection of cases. Miss Barrington and Prof. Pearson failed to find in them any Mendelian indications.

But if we consider the nature and history of the Shorthorn breed the Mendelian characters come out. The Shorthorn is a composite breed. A hundred and fifty years ago it consisted of at least three, and possibly four, different strains. The chief ancestry came from the Low Countries. They were red-and-white flecked cattle—*fleckvieh*. In Durham and Yorkshire they wedged themselves in between the original British black cattle in the north and the Anglo-Saxon red cattle in the south. They also possibly reached westwards to the Longhorns. The Anglo-Saxon red cattle were probably the purest. The northern black cattle and the western Longhorns were not pure. They were intermixed with white cattle—cattle which had been introduced originally by the Romans. It was impossible for the recently introduced flecked cattle not to become mixed with black blood in the north, with white blood in the north and west, and with red blood in the south. Breeders, however, did not like the black blood, and it was soon bred out. The white was retained, but, so far as I know, it is difficult to say how much Anglo-Saxon red blood was retained. It is on that ground any uncertainty arises. But, if red blood was retained, it was nearly related to the red and white blood introduced from the Continent.

If we look upon the Anglo-Saxon red cattle and the Low Country red-and-white cattle as being of one race, then, since the black blood was bred out, the Shorthorn is a combination of two races. If we look upon these red and red-and-white cattle as different races, then the Shorthorn is a combination of three.

I tried to find Mendelian characters among the cases collected by Miss Barrington and Prof. Pearson by assuming the Shorthorn to be a three-fold combination, but unsuccessfully. Then Prof. Arthur Thomson's account of the blue Andalusian fowl in his newly published "Heredity" suggested the idea that the red, red and little white, and red-and-white Shorthorns might be taken as one race. Are not these Shorthorns splashed reds just as one of the blue Andalusian parents is "splashed white"? The Shorthorn, then, becomes a composite breed with one parent white and the other splashed red. Assuming this to be so, then the Mendelian characters of the Shorthorn come out. There are one or two small discrepancies, but they can be explained. It is sometimes difficult to say whether a calf is red-and-white or roan. Thus all that are labelled red and white may not be really red and white, and all that are labelled roan may not be really roan. Among Shorthorn breeders white calves are not desirable. Cases of false registration and the substitution of another calf for a white—that is, giving a red or a roan calf a white calf's pedigree—have not been unknown. Thus some red or roan calves may not be the progeny of the parents attributed to them. For the same reason that white calves are undesirable, a good many white calves are not registered at all. Thus the real numbers of white calves born are greater than the numbers registered, and the number of matings recorded is less than it ought to be through matings that produced white calves being unrecorded. For the reason that white calves are not wanted, a white bull and a white cow are very seldom mated. Thus very few such matings are registered.

Assuming the Shorthorn to be a combination of two races, a red and a white, then, according to the Mendelian formulæ as exemplified by the blue Andalusian fowl, we ought to get the following results:—

(1) Red crossed by red should give red calves.
(2) White crossed by white should give white calves.
(3) Red crossed by white should give roans.
(4) Roans inbred should give reds, whites, and roans in the proportion of 1, 1, 2.
(5) Roans crossed by reds should give roans and reds in equal proportions.
(6) Roans crossed by whites should give roans and whites in equal proportions.

This, giving heed to the expected exceptions as indicated above, is what we find, viz.:—

	Red	Roan	White
438 Reds crossed by reds give ...	413	25	0
3 Whites crossed by whites give	0	0	3
71 Reds crossed by white give...	3	68	0
514 Roans crossed by roans give ...	152	278	84
456 Roans crossed by reds give ...	226	230	0
23 Roans crossed by whites give...	0	14	9

For the breeder of Shorthorns this means that, if he wishes to avoid white calves, he is limited to three crosses, viz. red with red, red with roan, and red with white. He gets whites when whites are bred together, when whites are bred with roans, or when roans are bred together.

JAMES WILSON.

Royal College of Science, Dublin, March 19.

The Nature of γ and X-Rays.

IN a letter to NATURE of January 23 (p. 270) Prof. Bragg mentions the results of some experiments on γ rays from which he concludes that the ether pulse theory of γ rays is not tenable, but which support his theory that the γ rays consist of neutral pairs revolving in a plane containing their direction of translation. From the close resemblance of X-rays to γ rays he assumes that they also consist of neutral pairs. His reasoning seems to be that if the γ rays are ether pulses only, they should produce in any substance which they strike secondary kathode rays which come off equally in all directions, and if they do not the ether pulse theory cannot be correct.

Prof. Bragg's experiments show that the secondary kathode rays coming from the side of a substance on which the γ rays fall differ in the amount of ionisation they produce from those coming from the side from which the γ rays emerge. Also that the "emergence" kathode rays from a substance of low atomic weight are greater than those from a substance of higher atomic weight, while with the "incidence" kathode rays the substance of high atomic weight gives off more than the substance of lower.

I have been working for some time upon the secondary kathode rays produced by X-rays with a form of apparatus which can be easily adapted for a repetition, with X-rays, of Prof. Bragg's experiments with γ rays (see *Amer. Jour. Sci.*, October, 1907, p. 285). I have therefore tried to

find out whether his results with γ rays hold also for X-rays.

Following closely Prof. Bragg's method of procedure with pairs of metals consisting of lead and aluminium, copper and aluminium, and copper and lead, I found that in every case the ionisation due to the "emergence" secondary kathode rays was greater than that due to the "incidence" rays. The "incidence" secondary rays were, in different experiments, from 50 per cent. to 90 per cent. of the "emergence." It appeared, however, that the difference was not as large in the case of lead as in the case of copper. This is in agreement with Prof. Bragg's result for γ rays.

A separate experiment showed that the thickness of the layer of copper from which the secondary rays can emerge is not great enough to absorb the primary rays to an extent sufficient to account for the marked difference between the "emergence" and "incidence" secondary rays.

On the other hand, however, both the "emergence" and "incidence" secondary radiation produced greater ionisation when it came from a metal of high atomic weight than when it came from a metal of lower atomic weight. This difference was very marked with the above-mentioned pairs, and also with lead and carbon. This is directly opposite to the effect observed by Prof. Bragg with γ rays.

It should be noticed that the ionisation chambers used in these experiments were so short that a very small fraction of the secondary X-rays coming from the metals was absorbed in them, while they were long enough to absorb all the secondary kathode rays. Thus practically all the ionisation was due to the secondary kathode rays.

Although these experiments, together with those of Prof. Bragg, show that for both X-rays and γ rays the secondary kathode rays are not produced equally in all directions, I cannot agree with Prof. Bragg that the evidence is conclusive that X-rays and γ rays must consist of some type of radiation other than electromagnetic pulses. The reason he gives on the neutral pair theory for lack of symmetry in the secondary rays is that these secondary rays are the negative parts of the primary pairs. As these primary neutral pairs possess momentum in the direction of propagation, it is natural to suppose that their negative parts, when liberated from the positive, would be more likely to continue in their original direction than to turn back.

On the other hand, an electromagnetic pulse possesses momentum also in the direction of propagation. Though little is known of the mechanism of the production of secondary kathode rays by ether pulses, it is not unreasonable to suppose that an ether pulse could contribute some of its momentum to the secondary kathode particles, causing them to go more in the direction of propagation of the primary than in any other.

Since we know that X-rays, which come from a region where electrons are being violently accelerated, must consist in part, at least, of ether pulses, and since all the experimental evidence previously gathered in regard to their nature has been favourable to the ether pulse theory, it seems to me more reasonable to look to the ether pulse theory for an explanation of both X-rays and γ rays than to a theory of neutral pairs. It must, however, be recognised that this lack of symmetry in the secondary kathode rays is a difficulty in the way of the ether pulse theory which needs explanation. I hope soon to determine by means of absorption experiments whether this lack of symmetry is due to a difference in penetrating power or quantity of secondary kathode rays.

CHARLTON D. COOKSEY.

Sheffield Scientific School, Yale University, New Haven, Conn., March 7.

Martinmas in May.

SIR NORMAN LOCKYER in his book on "Stonehenge" connects the festival of St. Martin, which falls on November 11, with the beginning of winter in the May-November year, which falls astronomically on November 9. He does not, however, seem to be aware that there was another festival of St. Martin which fell on May 12. This was the *Subventio St. Martini*, a festival which was appointed to be observed by a council held at Tours in 841 to commemorate the restoration of the relics of the saint to Tours after they had been hidden on account of the incursions of the Northmen. Sir Harris Nicolas in his "Chronology of History," published in 1838, stated that the festival was still observed in the province of Tours. The date of the appointment of the festival is late, but reverence for sacred stones survived until long after that time, and it might be worth while to try to discover whether any connection can be traced between the appointment of the festival and an attempt to discourage the old stone-worship.

It seems clear that it was this festival of the *Subventio* which is alluded to in the entry in the Parker Manuscript of the Old English Chronicle for the year 913:—"In this year about Martinmas King Edward bade build the northern fortress at Hertford, between the rivers Maran, Beane, and Lea: and then after that in the summer between Gang-days and Midsummer King Edward went with part of his forces to Maldon in Essex." The King opened his campaign at Martinmas, May 12, by commencing a fortress at Hertford, and then between Rogation-tide (May 23–25) and Midsummer he marched to Maldon. The fact that the chronicler regards the period between May 25 and June 24 as summer has a bearing on the question of the observance of a May-November year. It is likely that the Martinmas of 919 is also the May festival, but it is clear that the Martinmas of 918 and of 921 must be the festival in November.

C. S. TAYLOR.

Banwell, March 24.

An Annotated Copy of Newton's "Principia."

ABOUT three months ago I was asked to look through a list of old books, which had recently come to Australia as portion of the personal property in an estate which had been in Chancery some years. The books had become the property of a resident of this city, who employed an agent to dispose of them.

Among a number of books which I bought was a copy of Newton's "Principia," and when I came to examine it more closely I found that it was one of the original edition of 1687, with the imprimatur of S. Pepys "Reg. Soc. Præses Julii 5 1686." I found also that it contained nearly five pages of MS. additions and corrections for a second edition, written in Latin, as well as numerous corrigenda throughout the book, with occasional detailed alterations in the diagrams.

Inside the cover, in another handwriting, there was the following note:—"The Amendments in this book were written by Sir Isaac's own hand. See his original MSS. of his Optics in Trin. Coll. Library, Cambridge."

I have since compared the handwriting of these "additions and corrections" with a facsimile of Sir Isaac Newton's handwriting in the Commonwealth Parliamentary library, and consider there is a distinct similarity.

I have now had the first two pages of the notes photographed, and have forwarded them to the librarian of the college referred to in the note, with the view of a further comparison.

The notes are punctiliously detailed, with a reference to each page, and the alterations in the body of the text of the book are made with almost microscopic care. As the notes are headed as intended for a second edition, I cannot see what other source but the mind and hand of the author they could have come from.

I am informed by the former owner of the book (Mr. H. C. Elderton) that it belonged to the family of James, of Ightham Court, Kent, probably to Sir Demetrius James, who is supposed to have been knighted about the year 1685. It and a number of other old books formed a small collection which were set apart, packed in oak chests, and stowed away in an old clock-tower, where they remained ever since until brought to Australia.

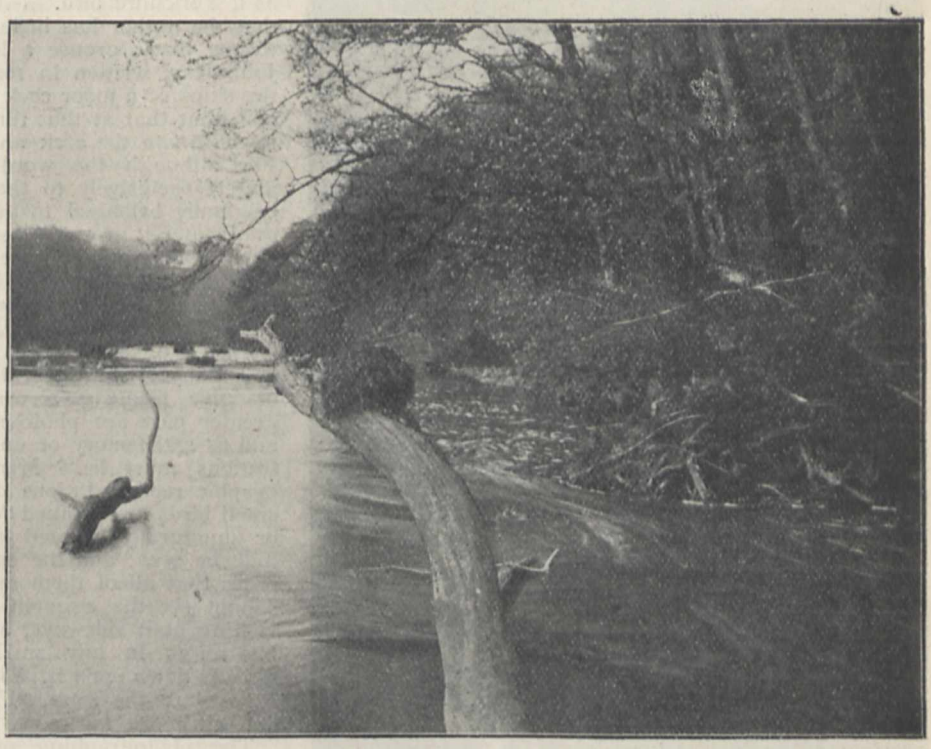
I shall let you know the result of my inquiries, and, in the meantime, perhaps some of your numerous scientific readers may be able to throw some light on the book's history, for if it should be Sir Isaac Newton's personal copy, and contain his personal notes, it must become an object of great interest to the scientific world.

BRUCE SMITH.

149 Phillip Street, Sydney, Australia, February 25.

TWO COUNTY BIRD-BOOKS.[1]

TO write a history of the birds of Yorkshire, so far the largest of our English counties as to include almost every kind of natural feature to be found in this country, was no light undertaking, and Mr. Nelson is to be congratulated on the conclusion of his labours, extending over many years, and upon the able way in which he has arranged and digested the unrivalled and exceptionally complete mass of material placed at his disposal, which has been accumulated by the numerous ornithologists who, from the time of Thomas Allis (who wrote the first complete list of Yorkshire birds in 1844) down to the present day, have been engaged in working out the local ornithology of this great section of England. This information Mr. Nelson has been able to supplement with his own observations for many years past. The scope of the work is comprehensive. The account of each species includes particulars of faunistic position, distribution, migration, nidification, folklore, varieties, and vernacular names; whilst the report on the birds of Yorkshire prepared for the York meeting of the British Association in 1844 by Thomas Allis is here published for the first time. A voluminous introduction deals with the physical aspect of the county and the several districts into which the great diversity of its natural features has made it convenient to divide it. Following this, migration, so remarkable on the Yorkshire coast from its geographical position, is duly considered, and the chapter concludes with a review of the avifauna of the county.



R. Fortune.

FIG. 1.—Unusual Site for a Dipper's Nest, on the River Nidd. From "The Birds of Yorkshire."

Situate about midway on the eastern seaboard of the British Isles, and directly opposite the European continent, Yorkshire is sufficiently far south to include species the distribution of which is of the southern type—such as the nuthatch and nightingale, which find in it the northern limit of their range—while it is sufficiently far north to admit of the inclusion of such species as the curlew, dunlin, &c., "which here meet with their southern breeding limits." These remarks, though true on the whole, must not be taken in too literal a sense, for both the last-named birds breed in Great Britain further south than Yorkshire. The author states that the avifauna of Yorkshire, compared with that of other counties, stands unrivalled, not only in its numerical extent, but also—a circumstance of much greater significance—in the inherent richness which is shown by the number of species breeding annually within its limits. That this should be so would be anticipated by anyone who has read the topographical description of the county, in which are found wild mountainous country, heathery moorlands, and romantic dales; pasture and arable land, woodlands, marshlands, chalk wolds, and a coast line 117 miles long, and one of the most diversified possessed by any English county. We find, indeed, in Yorkshire almost every kind of natural feature that England affords.

The configuration of the coast line materially increases the advantage of the position, which is still more enhanced by the possession of two such projections as Spurn Point and Flamborough Head (the latter on the same parallel of latitude as Heligoland, the island which is so famous for the vast hordes of migratory birds which pass and repass it in spring and autumn), which as a locality productive of rare birds has few equals.

We accordingly find Yorkshire accredited with a list of 325 species after excluding 21 recorded on insufficient evidence. Of these no fewer than 123 are considered to be annual breeders. It is in this list of breeding species (which it owes to its size, diversity of natural features, surface, soil and climate, and to its peculiar geographical position) that the strength of the Yorkshire list mainly consists.

Among the resident species are the nuthatch, woodlark, and lesser spotted woodpecker, which here find the northern limit of their general distribution in Britain during the breeding season; the raven, buzzard, and peregrine falcon—now reduced to a few pairs—as well as the goldfinch and the shieldrake, both of which are local. The nightingale, reed-warbler, wryneck, turtle dove, and stone curlew

[1] (1) "The Birds of Yorkshire. Being a Historical Account of the Avifauna of the County." By T. H. Nelson, with the cooperation of W. Eagle Clarke and F. Boyes. 2 Vols. Pp. xlv+xii+843; illustrated. (London: A. Brown and Sons, Ltd., 1907.) Price 25s. net.

(2) "Notes on the Birds of Kent." By R. J. Balston, Rev. C. W. Shepherd, and E. Bartlett. Pp. xix+465; with 9 plates and a map. (London: R. H. Porter, 1908.) Price 20s. net.

(among the summer migrants) reach in Yorkshire the northern limit of their annual distribution during the breeding season. If we add to these and other well-known midland and southern species the very local pied flycatcher, which is common in many localities, and such moorland and fell birds as the merlin, twite, dipper, grey wagtail, grouse, golden plover, dunlin, and curlew, various wild ducks, and the numerous rock birds which resort to the sea cliffs in the nesting season, we get a breeding avifauna which is probably unequalled by that of any block of adjacent English counties equal to Yorkshire in size, although it is surpassed by that of North Wales, with a much smaller area. Yorkshire is, however, singularly deficient in terns.

Among the many rare and accidental visitors may be mentioned the Siberian meadow bunting (the only known European example), the cuneate-tailed gull—better known as the wedge-tailed or Ross's gull—and Bulwer's petrel, which were both until recently unique as British specimens, the desert wheatear, rufous turtle dove, McQueen's bustard, &c. Like other districts, Yorkshire has lost several breeding species, *e.g.* the kite, the harriers, bittern, bustard, grey geese, avocet, ruff, godwit, and black tern. Probably the article which will claim the most general attention, and to which many ornithologists will turn first, is that on the guillemot and the famous "loomery" on the Flamborough cliffs. A most interesting and valuable account of this bird and its breeding habits, and the extraordinary variation in the colour and markings of its eggs, will be found here; as also of the practice of climbing for eggs carried out on the Yorkshire cliffs, accompanied by some excellent illustrations, which make the account given quite clear to those who have never been present at this harvest of the cliffs. Notwithstanding the fact that about 80,000 eggs is the average yearly "take," it is stated that there is no diminution in the numbers of the birds. But the egg collecting is carried out with some care, some portions of the cliffs being "fallowed" occasionally; and, moreover, there are dangerous parts of the cliffs which are never climbed, and in these places the birds hatch out their first eggs without interference.

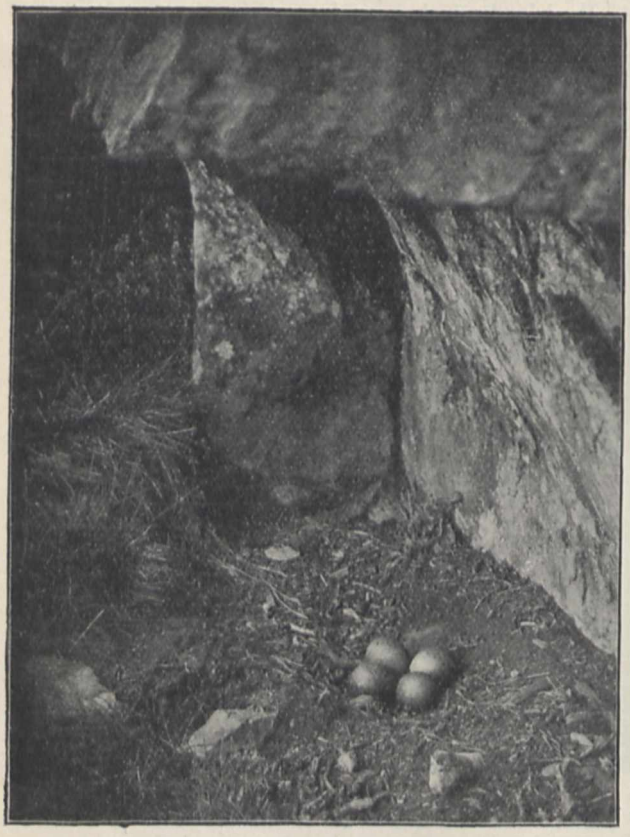


FIG. 2.—Peregrine Falcon's Eyrie, North-west Yorkshire. From "The Birds of Yorkshire."

In the carefully prepared articles on each species, the history in the county of the declining or recently extinct birds is fully given, every bit of available evidence and information having been most praiseworthily preserved. Especial attention may be directed to the excellent articles on the raven, the rarer birds of prey, and the great bustard. A point is made of the earliest allusion to each species as a Yorkshire bird. In this connection we notice that the author has included as an early reference to the black grouse a letter from Fr. Jessop to John Ray, written in 1668, saying he had stuffed the skins of a moor cock and moor hen. We may point out that at that time these names were used to designate the cock and hen of the red grouse. For although the word grouse is now applied almost exclusively to the red grouse, it probably originally belonged to the black grouse or black game, our "grouse" being commonly spoken of until comparatively recent times as moorgame. That the latter was the bird referred to by Jessop is quite clear from another letter addressed by him to Willoughby (*vide* Derham's "Philosophical Letters," p. 367). The work is lavishly illustrated, and many of the illustrations are most interesting, or give pleasing scenes of bird-life. But the greater part are photographs of nests and eggs, and as satisfactory or unsatisfactory as such illustrations must be. Many, indeed most, photographic representations of the nests and eggs of small birds are "faked"—the nests tilted forward or unnaturally exposed in order that the contents may be seen, and the eggs must be arranged in order that all of them may come into view. You cannot see the eggs in a reed-warbler's nest by looking at it sideways, nor can you see the whole five eggs in any small nest without looking directly down upon it. Tits' nests are not naturally exposed to the gaze. Pictures of nesting scenes and sites are far more valuable.

The photographing of birds' nests has been rather overdone. A large proportion of such pictures are worth little, and many of them do not really represent what would be seen by the observer; and it is to be regretted that in their desire to get prints of the nests of different species the disciples of this new sport have made many a pair of birds desert their eggs, and by keeping away their parents have caused young birds to suffer from prolonged exposure to cold, from which they so often do not recover. No nest of a really rare bird, at all events, should be subjected to risks of this kind. The same species can always, if it is really desirable, be photographed where it is comparatively common.

But there are many good and useful pictures in these volumes. The dipper's nest on a branch, the sparrow-hawk's, showing the tufts of down; the falcon's eyrie, and the crow's nest showing the tree, may be mentioned; while sites such as Cautley Crag, the island in Swinsty Reservoir, the Humber mudflats at Spurn, Hornsea Mere, and the many views of cliff scenery, as well as the snow scene with red grouse sitting on the roof of a moorland cottage in Teesdale, illus-

trate most excellently the ornithological characters of Yorkshire. The errata, in which there is a curious misprint, is not quite complete, and omits to state that *lesser* spotted woodpecker should be *greater* (p. 276), and *blue* tit should be *great* tit (p. 114). There are two indices, but unfortunately no map.

The latest work on the birds of Kent (which from its title, indeed, does not claim to be a complete history of the subject) is founded on the material brought together in connection with a certain area of that county; but in that limited portion of the county it was noticed that the avifauna would scarcely be of sufficient importance to fill even a small work. It was therefore found advisable to take in the whole of the county. It was also thought desirable to collect all the material hitherto written, and give to those who have done so much towards our knowledge of the birds of Kent full credit for their observations. This has in the main been carried out, and the result has been a compilation giving us a great deal of information about the birds of Kent. Indeed, so anxious have the authors been to give all possible credit to those who have written anything about the local ornithology that they have been misled into including in their book a number of notes and observations which were not worth reproduction, and the discursiveness of which has made it extremely difficult to arrange the facts in the present work in an orderly and systematic manner. In fact, the book is very well described by its title, and although the reader has never been led to expect a systematic history (from a local point of view) of the birds of Kent, the book is a storehouse of facts relating thereto.

We should have been glad to have a complete book on the subject to fill up a blank in the county bird-book shelf; a volume with more personal observations from the authors, and a compilation more complete. The present volume has not been brought up to date. For instance, a valuable paper published in the *Zoologist* so long ago as February, 1907, has been quite overlooked. Had this been consulted the sheldrake might have been added to the list of ducks breeding in Kent, while the status in the county of the shoveller and some other ducks, as given in the volume under notice, would have been somewhat modified. Nor has the information relating to the various birds always been brought down even to recent years.

Concerning the guillemot breeding on the Kentish coast, we have a description of the breeding colony in St. Margaret's Bay, written so long ago as 1852, and a note on the same made in 1887, but nothing more recent in the way of exact information about the bird breeding on the coast at the present day, although we are told that the bird is, during the summer and breeding season, very numerous. It would surely have been worth the while of one of the authors to ascertain the exact conditions of the breeding place or places after the lapse of twenty years. This is only one instance out of several. Again, on turning to the articles on the birds more particularly associated with Kent, we find that the greater part of that on the Sandwich tern consists of matter written in the eighteenth century, and we are left in doubt as to whether this bird still breeds annually on the coast or not.

The article on the Kentish plover is more satisfying, although it consists almost entirely of quotations (excellent in themselves), with no qualifications, remarks, or annotations by the authors. An exact statement of the status in Kent of each bird would have been welcome. Kent is credited with a list of 320 species, but of these the black grouse is stated to have long been extinct. We cannot quite follow the authors in their application of this word when they go on to say that many of the birds, which might also come under the same word, such as the crane, bustards, cream-coloured courser, &c., are likely to become occasional visitors, *although comparatively extinct in the county* (italics ours). There are certainly no grounds for calling the last-named bird "extinct" in the county, as it has never been anything more than a purely accidental straggler to these islands; while the other two species are absolutely, and not only comparatively, extinct as native birds in Great Britain, although they may occur from time to time as visitors. Speaking of the rarer visitors to Kent, the authors remark on one very extraordinary circumstance, viz. that a very large number of the rare seed-eating and other birds should have been found on the Sussex coast, whereas none of them have been observed in the adjoining county of Kent; and the suspicion here expressed that most of these birds have been introduced by human agency has certainly been entertained by many people.

The introduction contains an excellent topographical account of this maritime county (with its 140 miles of coast lapped by tidal water) and its natural features. There is an index, and a map of a handy size and sufficient for its purpose. The frontispiece to this well-got-up volume is a picture from a photograph of a bit of woodland with a woodcock on her nest, and is one of the most beautifully executed and successful pictures of this kind we have ever met with. The difficulty in at first seeing the sitting bird, and the failure of the eye to pick it up at once on again glancing at the picture, as well as the way the figure and details of the bird seem to grow on the sight when once it is located, or located once more, is an admirable representation of the real facts of such cases. The other eight full-page plates depict birds—like the masked shrike, which has only occurred once in Great Britain—especially associated with Kent, and (especially the one named) are very welcome. But they would have been more useful had they been more correctly coloured. The wing coverts of the lesser kestrel should not have been grey, and the legs of the avocet should have been bluish-grey and not olive-green, a colour which has been also used for the legs of the Kentish plover instead of the correct black or brownish-black. Ornithologists will be glad to have the voluminous literature relating to the birds of Kent collected in this nice-looking volume, the paper, binding, and general get-up of which do the publisher great credit.

MODERN NITRE BEDS.

EVER since the invention of "villainous saltpetre," the provision of a sufficiency of nitrates has been one of the preoccupations of a ministry of war, and the necessity has become greater rather than less under the conditions of modern warfare. The potassium nitrate that was required for the fabrication of gunpowder is now replaced by the nitric acid used in making the various types of nitro-explosives, but it is always the nitric ion that has to supply the oxygen, and the consumption in a modern battle attains a magnitude of which our immediate predecessors using black powder had no conception. Indeed, one truly scientific argument against war may be drawn from the enormous losses it occasions in the world's limited stock of combined nitrogen.

Up to the middle of the nineteenth century, India was the only source of nitrates on a large scale, and though a certain amount of nitre was recovered from the efflorescence of the walls of cellars and from artificially made beds of earth mixed with decaying animal

matter, it was not until the closing of the seas to France during the wars of the Directory that the necessity of an internal supply of nitrates directed the attention of the French savants to the process of nitrification. Their labours reduced to a system the making of nitric beds, but the maximum production was never more than about 5 kilos. of nitre per metre cube after the bed had been established for two years.

It was nearly eighty years later that the researches of Schloesing and Müntz, Warington and Winogradsky showed that nitrification was brought about by bacteria, and at the same time afforded a justification and an explanation of the procedure which had been worked out empirically for the nitre bed. The discovery of the nitrate of soda deposits in Chile left no place for the old nitre beds, but as MM. Müntz and Lainé point out in a very interesting memoir lately presented to the Société d'Encouragement pour l'Industrie nationale (T. cix., pp. 951–1042. Paris, 1907), the conditions that prevailed at the close of the eighteenth century might recur, and France be again driven to manufacture her war stores of nitrates at home. The authors have therefore been studying in detail the process of nitrification on a large scale to ascertain if the process could be so quickened and intensified as to have any practical value. Starting with sulphate of ammonia as a home product obtainable on a large scale, they worked out the conditions of temperature, concentration, nature of medium, &c., which would result in the maximum formation of nitrates. The most important step they have made is to show that humus, so far from being inhibitive of nitrification, as most organic substances are, is actually favourable, so that peat or turf, which is almost wholly humus, by reason of its great water-absorbing powers and the large surface it offers, becomes the best of all substrata for nitrification, if it is also supplied with a sufficiency of carbonate of lime, and a vigorous growth of the necessary organisms is first established in it.

As a final result of their investigations, MM. Müntz and Lainé show that the optimum production of nitrates is attained when the ammoniacal liquids percolate through successive beds prepared of finely divided peat mixed with carbonate of lime. It is impossible to begin with a concentrated solution of the sulphate of ammonia, 7·5 grams per litre being about the optimum when the "nitrière" is in full activity; but after this liquid has been nitrified, successive additions of fresh sulphate of ammonia can be made, and the liquid put through another bed until a concentration of 47 grams of calcium nitrate per litre is reached, a figure which is still well below the limit of 20 per cent. at which nitrification ceases. With such an installation the authors expect a daily formation of 7·5 kilos. of nitrate of calcium per metre cube of turf, which represents an extraordinary advance upon the old nitre beds producing 5 kilos. of potassium nitrate per metre cube in two years.

Of course, the process at present is not within the domain of practical politics; ammoniacal nitrogen has practically the same market value as the nitric nitrogen produced, so that the labour expended and the cost of evaporating the final solution would all be wasted; but, as the authors began by pointing out, the occasion may yet arise when a country without command of the sea may require to manufacture its own nitrates. Then "nitrières" could be established by a peat bog to convert into nitrates the ammonia which could be distilled out of the peat. The only doubt that occurs to us is what opening the recent electrical methods of making nitrates from atmospheric nitrogen will even then leave for such a process.

A. D. H.

PROMINENCE AND CORONAL STRUCTURE.[1]

ANYONE who has studied the forms of the corona observed at different eclipses knows that these forms change from time to time, going through phases which are more or less repeated every eleven or twelve years according to the solar activity. I have previously indicated (*Monthly Notices*, R.A.S., vol. lxiii., No. 8, p. 481) that there is reason to believe that these changes of shape depend, not on sun-spot action, but on the position and percentage frequency of solar prominences, so that when prominences are most frequent, either near the solar poles or equator, the coronal streamers follow suit.

Prominences can now be observed and photographed every day, but coronal streamers and the lower corona can only as yet be seen during eclipses. From photographs taken during eclipses, it is difficult always to associate certain streamers with prominences, and indeed this should be the case. The reason for this is that prominences are only seen on the limb of the sun that is in profile in such photographs, while streamers may be observed in perspective in addition. The base of a large streamer need not necessarily, therefore, be situated on the solar limb.

It is, I think, now generally acknowledged that a study of eclipse photographs has shown that there is an intimate association (*a*) between streamers and the lower corona, and (*b*) between the lower corona and prominences. The more, therefore, the form of the lower corona can be attributed to prominence action the more the streamers will depend on prominence activity.

In the eclipses of 1898, 1901, and 1905 "arched" or "envelope" structures were photographed. Thus Prof. Dyson, in describing the series of three arches he photographed in 1901, said, "A very remarkable arch in the corona. Round the prominence three separate arches are shown, one inside the other. . . . They have the appearance of cloud over an eruption."

Again, the Astronomer Royal, referring to his photographs of the 1905 eclipse, writes, "very bright prominence associated with oval rings and arched structure in the corona."

The question arises, are these "arched" forms composed of prominence or coronal material? Photographs taken with prismatic cameras during these eclipses might answer this question, since they are capable of recording, in monochromatic light, images of the sun's surroundings.

An examination of such photographs taken by the Solar Physics Observatory's expedition had, however, shown no indication of any such "arch" systems, but it is quite possible that the comparative faintness of the objects in question and the insufficient lengths of exposure given may account for their absence in the records.

So far as I am aware, no such series of "arches" has been photographed except during the eclipses above mentioned, so that whether the material composing the arches is "coronal" or "prominence" is still undecided.

Although the routine work with the spectroheliograph of the Solar Physics Observatory since the year 1904 has been to secure, daily if possible, photographs of the sun's disc and limb in the wavelength of the "K" line of calcium, it was not until July 17 of last year that a photograph was obtained which presented a magnificent series of "arches."

[1] Abstract of a paper read before the Royal Society on January 16 (Roy. Soc. Proc., Series A, vol. lxxx., No. A 537, pp. 178–183).

The disturbed area on the sun was situated near the south pole in the eastern quadrant. Two photographs of this region were secured, one at 3h. 14m. p.m., G.M.T., and the other at 3h. 50m. p.m., G.M.T. In the first (*see* Fig. 1) the arches are clearly visible and complete, but in the second they are less discernible and partially broken up, in spite of the fact that the second photograph had the better exposure.

The most conspicuous feature of the whole disturbed area, shown in Fig. 1, is the series of three concentric arches, which nearly reach down to the chromosphere. Their heights, as measured from the chromosphere, are 1′·5, 2′·9, and 3′·6. The radii of the arches photographed and measured by Prof. Dyson for the 1901 eclipse were 1′·2, 2′·4, and 3′·7. It will thus be seen that both are of about the same order of magnitude.

It will be noticed further that the intensity of the arches is not uniform; thus the outside one has five points of increased intensity, while the next in order has three such maximum points. On the eastern side of these arches there is another distinct semi-oval which intersects two of the three main arches. On the southern side are some minor projections from the chromosphere which by their curvature seem to indicate that they form part of the whole disturbance.

The magnitude of this very active region will be more readily grasped when it is stated that the extreme portions were separated by 12′·7 and the highest point from the chromosphere measured 3′·6. Thus the breadth extended 353,000 miles, or more than three-quarters of a solar radius, and the height was about 101,600 miles.

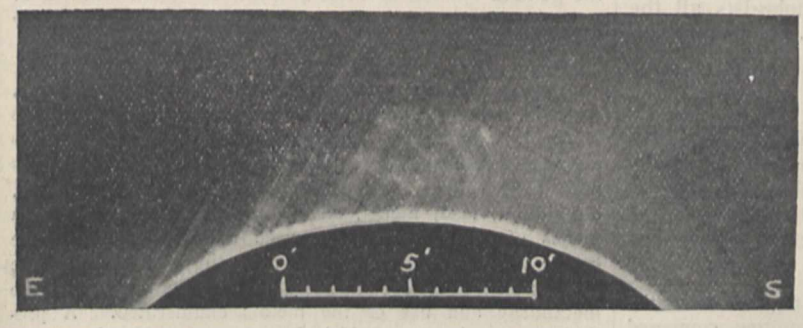


FIG. 1.—A prominence in the form of "arches" photographed in "K" light on July 17, 1907, at the Solar Physics Observatory, South Kensington.

It is interesting to note that there is apparently no large prominence underlying these envelopes, but whether there is one just on the near or far side of the limb cannot be stated.

The above photograph demonstrates that "arches" similar in form and magnitude to those secured during eclipses have now been photographed in the light of calcium vapour. This indicates that at any rate one of the components of the material of which they are built up is calcium. As the spectrum of the corona has no line at this wave-length, the deduction may be made that the arches photographed during eclipses are most probably of "prominence" and not of "coronal" material.

We have, therefore, another link in the chain to show the dependence of the form of the corona on prominence activity.

Since the above paper was communicated to the Royal Society, M. A. Hansky has published the results of his discussion of the corona pictures he secured at the total solar eclipse of August, 1905, and one of the conclusions which he has arrived at is as follows:—

"Il est très probable que la forme et la direction des rayons coronaux dépendent de la form et la direction des protubérances au-dessus desquelles ils se trouvent" (*Mitt. d. Nikolai-Hauptsternwarte zu Pulkowa*, Band ii., 1907, No. 19, p. 118).

WILLIAM J. S. LOCKYER.

DR. A. W. HOWITT, C.M.G.

BY the death of Dr. A. W. Howitt, recorded in NATURE of March 12 (p. 443), a link has snapped between the old days of the perilous exploration of Australia and the detailed scientific investigations of the present day. As early as 1858, Mr. Howitt's knowledge of bush-craft was such that a syndicate in Melbourne appointed him head of an expedition to acquire a tract of the "Promised Land" in Central Australia, of the existence of which Warburton had recently confirmed the report of Stuart. In 1860 he conducted a prospecting expedition in Gippsland. The following year he was selected to lead a party in search of the ill-fated Burke and Wills Expedition, of which John King, the last survivor, was rescued; later Mr. Howitt penetrated into the Great Stony Desert. Thus for many years Mr. Howitt had a wide personal acquaintance with the physical characters of southern and south-eastern Australia. On his numerous expeditions and journeys he came into close and friendly contact with the natives, some of whom were in a condition of complete savagery, and, later on, circumstances enabled him to acquire considerable influence over tribes in south-east Australia, so much so that he was even permitted to be present at their sacred ceremonies.

In 1873, Mr. Howitt joined the late Dr. Lorimer Fison in investigating the classificatory system of relationship which obtains among certain tribes, as well as the tribal class system and the rules of marriage and descent connected therewith. These investigations were published in 1880 in their memorable book, "Kamilaroi and Kurnai," which laid the foundations of a truer conception of Australian sociology than was previously possible. Of similar joint authorship were papers "From Mother-right to Father-right" and "On the Deme and the Horde," in the Journal of the Anthropological Institute (1882, 1884). In the same journal, from 1883 to 1908, Mr. Howitt published a series of papers of great value dealing with Australian sociology, initiation ceremonies, religion, and other phases of native customs and beliefs. In the production of these Mr. Howitt was assisted by some sixty correspondents from various parts of the continent; these informants were subjected to continued questioning, which elicited more detailed knowledge. Mr. Howitt also published in the annual report of the Australasian Association for the Advancement of Science (1890, 1891, 1901), papers "On the Use of Gesture Language in Australian Tribes," "Anthropology in Australia," and "On Trade Centres in Australian Tribes." On the occasion of the meeting of the British Association in Cambridge in 1904, the University of Cambridge presented Mr. Howitt with the honorary degree of Doctor in Science, in recognition of his ethnological investiga-

tions. Later in the same year Dr. Howitt published, with Messrs. Macmillan and Co., Ltd., his great work on "The Native Tribes of South-east Australia," in which is embodied his life's work in ethnology. By far the greater part of the materials was collected and recorded before 1889. Since then the native tribes have more or less died out, and in the older settlements of south-eastern Australia the tribal remnants have now almost lost the knowledge of the beliefs and customs of their fathers. Fortunately, Dr. Howitt began to observe and collect information before it was too late, but even then much had disappeared.

Dr. Howitt's book contains a great mass of information concerning numerous tribes, and thus it serves as an invaluable storehouse for students, but it is more than this, as it embodies the mature opinions of the father of Australian ethnology, who, by his kindly and sympathetic nature, was able to gain and retain the confidence of his native friends. The opinion of a man of such prolonged and varied experience in the field, combined with the knowledge of what others had collected, must always carry weight. The collecting and recording of complete ethnological data are naturally matters of first importance, but of even greater interest is the true appreciation of the ideas which underlie the actions of men. He who has lived among the people he describes should be the best interpreter of their ideas and ideals, and in these matters we are not likely to find a surer guide than the genial explorer and student whose death will be deplored by ethnologists all the world over. A. C. HADDON.

NOTES.

THE astronomical section of the Paris Academy of Sciences has elected M. Maurice Hamy, of the Paris Observatory, to succeed the late Dr. Janssen as a member of that section of the academy. M. Hamy entered the observatory in 1884, and was awarded the Lalande prize in 1895.

THE Paris correspondent of the *Times* states that the Academy of Sciences has appointed a committee, composed of MM. Becquerel, Bouquet de la Grye, and Poincaré, to consider a suggestion by M. Bouquet de la Grye concerning the application of wireless telegraphy to the problem of the determination of longitude at sea. The idea is to utilise the wireless telegraphy station of the Eiffel Tower in order to send, for instance, every night at midnight a Hertzian signal giving the time of the meridian of Paris. M. Bouquet de la Grye thinks, indeed, that if a wireless telegraphy station were established at the Peak of Teneriffe signals could be detected completely around the earth.

THE next International Congress of Archæology will be held at Cairo in 1909.

FOR the purpose of discussing subjects of interest to those concerned in the work of museums, art galleries, and kindred institutions, a conference of members of the Museums Association and others interested will be held in the Harris Free Public Library and Museum, Preston, on the afternoon of Saturday, April 11.

THE twenty-fourth annual meeting of the Society of Dyers and Colourists will be held on April 3, at 4.30 p.m., at the Technical College, Bradford. The president, Prof. R. Meldola, F.R.S., will deliver his presidential address on "The Founding of the Coal-tar Colour Industry." The first awards of the Perkin medal will be made to Profs. C. Graebe and C. Liebermann for their synthesis of alizarin. On the evening of the same day the members of the society will dine together at the Great Northern Victoria Hotel, Bradford.

EARTHQUAKE shocks occurred at Mexico City during the evening of March 26, and were felt also at Guanajuata and Rincon. The town of Chilapa, in the State of Guerrero, was destroyed. The disturbances were recorded by Prof. Milne, F.R.S., at Shide, in the Isle of Wight; by Prof. Belar at Laibach, Austria; and by Prof. Michie Smith in southern India, all of whom communicated their observations to the *Daily Mail*. The earthquake is reported to have begun soon after 11 p.m. on March 26, to have reached its maximum at 11.53 p.m., and continued for more than three hours. The shock was felt at St. Thomas, in the West Indies.

WE learn from the April number of *Nature Notes*, the magazine of the Selborne Society, that at last a Bill is to be introduced into Parliament to restrict the importation of birds' skins, and so prevent in some measure the rapid extermination of beautiful birds, of which the egret ("osprey") and birds-of-paradise are typical examples. A short time ago, Lord Avebury, president of the Selborne Society, called together a meeting of representatives of the various learned societies at his house to consider whether legislation ought to be attempted, and this being the general opinion of those present, the main features of a Bill drafted by Mr. James Buckland were adopted for presentation to the societies interested.

EFFORTS are being made to form an Institute of Metals, which it is hoped by the promoters will follow similar lines to the Iron and Steel Institute. The proposed institute is intended to advance the knowledge of non-ferrous metals and their alloys, more especially copper, zinc, tin, aluminium, lead, nickel, silver, and platinum; to form a means of communication between members of the same trade; and to arrange periodical meetings for the purpose of discussing practical and scientific subjects relating to the metallurgy and use of the metals enumerated. A preliminary meeting was held in Manchester on March 11, and was well attended. A representative committee comprising practical men engaged in the industries concerned and men of science was elected, and it was decided to arrange a further meeting in London. This special meeting will, we are informed, be held on June 10 next, at 2.30 p.m., at the Institution of Mechanical Engineers, Westminster. On this occasion the committee will report progress, and it is hoped the proposed institute will be constituted formally. All inquiries should be addressed to Mr. William H. Johnson, c/o Messrs. R. Johnson, Clapham and Morris, Ltd., 24 and 26 Lever Street, Manchester, who is acting for the honorary secretary, Prof. Carpenter, during his indisposition.

IN the March issue of the Bulletin of the St. Petersburg Academy, Dr. E. Jäderholm gives a preliminary account of the hydroid polyps collected in the Arctic Ocean north of Siberia by the Russian Polar Expedition of 1900–3, while Dr. Salensky continues his description of the development of the gephyrean worm (mis-called echinoderm on p. 493 of our last issue) Echiurus.

THE American white ant (*Termes flavipes*) and the bagworm (*Thyridopteryx ephemeraeformis*) constitute, respectively, the subjects of two illustrated "Circulars," Nos. 50 and 97, of the U.S. Bureau of Entomology. An excellent account is given in the first of these of the social economy

of the white ant, and the damage inflicted by the species in the Southern United States.

THE existence of an intimate relationship between the fauna of the eastern coast of Arctic North America and that of northern Europe has for some years been admitted by naturalists. Supplementary evidence to the same effect is afforded by a recent study on the part of Mr. J. A. Cushman of minute fresh-water crustaceans from Labrador and Newfoundland, the results of which are published in No. 1589 of the Proceedings of the U.S. National Museum. Cladocera were represented in the collection by seven and the Copepoda by one species, all of which are common to Europe.

THE second part of the new Leipzig journal *Vorträge und Aufsatze über Entwickelungsmechanik der Organismen* is devoted to a paper read by Mr. Jacques Loeb before the International Zoological Congress held at Boston (Mass.) in August last, on the chemical character of the secretions of the reproductive organs. Starting with the axiom that the special prerogative of living organisms is the power of automatic reproduction, the author proceeds to describe the chemical composition of the reproductive elements, and the bearing of this on certain biological theories.

Zeitung für Literatur, Kunst und Wissenschaft for March 15 contains a summary of the results of the Hamburg Expedition to the Magellan Strait in 1892–3, as detailed in a work of three volumes just issued by the Hamburg Museum of Natural History. A feature on which the Hamburgers specially pride themselves is that the expedition was practically "run" by the municipality and inhabitants of their own city, while even the scientific workers are to a great extent their own fellow-citizens. According to the notice in the *Zeitung*, special attention appears to have been directed to the subject of "bipolarity," that is to say, the occurrence of similar types of animal life at the two poles and their absence from almost the whole of the intervening area. The geological and faunistic resemblances of South Africa, South America, and Australia are also referred to, with the remark that most of the common types indicate extremely ancient forms of life.

THE importance—or rather the absolute necessity—of cooperation among workers in different branches of biological research formed the subject of discussion at a meeting of the American Society of Naturalists in December last, in which Profs. Lillie, Trelease, Donaldson, Howell, and Angell took part. The discussion is reported *in extenso* in *Science* of March 5. The first speaker, Prof. Lillie, took for his text the American Marine Biological Laboratory as an example of cooperation, not only among the members of its governing body, but with various other institutions. As it is, several branches of sciences are represented in the laboratory, but it is suggested that it will be necessary to add a chemical section. Prof. Trelease, on the other hand, took his illustrations from the fact that at the present day interest in biology centres on the mechanism of animals and plants, and their relations to environment—factors demanding the cooperation of morphological and physiological research. A further advantage claimed for cooperation is that by its means alone is it possible to discover the most productive and original research-workers.

A PART (vol. iii., No. 4) of the Records of the Botanical Survey of India is assigned to a revision of the Indo-Malayan species of Cedrela undertaken by Prof. C. de Candolle. The author restores to the genus the species separated by some systematists under a genus Toona. The columnar receptacle of the flower is noted as a character of systematic value. As it was found difficult to assign specific limits to the specimens ranging round the species Toona, the forms are split up into numerous varieties. Of three new species created, *Cedrela Hainesii* is the most notable on account of the staminodes that are present in the flower.

WRITING on the Florida strangling figs, an article intended for the nineteenth annual report of the Missouri Garden, Prof. E. A. Bessey describes the characters of the two indigenous species *Ficus aurea* and *Ficus populnea*. The former commonly, the latter rarely, begins life as an epiphyte; in this connection it was experimentally determined that the seeds of *Ficus aurea* require light for germination. The seeds of *Ficus populnea* show a less marked light requirement. Neither species develops the two distinct types of pistillate flowers known as seed and gall flowers, but larvæ are produced if the flowers are visited by ovipositing Blastophagæ; otherwise seeds are formed.

THE early stages of development of the sporangia and the sporocarps of Azolla have been carefully studied by Miss W. F. Pfeiffer; the account published in the *Botanical Gazette* (December, 1907) corrects and amplifies previous information on the subject. In all cases a megasporangium is formed at an apex, and the wall rising below as an annulus quickly outgrows and encloses the sporangium. The development of the megasporangium is normal up to the formation of eight tetrads. Meanwhile, the microsporangia begin to appear as initial cells on the broad stalk of the megasporangium. At this stage, for reasons undetermined, either the megasporangium develops and the microsporangia cease to grow, or the megasporangium aborts and the microsporangia then develop normally.

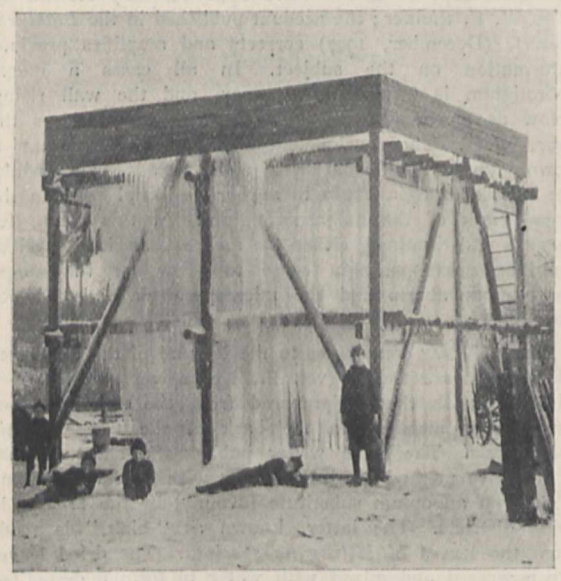
MR. L. WRAY contributes to the Journal of the Federated Malay States Museum (vol. ii., No. 2) an account of a Malay varnish that is prepared from the resin obtained by making incisions in the bark of the tree *Garcinia merguensis*. The same writer publishes a short account of a native method of embroidering with gold thread, and a note on an opium substitute favoured by the Malays in some districts. The latter, known as "biak," is made from the leaves of *Mitragyne speciosa*. The dried leaves are powdered and mixed with water to form a decoction, or an extract is made that is smoked like "chandul," the extract of opium. In the same number will be found a hand-list of birds of the Malay Peninsula compiled by Mr. H. C. Robinson.

MR. N. W. THOMAS, in his "Bibliography of Anthropology and Folk-lore," published under the auspices of the Royal Anthropological Institute and the Folk-lore Society, has issued the first number of an annual series which will be indispensable to all students of the subjects with which it deals. His bibliography includes papers and articles in no fewer than 165 publications—proceedings of learned societies, magazines, and other ephemeral literature. In subsequent issues we may hope for a more full analysis of the papers with which the compiler deals. But, as it stands, this pamphlet, which is provided with excellent indexes, serves a distinctly useful purpose.

LAWYERS in India have long been aware that, besides what may be called the official or sacerdotal view of law contained in the Institutes of Manu and other codes of

the same kind, there is a vast mass of local and tribal usage which is independent of, and in many cases directly opposed to, the legislation of the Brahmans. The powerful tribal organisation in the Punjab has made the conflict between these two bodies of law more obvious than in other parts of the Empire. The materials for a study of the subject are voluminous and complex, and Mr. H. A. Rose, the superintendent of the Ethnographical Survey, has done useful service in codifying the district reports in his recently issued "Compendium of the Punjab Customary Law." He divides his subject into three chapters—marriage, inheritance, alienation—and in connection with such subjects as endogamy, exogamy, polyandry, and polygamy he has collected a mass of curious facts which will be interesting to anthropologists, particularly as they represent the usages of a very primitive type of tribal society.

MR. H. WARTH sends us a photograph, here reproduced, representing a method in use in south Germany for producing ice from pure water in winter. The photograph was taken last January in Balingen (Württemberg). The illustration shows a large wooden framework in two storeys, 6 metres square and 6 metres high. Each storey is covered with a floor of eighteen parallel beams, in the



Production of large Icicles.

centre of which a tube, encased in wood, rises beyond the upper floor. This tube is connected with the water-main, and the water issues through a rotating disc, which sends a moving spray on the beams. As the water drops from the beams icicles are formed, which reach the middle floor and finally the ground. The volume of water is regulated according to the temperature of the air, which may vary between −3° C. and −18° C. During low temperature 20 cubic metres of ice may be formed in one night. As the ice retains the shape of isolated columns, it is easily broken up and removed. The ice is then stored for use in summer.

IN the Transactions of the South African Philosophical Society of December, 1907, Mr. J. R. Sutton, of Kenilworth (Kimberley), discusses the question of the supposed cloud-dispersing power of the full moon. From observations of the state of the night sky at Potsdam from January, 1894, to June, 1900 (*Met. Zeits.*, May, 1907), Herr Meissner found no such dispersing power, but a minimum amount of cloud about the time of new moon and a maximum shortly after full. Mr. Sutton thinks that if there be no lunar influence whatever upon the clouds something like Meissner's result might be expected, as the moonlight makes clouds visible (see Schmid's "Lehrbuch d. Met.," 1860, p. 681). At Kenilworth Mr. Sutton finds that cirrus and cirro-stratus appear to dissolve at sunset, but the rising moon makes them plainly visible again. The 8h. p.m. observations taken between January, 1900, and January, 1907, show considerably more cloud between the third and eighteenth lunar day than between the eighteenth and third. Dr. Shaw's interesting paper, "La Lune mange les Nuages" (Quart. Journ. Roy. Met. Soc., April, 1902), shows that any diminution of a floating cloud is due to evaporation by loss of heat, and that "any effect of direct radiation from the moon may be quite properly disregarded."

THE Survey Department of the Egyptian Ministry of Finance has issued, as a pamphlet of thirty-eight pages with thirteen index maps, a list of maps, plans, and publications published up to December 31, 1907. The list includes town maps, cadastral maps, topographical maps of Egypt, special maps, and maps of the different provinces.

PROF. E. GUARINI has published a pamphlet (Paris, 1908) on the resources of Peru. The mineral resources include many rich deposits of gold, silver, copper, and iron ores, which are at present unworked owing to lack of economical methods of transport. The author believes that by the introduction of electric-power transmission and electric smelting, Peru might rank amongst the leading industrial States of the world.

THE question of handling materials in industrial plants is one continually presenting itself to owners and engineers for proper solution, and some striking illustrations showing the remarkable progress recently made in America in economical material-handling equipments are given by Mr. Werner Boecklin in the *Engineering Magazine* (vol. xxxiv., No. 6). The depreciation of such equipments is necessarily high, but in the majority of cases an increase in the first cost, which will materially decrease this charge, is warranted. In the same issue Mr. T. Kennard Thomson describes the construction of hoisting machinery for the handling of materials. He shows that here, as elsewhere in the domain of modern enterprise, economy in unit costs and maximum of output can be secured only where intelligent use is made of the mechanical facilities afforded for the handling of material.

THE application of the camera as an adjunct to topographical mapping began practically with its invention, and it has been employed with varying success since that time. An interesting development is described in the bi-monthly Bulletin of the American Institute of Mining Engineers (1908, No. 19) by Mr. C. W. Wright, who has successfully employed in the field a panoramic camera taking a 5-inch by 12-inch view, including an angle of 140°. The plotting of a map from the views taken by the phototheodolite is a tedious process, and the office work is many times greater than that required for the same amount of mapping by the panoramic camera.

WITH the view of ascertaining whether the results of recent chemical investigations would be of value in lessening the amount of evaporator scale formed in the sugar mills of Hawaii, an elaborate series of experiments was carried out by Mr. S. S. Peck, and the results are published in Bulletin No. 21 of the Hawaiian Sugar Planters

Association (Honolulu, 1908). While the results offer no precise solution to this problem, they explain some of the phenomena of scale formation, and contain much of interest to other investigators, practical and theoretical, of this question, perhaps giving them a clue which will lead to the discovery of a successful method of treating the juice of the cane which will inhibit to some extent the formation of scale during evaporation.

MR. W. GALLATLY has published (Cambridge: Elijah Johnson, 30 Trinity Street) a pamphlet on the nine-point circle, consisting of a collection of short notes reprinted from the *Mathematical Gazette* and other sources. Most of the notes deal with analytical rather than geometrical properties associated with a triangle and the circle in question.

IN the Proceedings of the American Academy of Arts and Sciences, xliii., 8, Messrs. C. R. Sanger and O. F. Black discuss the quantitative determination of arsenic by the Gutzeit method. They find that consistent results can be obtained, and the main difficulties avoided, by allowing the arsenic deposit to travel along a strip of paper, and by sensitising this with mercuric chloride in preference to silver nitrate.

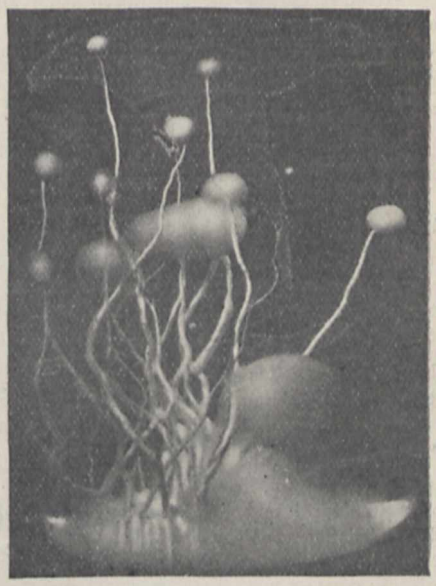
IN the Proceedings of the Tokyo Mathematico-Physical Society (January), K. Aichi discusses the capacity of nearly spherical electrical conductors. The property, obvious from the general principles of the theory of maxima and minima, that the capacity of a nearly spherical conductor is, to the first order of small quantities, equal to that of a spherical conductor of equal area, is deduced from analytical formulæ.

IN *Engineering* of March 27 illustrations are given of the new plant of the Stavely Ironworks, Chesterfield, an undertaking with a record of two centuries. The new works are of great interest, not because of any distinctive departure, but because great discrimination has been exercised in weighing the relative merits of different systems in order that the many mechanical features in the complete equipment should harmonise with the aim to ensure efficiency.

THE application of electricity is fast revolutionising many industries, and an interesting application in the chemical industry is described in the Journal of the Franklin Institute by Mr. E. R. Taylor, who gives an account of the process and apparatus for the production in the electric furnace of carbon bisulphide, the manufacture of which in retorts is one of the most disagreeable of manufactures. The furnace used is 10 feet in diameter and 20 feet high, and will produce 5000 lb. per twenty-four hours with economy and satisfaction. Two electrodes only are provided. The market for carbon bisulphide is a limited one, and no larger furnace than those now in use would be justified under present conditions. But were the market for carbon bisulphide as large and as regular as that for pig iron, the size of the furnace need only be limited by market requirements and the amount of electricity available.

UNDER the title "Two Oxford Physiologists" (Clarendon Press, Oxford, price 1s.), Prof. Francis Gotch has published an address, delivered before the Oxford University extension summer meeting of last year, which deals with the life and work of Richard Lower (1631–1691) and John Mayow (1643–1679). The address contains an admirable account of the work of Lower, who is best known as being the first to carry out the transfusion of blood from one animal to another, and of Mayow, who first recognised the true nature of respiration, and whose "medico-physical works" have just been translated from Latin into English (NATURE, vol. lxxvii., p. 339). Prof. Gotch's eloquent address has an especial interest for the general reader in so far as it throws a clear light on the conditions under which scientific work was performed in the seventeenth century.

WE have received a reprint of a lecture by Prof. Stéphane Leduc on "Diffusion and Osmosis" delivered before the meeting held at Rheims in 1907 of the French Association for the Advancement of Science. Certain remarkable experiments are described dealing with the formation and properties of the so-called "waves of diffusion"; the phenomena dealt with, although evidently due to the transmission of material particles, are accompanied by effects entirely similar to those produced by wave motion, especially in so far as they show interference and diffraction. It is stated also that by means of diffusion under certain chosen conditions, using merely solutions of different concentration coloured with a little Indian ink, the phenomena of karyokinesis can be reproduced in their proper order and form. Peculiar growths, presenting an appearance similar to that of true vegetable growths, can also be obtained by leaving "seeds," consisting, for example, of copper sulphate mixed with sugar, in an aqueous solution of potassium ferrocyanide saturated with common salt, and containing more or less gelatin and other salts (see accompanying figure). In different experiments growths analogous to roots, rhizomes, stems, leaves, and terminal organs of true plants were obtained, each with a characteristic internal structure depending on the nature of the salts in solution. By these experiments the interesting question is raised, how far the morphology of ordinary plants is determined by purely osmotic phenomena.



Osmotic growths.

IN 1869 Bunsen wrote to Sir Henry Roscoe an account of a mysterious explosion caused by touching with the finger some reduced rhodium and iridium. The question of the explosive platinum metals has been taken up several times since then by various investigators, but the exact cause of the explosive properties of these metals has not

been made clear. The explosive material is obtained by treating the zinc alloy of the platinum metal with an acid, and has been regarded as an allotropic modification of the metal. In the *Zeitschrift für physikalische Chemie* for February 25 is an interesting account, by E. Cohen and Th. Strengers, of a long series of experiments on this subject. It was found that the residues from the action of hydrochloric acid upon zinc alloys of rhodium, iridium, ruthenium, and platinum are explosive; palladium and osmium do not furnish explosive residues. Explosive rhodium is now shown to contain both oxygen and hydrogen, and if air is carefully excluded during the removal of the zinc by the acid, the residue is not explosive. The heat evolved during the explosion was measured, and found to be of the same order of magnitude as the heat of combination of the quantities of hydrogen and oxygen actually occluded by the metal. The most probable explanation of the explosive properties of these reduced platinum metals is that the explosion is due to the sudden combination of the occluded hydrogen and oxygen. It was found, however, that in the case of ruthenium an explosive material was obtained even if oxygen was rigorously excluded during the separation from zinc, and this point still remains to be cleared up. In one of the calorimetric measurements, 4 grams of the rhodium destroyed a platinum calorimeter. A photograph of the remains of the calorimeter after the operation is given, and the authors remark that the effect of the explosion of *a pound* of this material (the quantity Bunsen had in the experiment above mentioned) can be easily imagined. Bunsen, fortunately, escaped with superficial burns on the face and severe burns on the hands.

THE name of Dr. R. W. Stewart should have been given as the author of the books on heat, light, and sound for matriculation candidates reviewed in NATURE of March 26 (p. 482).

MR. H. J. GLAISHER has published the April issue of his catalogue of publishers' remainders; it contains particulars of many scientific and other books which, though in a new condition, are offered at greatly reduced prices.

MESSRS. OLIVER AND BOYD have published a second edition of "Structural and Field Geology for Students of Pure and Applied Science," by Prof. James Geikie, F.R.S. The first edition of this work was reviewed at length in NATURE of July 6, 1905 (vol. lxxii., p. 223), and the present issue differs but little from its predecessor, though some omissions have been supplied and a number of emendations and corrections made.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES IN APRIL:—

April 4. 1h. 24m. Venus in conjunction with Moon. Venus 5° 52′ N.
,, 1h. 28m. Mars in conjunction with Moon. Mars 4° 15′ N.
,, 3h. 27m. Venus in conjunction with Mars. Venus 1° 37′ N.
9. 10h. 55m. Jupiter in conjunction with Moon. Jupiter 1° 21′ S.
14. 11h. 56m. Minimum of Algol (β Persei).
17. 8h. 45m. Minimum of Algol (β Persei).
19–22. Epoch of April Meteors (Radiant 271°+33°).
20. Venus. Illuminated portion of disc=0·540.
22. 3h. 12m. Uranus in conjunction with Moon. Uranus 0° 27′ N.
24. 4h. 45m. to 8h. 27m. Transit of Jupiter's Sat. III. (Ganymede).
26. 7h. Venus at maximum elongation (45° 37′ E.).

COMET 1907 II.—We have received an abstract of a paper read by Prof. E. Weiss before the Vienna Academy of Sciences on February 6, in which the author directs attention to the striking similarity of the orbit of comet 1907 II. to that of the comet of 1742. It appears probable that they refer to the same body, having a period of 165 years. From the fact that the earth passes very near to the ascending node of the cometary orbit towards the end of March, Prof. Weiss expects that a fairly rich meteor shower, from a radiant at $\alpha=307°{\cdot}6$, $\delta=-60°{\cdot}7$, should be observed in the southern hemisphere.

THE PRESIDENT OF THE ASTROGRAPHIC CONGRESS.—At the request of several members of the permanent committee of the Astrographic Congress, Sir David Gill has, we understand, proposed to the permanent committee that M. Baillaud, the new director of the Paris Observatory, should be elected president of the international congress in succession to the late M. Loewy. Remembering the important part played by France in the labours expended on the Carte du Ciel, the generous support of the Institute of France in the publication of the committee's reports, and the great and successful efforts of Admiral Mouchez, M. Tisserand, and M. Loewy in the furtherance of the work, it is almost as a matter of course that the director of the Paris Observatory should be elected to fill the important position of president of the international committee.

THE HELIUM, D_3, LINE IN THE SOLAR SPECTRUM.—In No. 394 (March, p. 133) of the *Observatory*, Captain Daunt continues the discussion as to the presence of D_3 as a dark line in the solar spectrum, raised by the photographs taken at Kodaikanal by Mr. Nagaraja last year, and comes to the conclusion that the fine dark line shown on the photographs is not an absorption effect of D_3 at all. The main objection raised by Captain Daunt is that the fine dark line on the photographs runs right across the spectrum, and is sligtly widened over the spot, whereas, according to his own and to Mr. Buss's observations, the helium absorption line is generally very broken and patchy, and has never been seen over the spot itself; it always appears in the faculic areas surrounding the spot.

TWO REMARKABLE SPECTROSCOPIC BINARIES.—In a note published in the *Observatory* (No. 394, p. 139, March) Mr. Gore shows that two spectroscopic binaries, α Carinæ and α Pavonis, recently discovered at the Lick Observatory, must have remarkably small masses. In the case of the former, if the inclination of the orbit be 90°, the mass is but 0·007 of the sun's mass, and if the inclination is 30° this value is only increased to 0·056. The corresponding mass values for α Pavonis are 0·00047 and 0·0038 respectively, and in this case the result is more remarkable still, for α Pavonis is a brighter star, mag. 2·12; its spectrum is of the Orion type. Mr. Gore suggests that both these stars are probably near our system, and an effort should be made to determine their parallaxes.

VARIATION IN THE RADIAL VELOCITY OF β URSÆ MAJORIS.—In No. 4239 of the *Astronomische Nachrichten* Dr. H. Ludendorff announces that plates taken at Potsdam show the radial velocity of β Ursæ Majoris to be variable. The values given range from −6 km. (March 27, 1904) to −26 km. (April 28, 1905), and in a footnote it is stated that later observations show the period to be twenty-seven days.

DR. NORDMANN'S VARIABLE STAR OBSERVATIONS.—Following up the researches mentioned in these columns last week (p. 497), Dr. Charles Nordmann has obtained equally striking results from observations of β Lyræ and δ Cephei. In these cases the epochs of maxima and minima, as observed through the coloured screens, agree with the ephemerides, but the amplitude and form of the light-curves vary with the region of the spectrum observed. Thus for β Lyræ the difference between the principal maximum and minimum amounts to 0·66 magnitude with the red, 0·94 magnitude with the green, and 1·34 magnitude with the blue screen. The differences between the two principal maxima vary from 0·3 magnitude with the blue to zero with the red screen, and it is shown that this star emits a greater proportion of the less refrangible rays at the principal than at the secondary minimum. Similar results accrue from the observations of δ Cephei (*Comptes rendus*, No. 10, p. 518, March 9).

THE NATIONAL PHYSICAL LABORATORY DURING 1907.

THE report for 1907 of the National Physical Laboratory, presented to the general board on the occasion of the annual meeting and inspection of the laboratory on March 20, contains abundant evidence of the rapid growth and extension of its activities during the past few years, as well as of the usefulness and importance of the research work which such an institution is able to undertake. Following closely upon the report of the Treasury Committee, which has done valuable service, both to the laboratory and to the public, in defining more precisely the limits to be set and the conditions to be observed in regard to the acceptance of certain classes of test work, this account of the past year's work affords conclusive evidence that the organisation of special departments for the verification of instruments and examination of materials need be no hindrance to the concurrent prosecution of those researches which constitute the most important part of the laboratory's work.

It is interesting to note the changes effected since the opening of the laboratory in 1901. Apart from the observatory department at Richmond, the laboratory originally comprised a physics department at Bushy House and an engineering department housed in an adjoining building of two bays. At the present time the accommodation afforded in Bushy House is supplemented by that of three other buildings, together covering an area at least double that of Bushy House itself, in addition to a smaller building mainly devoted to the test work for the Indian Government, transferred to the laboratory from Coopers Hill, and a special building erected for the War Office standard leading screw lathe. Of the three larger buildings, the engineering building is now nearly doubled in size; the building for electrotechnics and photometry was completed in 1905, and considerable progress has been made with its equipment, which is described in a special appendix to the report, referred to below; while the building for metrology has been more recently erected, and the transference to it of the comparators and apparatus for measurements of length is only now being begun. One special feature of the metrology building is a long passage arranged for the verification of 50-metre surveying tapes and wires, whether on the flat or in catenary.

Of general public as well as of special scientific interest is the completion of the new magnetic observatory at Eskdalemuir, in Dumfriesshire. Primarily intended for the resumption of the magnetic work interrupted at Kew by the coming of the electric tram, it will be equipped generally with the recording and other apparatus necessary to a first-class meteorological station, and will maintain a close connection with its parent institution at Richmond. Dr. Chree's admirable work in the analysis and interpretation of the Kew records will thus be continued and extended. Eskdalemuir is situated towards the head of the Esk valley, some eighteen miles from Lockerbie on the Caledonian, and from Langholm on the North British Railway, sufficiently far from the nearest point of either line to be secure from magnetic disturbance. The locality promises to be no less free from social perturbations, and the relief measures to be adopted in the event of a severe winter will no doubt engage the attention of the committee at an early date. Mr. G. W. Walker, of Trinity College, Cambridge, and Glasgow University, is the first superintendent.

Among other matters of general interest, one or two branches of work recently undertaken by the laboratory may be referred to shortly. The transference to the laboratory of the Indian Government test work has led to the formation of a new department, of which Mr. Rosenhain is superintendent. The equipment of the new building in which the work is carried out has been systematically planned with the view of securing ease and rapidity of working; a description of the arrangements and of the methods of analysis employed is given in the report of the department.

FIG. 1.—General view of large bay of Electrctechnical Building, looking east.

The testing of taximeters, undertaken for the Commissioner of Police, has aroused a good deal of public attention. The tests applied consist of an exhaustive examination both in the laboratory and on the road of one instrument of a type, and of its mechanism, and of a simpler verification of the accuracy of each individual instrument. The tests are carried out at the laboratory, but a building has been erected in the Lambeth Road for the reception of taximeters for re-examination after use.

The testing of glow-lamps under the specification issued by the Engineering Standards Committee may also be mentioned here. The Lamp-testing Bureau of New York is responsible for reporting annually on some 13,000,000 lamps, to the benefit alike of the manufacturer and the consumer. Indications are not wanting of a demand for such tests in this country; increased facilities for the work are being provided in the photometry department.

Turning now to research, the papers published during the year include some of the most important work carried out by the laboratory. Foremost among these must be mentioned the three papers on the fundamental electrical

units, for which—in conjunction, as regards some parts of the work, with Prof. Ayrton, Mr. Mather, and Dr. Lowry—Mr. F. E. Smith is responsible, and which, with an earlier paper on mercury resistance standards, embody the results of the work of the electrical standards department from the foundation of the laboratory. We shall, no doubt, have occasion to refer more particularly to these three papers in dealing with the "Collected Researches" of the laboratory, vols. iii. and iv. of which are now ready for issue. The ampere balance, planned originally by Viriamu Jones and Ayrton, the electrical part of which was constructed at the laboratory, with such modifications of the original design as experience showed to be necessary, under Mr. Smith's supervision, has given results "far exceeding that secured in any absolute determination of any electrical unit. . . . The balance was intended to give the ampere to 1 part in 10,000, but about 1 part in 50,000 appears to have been attained. A little uncertainty exists as to the value of g and the axial length of the coils; the latter uncertainty may shortly be removed" (by the construction of new coils).

The work on the comparison of various forms of silver voltameter has led to results of the same order of accuracy. Mr. Smith has shown that under specified conditions all the different types of voltameter experimented with give identical results for the electrochemical equivalent to within 2 parts in 100,000. In a suggested specification for the international ampere the Rayleigh form is recommended as the easiest to erect.

The paper on the Weston cadmium cell summarises the results of all the observations made at the National Physical Laboratory, and establishes the reproducibility and constancy of the cell. The results of comparisons between American, French, German, and English cells are given in the report, and show that standard cadmium cells can be set up by different experimenters with different materials to agree within a few parts in 100,000.

The results obtained in these researches and in those simultaneously carried on in the standardising institutions at Washington, Paris, and Berlin should make the way clear for the International Conference on Electrical Units to be held in London probably this year. Mr. Smith is to be congratulated on having placed the laboratory in the forefront of the institutions engaged in this work. The construction of the Lorentz apparatus, to be presented to the laboratory by the Drapers' Company, has been already commenced, and may perhaps be completed within the current year.

The research work of other departments must be dealt with more shortly. Mr. Campbell has published a valuable series of papers on mutual inductances: construction of standards, and methods of measurement. These latter include the use of a novel form of vibration galvanometer. Dr. Harker's high-temperature work has been delayed by his illness, but a new type of high-temperature furnace has been devised which promises well for the uniform heating of fairly large objects to about 2500° C. In the metrology department much time has been devoted to the development of methods of measurement of screws, and a 4-metre standard bar has been divided and calibrated. Mr. Hunter, in the optical department, has devised a method of considerable interest for the measurement of definition, more especially of photographic lenses. In the electrotechnics department a research on the dielectric resistance of insulating materials, undertaken for the Engineering Standards Committee, has been delayed by the failure of the 100,000-volt transformer under construction.

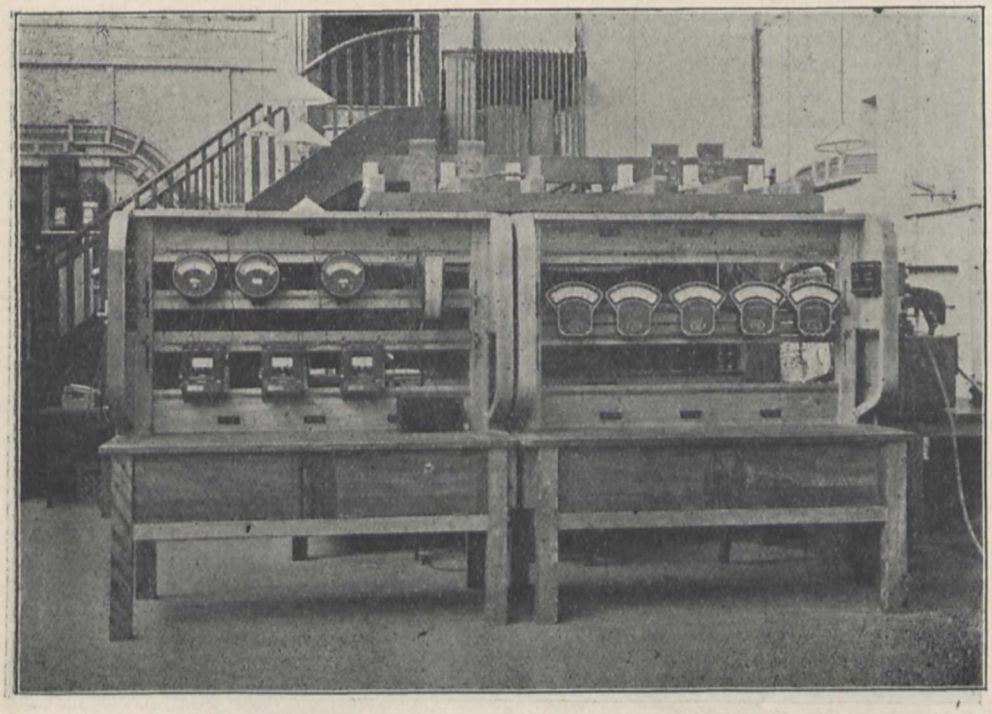


FIG. 2.—General view of one of the instrument-testing stations.

In the engineering department, Dr. Stanton has completed some important researches. The wind-pressure work has established interesting results as regards the relative pressures on large and small plates, which receive remarkable confirmation from the experiments of M. Eiffel. The comparison of open-air results on large models with those obtained earlier for small models shows that the values for large surfaces in the open can be inferred with accuracy from observations in the laboratory. Other researches carried out deal with the resistance of materials under repeated stresses and blows in four forms of impact testing machine, and the elastic limits of material under alternating stress.

In the new department for metallurgy Mr. Rosenhain has been very active, and at least three researches of first-rate importance were in progress during the year under his direction. The most interesting is perhaps the investigation of the alloys of aluminium, copper, and manganese, in continuation of the work carried out by Dr. Carpenter on the aluminium-copper alloys, which appears in vol. iii. of the "Collected Researches." For the purpose of the metallurgical research an ultra-violet microscopic outfit has been installed for obtaining photomicrographs at magnifications up to 3600 diameters.

The report is followed by an appendix, which gives some details as to the equipment of the electrotechnical laboratory (including the department for photometry). Much yet remains to be done to complete the equipment of this building, but the arrangements have been planned with the view of meeting the demands which are likely to arise, and the account given is of no little interest and

utility. The chief feature is probably the careful provision made for the distribution of voltage and current about the building, the utmost flexibility in this respect being essential for the varied purposes of test and research.

The building—mainly on one floor—comprises one large bay (Fig. 1) for machines and alternating current test work, two parallel rooms of half the area for heavier test work and resistance and direct-current work respectively, with offices and workshops beyond. The photometry section, on two floors, runs at right angles to these on the east. Above are the rooms for the photometric measurements, with a 90-feet track for arc-lamp work; the ground floor provides accommodation for life tests,

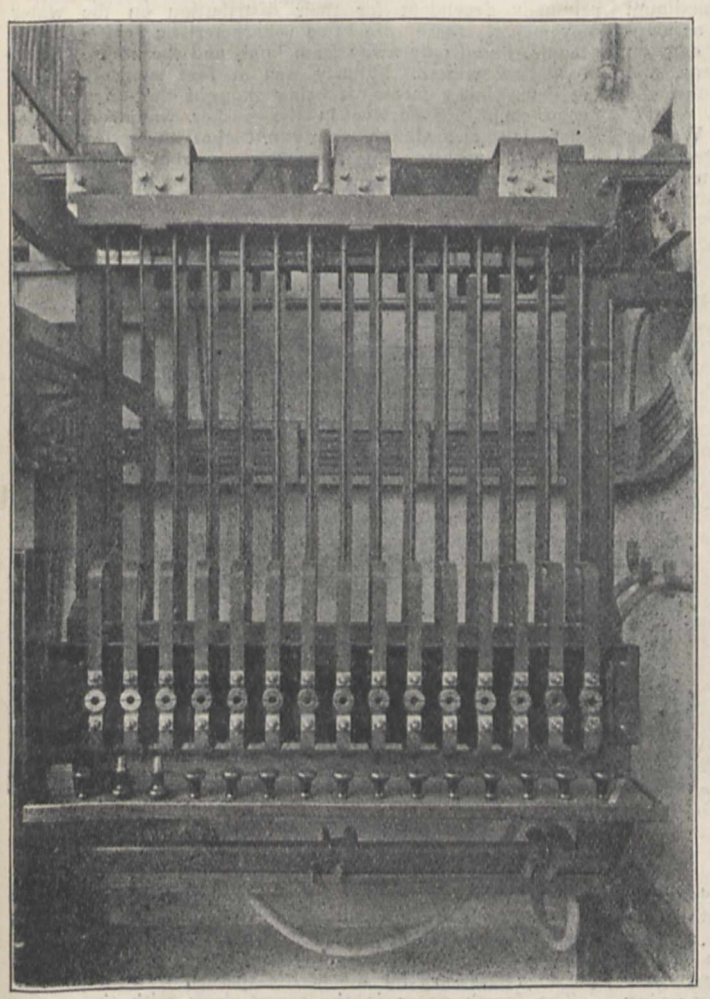


FIG. 3.—Water cooled regulating resistances—capacity 6000 amperes.

and is already largely occupied with the specially designed life-test racks necessary to cope with the probable demand to which reference has been already made. The results of the work on light standards at the laboratory since 1903 were laid before the Institution of Electrical Engineers by Mr. Paterson in December, 1906, in a paper which gained an institution premium, and much time has been devoted during 1907 to work on the pentane standard, while the photometry of differently coloured lights is also receiving attention.

The instruments for alternating current standard work occupy the centre of the main bay (Fig. 1); on the right, under a platform to screen off light, are the two standard electrostatic voltmeters, reading up to 400 volts, on two approximately circular scales 26 feet in length, with an accuracy of 1 part in 10,000. Outside the building, on the opposite side of the main bay, is a small, entirely detached, fire-proof high-tension transformer house, to be occupied by the 100,000-volt transformer, with the aid of which it is proposed that Mr. Rayner should continue the valuable researches on insulating materials already published. Twelve-inch ducts carry the high-tension current into the large bay.

Fig. 2 gives a general view of an instrument testing station—or testing bench—at the east end of the large bay (see Fig. 1). The bench part of the stand in front is arranged as a cupboard with glass top, in which instruments of horizontal type can be tested at any temperature; for other purposes the glass can be covered with teak lids. The back compartment contains heating lamps and a fan for carrying the heated air to any part of the station, the upper part being arranged so that it can be covered with a thin celluloid cover. Above the station may be seen the main heavy current leads. In Fig. 3 are shown the water-cooled regulating resistances employed for heavy current work, of 6000 amperes capacity.

The resistance room, in charge of Mr. Melsom, contains arrangements for all high and low resistance work, except that on ultimate standards; for tests on cables, insulation testing sets, &c., and for dry-cell testing. For accommodating accumulators under test a small building has been erected outside the north wall.

Mr. Paterson and his collaborators have given the utmost attention to all detail throughout the building, the benefit of which will doubtless be felt as the work increases.

Although the development of the laboratory since 1901 has been rapid, it is clear that even now it has but barely reached its most active period of growth. The need and the value of the services it can render become progressively more apparent, and Dr. Glazebrook's able administration and untiring energy may be expected to produce even greater, if perhaps not so obvious, advances in the next seven years.

THE NORTH SEA FISHERIES INVESTIGATIONS.

WHEN the British Government in 1902 undertook to cooperate with other countries bordering on the North Sea in an investigation into the fisheries of that region, it delegated its share of the work in the north to the Scottish Fishery Board and in the south to the Marine Biological Association of the United Kingdom. The latter has now issued its second report upon the work done by its naturalists and hydrographer covering the period 1904–5.

Four papers are included, and the first is by Dr. Wallace on the age and growth-rate of plaice in the southern North Sea, and is the result of the application of a method of determining the age of the fish by the otolith or "ear-stone." Various attempts have been made to determine the age of fishes. The scales furnish some evidence, but in most cases, at any rate, they are hard to read. The otolith method, on the other hand, is easy, and much more rapid than the scale method.

The otolith shows on its surface a series of concentric rings alternately light and dark, and Reibisch in 1899 found that each light ring represented the growth of the otolith during the summer, while the dark rings represented winter growth. There seems to be no difference in structure in the alternate rings, the different appearance being produced entirely by a difference in the density of the substance. In the light opaque rings the particles are more closely packed, while in the dark more or less transparent rings the particles are farther apart. Since

Reibisch's discovery of the importance of these rings as an indication of the age of the individual fish, Redecke, Johansen, and Wallace have all independently proved the correctness of his discovery.

In the present paper Dr. Wallace applies the method to determine the rate of growth of the plaice, its distribution in relation to age, and other points of interest with regard to the habits and life of the species.

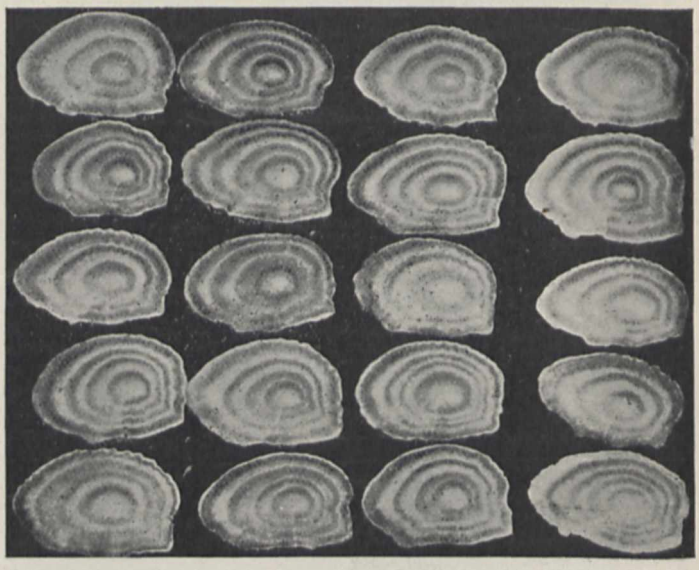
Previous to the application of this method the only means of getting approximately at the age of the fish was by measuring the length of large numbers of individuals and obtaining a frequency curve, but, as Dr. Wallace points out, this method had many disadvantages which are avoided by the otolith method.

By examination of the otoliths, not only is the average length for any age determined, but also the maximum and minimum lengths are obtained. The only assumption made is that all plaice emerge from the egg on April 1! Since the plaice only spawns once a year, and the spawning season at the most lasts three months, the error, owing to this assumption, is negligible.

Having determined the "age-groups," Dr. Wallace discusses their distribution in the area investigated, and in connection with this is brought out the existence of a "selective migration," that is, the distribution or sorting out of individuals according to size. The larger fish of the year tend to move into deeper water than the smaller. It is not a new observation that large fish are found in deeper water, but age is a factor which has not previously been taken into consideration. At any depth are to be found fish representing the larger ones of a recent year, the average sized ones of an earlier year, and the smaller ones of a still earlier year, and so on, but the bulk of the fish of any one size will belong to one particular year, so that at any given depth we shall find the fish of one particular year dominant.

Although this is the rule up to three or perhaps four years old, these older fish seem to be affected by other factors not yet sufficiently understood, as on apparently similar grounds the average size of the fish may differ considerably.

In discussing the average growth-rate of the plaice in the southern North Sea, Dr. Wallace points out that there is a different average growth-rate in the two sexes, and also that the longevity of the female is greater than that of the male. Up to five years of age the average number of males and females is apparently the same, but after that the males rapidly fall off in numbers, and in plaice of eight years old and upwards 91 per cent, are females. The males arrive at maturity one or even two years earlier than the females, and after seven years practically cease to grow.



Views of the concave (outer) surfaces of right otoli hs of twenty-five plaice, mostly with four rings. Magnified about three times.

We reproduce one of the excellent series of photographs of otoliths taken by Mr. R. A. Todd, representing the right otoliths of twenty plaice. The fish were 27 cm. long, and the majority were four years old, as can be seen from the otoliths, which nearly all show four white rings.

Dr. Wallace's paper is somewhat difficult reading owing to the short paragraphs and frequent interpolation of tables, diagrams, and references. A short summary covering all the ground would, we think, in the circumstances have been specially useful.

Mr. R. A. Todd has continued his researches on the food of fishes, and some most valuable results are brought out by his laborious work. First he notes the fact that the younger fish of every species examined (thirty-four in all) chiefly depend upon crustacea for their sustenance, amphipods, cumacea, and decapod larvæ forming the chief food supplies.

Secondly, he shows that although in the young fish competition between all species may be great, in the adults competition is not nearly so keen, except in certain cases which he mentions. The chief food of all fishes appears to be fish, molluscs, and crustaceans, but a few species seem to favour echinoderms and cœlenterates as supplementary supplies. Competition is avoided by each species preferring some few particular species, which often seem to form its staple diet.

Mr. Todd's researches have led to some interesting observations as to a fasting period peculiar to one or two Pleuronectidæ. It seems that this is connected with the spawning period, as in the salmon, but in the case of the plaice it is chiefly the male which abstains from food, since on the spawning grounds "the greater the excess of ♂ over ♀ the greater the proportion of empty stomachs."

The report upon the plankton of the English Channel, by Dr. L. H. Gough, contains some interesting observations as to the causes of distribution. In spite of the fact that the minute organisms constituting the plankton are primarily dependent for their distribution on the water movements, there are two characteristic classes, the oceanic, found only away from land, and the neritic, found in shallow waters. Salinity was at first supposed to be the determining factor, it being thought that the oceanic forms could not survive in the fresher waters near the coast, but Dr. Gough points out that these forms are capable of withstanding a greater range of salinity than is to be met with in the region explored. The most recent theory to account for this distribution is that the decomposing organic matters in the shallower waters where bottom fauna and flora flourish are poisons to the oceanic species, whereas they are either innocuous to or possibly necessary for the neritic species.

The fourth paper in the report deals with the surface waters of the North Atlantic Ocean south of 60° N. lat. from September, 1904, to December, 1905. Mr. D. J. Matthews explains that the paper is almost entirely descriptive, giving an account of the distribution of surface salinity and temperature over a period of sixteen months. Samples of water have been obtained over a large area through the assistance of the captains of a number of steamers.

Even during the short period covered certain striking facts have been observed as to the movements of the waters. For instance, a distinct waxing and waning of the Labrador current has been detected.

Monthly charts showing temperature and salinity for the whole sixteen months add greatly to the interest of the paper.

The volume forms a valuable contribution to science.

FRANK BALFOUR BROWNE.

EXTENSIONS AT UNIVERSITY COLLEGE, LONDON.

ON Thursday last, March 26, the Chancellor of the University of London, the Earl of Rosebery, visited University College, the occasion being the opening of the new libraries and the south wing after the changes made consequent upon the removal of the boys' school to Hampstead.

The Chancellor on his arrival was met by the Vice-Chancellor (Sir William Collins), Sir Philip Magnus, Lord Reay, Sir Edward Busk, Sir Felix Schuster, Sir Arthur Rücker, Dr. T. Gregory Foster, Dr. Bourne Benson, the deans of the college faculties, and other members of the college committee. After an inspection of the alterations, the Chancellor proceeded to the botanical theatre and gave an address, formally declaring the new libraries and south wing open.

In his address Lord Rosebery said they met on a very interesting occasion, because they met to celebrate the fact that, owing to the removal of University College School, the accommodation of University College itself had been increased by fully one-third, and that therefore it had taken one more gigantic stride onward in its progress as a great centre of university life. To achieve this result great exertions had been made. No less than 276,000*l.* had been raised by the magnificent bounty of various donors. As a result of these donations there had been found room for scientific departments hitherto inadequately housed. There had been found room for an adequate museum and class-rooms for geology; a biometrical laboratory for research, which enabled Prof. Karl Pearson to continue his experiments in much more advantageous circumstances; a laboratory had been added of national eugenics (owing to the bounty of Mr. Francis Galton) which could not but be of great advantage to that portion of the curriculum. In the school of engineering a museum had been added, and a hydraulic laboratory. In the school of electrical engineering the accommodation had been doubled. The research laboratory of experimental psychology had been lodged in entirely new quarters. The department of hygiene had been greatly enlarged and largely equipped mainly by the generosity of the Chadwick trustees. In the faculty of arts eleven new lecture-rooms had been added. But perhaps the library was the most remarkable feature of the new enlargement. The method of arrangement required notice by everyone who was interested in that subject—a large general library and a series of specialised libraries in enclosed subdivisions which served as conference rooms for teachers and pupils.

Last, but not least, Lord Rosebery alluded to the extra accommodation for the students of the union. He honestly thought that no wiser thing could have been done by the authorities than to make their students feel it not merely a class-room, but a home, and to give them accommodation where they could spend their leisure hours as their elders did in clubs. He had reason to believe that the University College Debating Society was one of the most formidable of those academic parliaments which sometimes invited their seniors to address them on the principle, he thought, on which the Spartans were wont to place a drunken helot in their midst to serve as a melancholy example of what might happen to them if they did not stop in time. He also directed attention to the new recreation grounds and the residential hall at Ealing, which will be ready next October.

This was a record of manifold activities and of splendid beneficence. It inspired certain expectations in those who were interested in the work of University College and of the University of London. There they had a college which yielded to few colleges in the world in its appliances, situated in the midst of the greatest metropolis in the world, educating and rearing hundreds and hundreds of students, the centre of one form of university life in the metropolis. What a long way they were from the old Stinkumalee, as it was derisively called by Theodore Hook. Stinkumalee, he told his young hearers, was the atrocious name that was applied to University College in the days of its youth. Did it not show what an enormous march had been made by that college since the time when it was known by such a nickname as that?

The whole of London at this moment was teeming with university life. All this life irresistibly was drawn to the University of London. He was sometimes tempted to ask himself if the machinery of their university was adequate to the great strain that was being put upon it by the multiplications of the institutions that were under its fostering care. He sometimes doubted, if they were to undertake new tasks and burdens, whether their constitution was sufficiently elastic to undertake them. They had not all the power that tradition gave of the splendour of antiquity, but they had the advantage of the vigour, the adaptability of extreme youth. They were a new bottle into which new wine could be abundantly poured without risk. He pleaded that University College might not forget its youth, because its youth was its strength, and he thought it well that he should put this consideration before them, because the occasion was not a light one, either in the history of the University or of the College, because the visit of the symbolic head of the University to University College on that occasion emphasised and embodied the alliance between the University and a college which had so lately taken place, and from which he and they all augured such immense advantage in the future.

The thanks of the meeting to the Chancellor were accorded on the motion of the Vice-Chancellor, seconded by Lord Reay (the chairman of the college committee), and supported by the Provost, Dr. T. Gregory Foster. On leaving, Lord Rosebery shortly addressed the students in the cloisters, declaring that they had had good advice poured over them like pots of ointment, like spikenards of eloquence. He would only detain them then to point out that the University in the last resort depended upon the men it turned out. He asked them, and it was his only message for the day, to turn out ladies and gentlemen worthy of the University of London.

In addition to the outline given by Lord Rosebery, we may signalise more in detail the changes in the engineering departments. In general engineering the drawing office has been enlarged and arranged so as to provide separate junior and senior offices controllable from the same demonstrators' boxes. There is accommodation now for 100 students working at the same time. Space has been provided for an engineering museum, the equipment of which has already begun. A small engineering demonstration room has been added. In the electrical department the lecture theatre has been removed to a quieter position, and is now a more commodious room. An excellent research laboratory has been provided, where the professor and his students are continuing their researches on wireless telegraphy. These include the design and insertion of instruments for measuring electrical waves used in wireless telegraphy, dielectrics, and the photometry of electric lamps. A private room, a small demonstration room, and an adequate apparatus room have been added.

In the department of applied mathematics the extensions include a general research laboratory. At the present time an elaborate research in craniology is being carried out. There are 2500 crania in store, of which 1600 are Egyptian of about 1500 B.C. and 900 Egyptian of about 7000 B.C., sent at various times by Prof. Petrie from Egypt.

The department of experimental psychology has two new rooms with adjoining dark-room accommodation allotted to it. The experimental methods now deal with all the higher intellectual processes, including attention, memory, association of ideas, judgment, apperception, the emotions, and will.

In general, we may say that the alterations enable large portions of the work of the college to be carried out in greatly more favourable circumstances than hitherto. The rooms are provided and the workers also. Much, however, is still required in the way of equipment and of endowment of research, so as to enable this to be carried out in a thoroughly efficient manner.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

MANCHESTER.—By the death of the Duke of Devonshire the University has lost its Chancellor, and although it is only a few months ago that the late Duke was elected to this office, he had as president, first of the Owens College

and latterly of the University, on many occasions taken an active part in forwarding the interests of the institution.

Under the will of the late Mrs. John Rylands, the University directly benefits by a legacy amounting to 75,000*l.*, and, in addition, the munificent endowment of the John Rylands library will be of great service to many engaged in literary study and research.

Two further recent bequests must be recorded. Mr. George Harrison, of Manchester, a retired cotton spinner, has left 10,000*l.* for the foundation of scholarships or fellowships, and Mrs. Margaret Stern, of East Barnet, 500*l.*

Prof. Ernest Rutherford, F.R.S., has been awarded the Bressa prize by the Academy of Science of Turin in recognition of the importance of his researches during the past three years.

Prof. W. Boyd Dawkins, F.R.S., has announced his intention of resigning the chair of geology, which he has held since 1874, at the end of the present session; he will, however, accept an honorary professorship and give special courses of lectures. Prof. Dawkins will continue to take an active part in the affairs of the Manchester Museum, in which he has taken so great an interest since he first came to Manchester in 1869 as its curator.

LORD RAYLEIGH will probably be elected to the vacant Chancellorship of the University of Cambridge in succession to the late Duke of Devonshire.

THERE will be an annual exhibition of students' work at the Borough Polytechnic Institute, Borough Road, S.E., on Saturday, April 4.

IT is announced that Prof. A. Crum Brown, F.R.S., professor of chemistry in the University of Edinburgh, contemplates retiring at an early date from the chair which he has occupied since 1869.

PROF. P. J. WHITE having been granted leave of absence for six months on account of ill-health, the Senate of the University College of North Wales has appointed Dr. W. A. Cunnington acting head of the department of zoology for the summer term.

THE Department of Agriculture and Technical Instruction for Ireland issued recently in pamphlet form the lectures delivered during 1906 in connection with the department's scheme of short summer courses for teachers, and an account of technical instruction in Ballymena by Mr. P. F. Gillies, which appeared first in the department's Journal.

IN connection with the forthcoming Franco-British Exhibition, a "children's week" is to be held. A number of French school children and their teachers, half of whom will represent secondary schools and half elementary schools, will be present. The scheme is receiving the support and sympathy of the French and British Governments, and careful preparations are being made to secure the comfort and health of the visitors. A daily educational course is to be given in the British section of education, in which both French and English children will participate. Physical exercises and games typical of both countries will take a prominent part. *Tableaux vivants*, in which the children of both nations will join, illustrating historical events and symbolical of the advantages of peace and the *entente cordiale*, will be another important item of the week's proceedings. The idea is excellent, and we are sure that no pains will be spared to make it a complete success.

IN introducing in the House of Commons on Tuesday a Bill to make further provision with respect to university education in Ireland, the Chief Secretary for Ireland adopted Sir Norman Lockyer's plea for a two-power standard in education as well as in naval defence. He pointed out that the provision of adequate facilities for higher education is as necessary as the aim to be at least twice as strong at sea as any two foreign nations. A short visit to Strassburg would be sufficient to show what the people of Germany are doing for the people of Alsace, and would also show that foreign universities may do this country, during every hour of every day of the academic year, a considerable amount of injury by way of competition. Something has been done in England, Scotland, and Wales to supply this undoubted want. A number of teaching universities have of recent years sprung up among our great and murky towns—Manchester, Liverpool, Leeds, Sheffield, and Birmingham are now being associated in the minds of their younger citizens, not merely with docks and warehouses, not merely with shops and factories, least of all with gaols, lunatic asylums, and workhouses, but nobler structures from which are streaming forth the inspiring traditions, the ever-strengthening traditions, of university life and training. The Bill introduced proposes to establish two new universities in Ireland; these two universities to have their seats respectively in Dublin and in Belfast. In Belfast there will be but one college, the present Queen's College, and it will not be able to have any other, except, of course, by a subsequent Act of Parliament. Dublin will have three constituent colleges, and three only—Cork, Galway, and the new college, with a charter and an incorporated body in Dublin. The existing Royal University will be dissolved as from some appointed day, and its buildings, property, and endowments will be dealt with in a manner mentioned in the Bill. It is suggested, as a matter of finance, that the 20,000*l.* from the Irish Church Fund shall be divided into two equal parts, and that the university in Belfast shall take 10,000*l.* for maintenance and the new university in Dublin the other 10,000*l.* for maintenance. In addition to the present charge on the Irish Church Fund of 20,000*l.* there is a present charge upon the Exchequer of 36,500*l.*, which the Bill proposes to increase to 80,000*l.* This is the provision by way of new endowment, 43,500*l.* Belfast will thus get 10,000*l.* for its university, part of the Irish Church Fund; it will also have 18,000*l.* by way of annual endowment, making in all 28,000*l.* a year. The new college in Dublin has first of all to be built, and then endowed and maintained, and the proposal is that out of the moneys suggested 32,000*l.* a year shall endow and maintain the new university in Dublin when it has once been started. Then the income of the Queen's College, Cork, will be increased to 18,000*l.* a year, and the income of Queen's College, Galway, will be increased to 12,000*l.* a year. It is proposed also that a grant of 60,000*l.* should be made to the new University of Belfast to enable it to provide itself with a university worthy of the province to which it belongs. It is believed that a *maximum* sum for the purpose of the University and college in Dublin should be 150,000*l.*, which, it is hoped, will be sufficient first of all to complete the present university buildings.

SOCIETIES AND ACADEMIES.

LONDON.

Zoological Society, March 17.—Dr. Henry Woodward, F.R.S., vice-president, in the chair.—Some observations on the effects of pressure upon the direction of hair in mammals: Dr. W. **Kidd.** This paper was a sequel to other communications on the subject of the direction of hair, and consisted chiefly of the observed effects of the pressure of harness on certain regions of the coats of domestic horses. This pressure was shown to produce reversed areas of hair, and it was held that these results supported the view put forward in other papers that changes in the arrangement of hair are due to mechanical causes. Fifty-three cases were brought together, and eight different regions of the coats of the horse were shown in which the effects of pressure were found.—Mammals obtained by Mr. C. H. B. Grant in the Gorongoza Mountains, Portuguese S.E. Africa: O. **Thomas** and R. C. **Wroughton.** This was the ninth of the series of papers on the mammals of the Rudd Exploration of South Africa. One hundred and fifty specimens were dealt with, belonging to thirty-one species and subspecies, of which three were described as new.—Notes upon some species and geographical races of serows (Capricornis) and gorals (Næmorhedus), based upon specimens exhibited in the society's gardens: R. I. **Pocock.** It was pointed out that the "grey" goral of the Himalayas was originally described by Hardwicke as *Antilope goral*, and that the "brown" goral, to which the specific title *goral* has been applied in recent literature, required a new name. The author proposed to call it *Naemorhedus hodgsoni*. Concerning the genus Capri-

cornis, he stated that although only one form had been hitherto distinguished from the Himalayas, the available material pointed to the existence of at least four subspecies in that mountain range.

Geological Society, March 18.—Prof. W. J. Sollas, F.R.S., president, in the chair.—The Carboniferous rocks at Loughshinny (county Dublin), with an account of the faunal succession and correlation: Dr. C. A. **Matley** and Dr. A. **Vaughan**. After an introduction recalling the succession at Rush, already described by the authors, a detailed account is furnished of the various sections in the Loughshinny area. About 1100 feet of Carboniferous rocks are exposed. They consist mainly of limestone, but also include a thick mass of conglomerate and many intercalated beds of shale and chert. The rocks have been much folded, and to some extent faulted. The lowest rocks belong to some part of the Dibunophyllum zone, the higher range through Cyathaxonia beds into Posidonomya Limestones and shales of Pendleside age. The Lane Conglomerate may be on or near the horizon of the Rush Conglomerate. Local decalcification has caused the more or less complete disappearance of some of the Cyathaxonia and Posidonomya Limestones. The region was close to an old shore-line of the Carboniferous Limestone Sea, the actual position of which appears to have been almost parallel to, and a short distance seaward of, the present coast-line between Rush and Skerries.—A note on the petrology and physiography of Western Liberia (West Coast of Africa): J. **Parkinson**. The country is low-lying, with a gradual rise northward from shore-level, and rivers mature in character with alluvial flats raised above flood-level. Where the River Tuma falls into the River St. Paul the remnant of a hanging valley can be seen. Flat-topped ridges and isolated hills trending parallel to the foliation of the gneiss are characteristic of the country around Sanoyei and Boporo. There is a striking absence of late deposits of old gravels and sands. In the southern part of the district there are indications of a series of garnetiferous gneisses, tremolite schists, kyanite schists or gneisses, garnet-graphite gneisses, &c., associated with others of granitic type, the latter being apparently free from microcline and containing a pleochroic pyroxene. These rocks are replaced in the north by biotite gneisses and hornblende schists, which have an approximate and singularly constant east-and-west (magnetic) strike in their foliation. Microcline is common. These old crystalline rocks are cut by an extensive series of basalts and ophitic dolerites, resembling so closely the post-Cretaceous dykes of Southern Nigeria that it is difficult to avoid the conclusion that they are of the same age.

Linnean Society, March 19.—Mr. H. W. Monckton, treasurer and vice-president, in the chair.—*Exhibits* (by permission of the director, Royal Botanic Gardens, Kew).—W. B. **Hemsley**: A second specimen of *Platanthera chlorantha* with three spurs. The plant exhibited a spike, each flower of which had the three petals spurred, a case of true peloria, whereas the specimen shown on January 17, 1907, had the three sepals spurred, a case of false peloria.—T. A. **Sprague**: Female flowers and fruits of *Sterculia Alexandri*, Harv., an extremely rare tree from Uitenhage, the only locality known for it.—C. H. **Wright**: Specimens of (*a*) *Sphaerothylax algiformis*, Bisch., a rare South African podostemaceous plant; (*b*) *Archangiopteris Henryi*, Christ and Gilsenh., a Chinese genus of Marattiaceæ, of which a better supply of material had been recently obtained.—*Papers*.—The Podostomata (=Pycnogonida) of the temperate Atlantic and Arctic Oceans: Canon A. M. **Norman**. The classification of Sars had been adopted, and the paper itself contained a complete enumeration of the group within the regions specified.—Amphipoda Gammaridea from the Indian Ocean, British East Africa, and the Red Sea: A. O. **Walker**. The total number of species from the three collections was fifty, in thirty-six genera, seven being new to science, and one being the type of a new genus.—A revision of the genus Codonopsis: T. F. **Chipp**. The author included the genus Glosocomia of D. Don, and other species which could not well be assigned to either. The genus was divided into four sections, dependent upon the attachment and insertion of the corolla and calyx. Finally, the distribution of this genus along the mountain ranges of Asia was described and illustrated by a map on the screen.—The Holothurians of the Sudanese Red Sea: E. **Hindle**.

PARIS.

Academy of Sciences, March 25.—M. H. Becquerel in the chair.—The theory of flow over a vertical thin edge and without lateral contraction: J. **Boussinesq**. The results of the theoretical investigation of the author are compared with the empirical formula of Bazin, the latter representing numerous experiments. The agreement is moderately satisfactory.—The theory of electrocapillarity: M. **Gouy**.—The determination, at the Observatory of Paris, of the systematic errors in the reproductions of the *réseaux* of the chart of the heavens: Jules **Baillaud**.—The applicability and various modes of representation of surfaces with coinciding lines of curvature: L. **Raffy**.—The application of an alternative method to the biharmonic problem: S. **Zaremba**.—Remark concerning a note on the differential equations of an electrified corpuscle in a magnetic field: Carl **Störmer**.—The gases arising from electric sparks: M. **de Broglie**. It has been shown by de Wattville and Hemsalech that if the air supply of a Bunsen burner passes over two metallic terminals between which electric sparks are passed, the flame of the burner gives the spectrum of the metal of the electrodes. The author has examined air thus treated, and finds it to contain ions of feeble mobility (about 10 μ per second in a field of 1 volt per cm.), neutral centres capable of being transformed into ions of feeble mobility by exposure to radium or Röntgen rays, and fine particles visible in a strong beam of light. The last are in part electrified, and probably constitute the chief source of the spectrum obtained.—The absorption spectra of crystals of the rare earths in a magnetic field at the temperatures of the liquefaction and solidification of hydrogen: Jean **Becquerel** and H. Kamerlingh **Onnes**. Previous work at temperatures down to $-190°$ C. has shown that the size of the bands varies proportionally to the square root of the temperature. At $-259°$ C. the majority of the bands no longer follow this simple law. Two of the bands from xenotime appear to pass through a minimum, and are wider at $-259°$ C. than at $-253°$ C. A few of the bands, however, appear to follow the same law as down to $-190°$ C. Down to the temperature of liquid air, all the bands show an increase of intensity corresponding to an increase of absorption. This does not hold for lower temperatures, and for each band there is a temperature at which the absorption passes through a maximum.—The detection of minute quantities of helium in minerals: F. **Bordas**. The exhaustion is carried out by means of charcoal cooled to the temperature of liquid air, and a Plücker tube is interposed between the vessel in which the mineral is heated and the charcoal vessels. The helium being much less readily absorbed by the cooled charcoal, very minute quantities can be detected. Helium has been recognised in this apparatus in 0·02 gram of Japanese naegeite.—The photography of the vibrations of the voice: M. **Marage**. The vibrations fall on a thin membrane of india-rubber, and are transmitted from this to a small plane mirror. Two reproductions of the photographs obtained accompany the paper. The apparatus, once set, can unroll, expose, develop, and fix 25 metres of paper without any manipulation. Various suggestions are made for practical applications.—Some examples of lines presenting a Zeeman phenomenon abnormal in the sense of the magnetic lines of force: A. **Dufour**. The second spectrum of hydrogen is formed of three types of line, the first being unacted on in the field, the second giving the ordinary Zeeman effect, and the third the abnormal Zeeman effect.—The action of chlorine upon dithymol: H. **Cousin**. The products of the action are a dichlorothymol, a dichlorothymoquinone, and a dichloride of the latter compound.—Some derivatives of phenylisoxazolone: A. **Wahl** and André **Meyer**. Condensation is readily effected between phenylisoxazolone and aromatic aldehydes, the product being precipitated in nearly quantitative yield.—The products of the action of aluminium chloride and hydrochloric acid gas on benzene: G. **Gustavson**. Methyl-

phenyl*cyclo*pentane has been isolated from the numerous products of this reaction.—Some derivatives of thiophene: V. **Thomas.** Magnesium acts on α-iodothiophene in presence of ether, giving an organomagnesium compound which behaves similarly to phenyl magnesium iodide in many of its reactions. Details of the products resulting from the action of various ketones are given.—The formation of acetic aldehyde in alcoholic fermentations: A. **Trillat.** The experiments described prove that acetic aldehyde is not a true product of fermentation, since if the fermentation is carried out in the presence of hydrogen or carbon dioxide, air being carefully excluded, no aldehyde can be detected. If air is freely admitted during the fermentation, more aldehyde is produced than if a little air is present.—The production of gum in the Moringa: F. **Jadin** and Volcy **Boucher.**—The phytology of the eastern region of Kabylie and Djurdjura: G. **Lapie.**—The levers in the organism: A. **Guillemin.** A discussion of the efficiency of the leg muscles and bones considered as levers.—The discovery of Palæolithic paintings of man and animals in the Portel cave: René **Jeannel.** More than forty paintings of animals and human beings have been found on the walls of this cave. None of the designs have been cut into the rock, and they are coloured either black or red, both in line and flat wash. Some of the objects are partially masked by stalagmitic deposit. Two designs represent man on foot in profile; others represent bison, reindeer, and horses, the last being the most numerous. Photographs have been taken of some of the objects, and the remainder will be photographed shortly.—Anemometric studies of helices copied from animals: Paul **Amans.**—The Pliocene and Pleistocene eruptions of Limagne: Ph. **Glangeaud.**—Contribution to the study of the solar calorific radiation: C. **Féry** and G. **Millochau.**

DIARY OF SOCIETIES.

THURSDAY, APRIL 2.

ROYAL SOCIETY, at 4.30.—Complete Survey of the Cell Lamination of the Cerebral Cortex of the Lemur: Dr. F. W. Mott, F.R.S., and Miss A. M. Kelley.—The Alcoholic Ferment of Yeast Juice. Part III. The Function of Phosphates in the Fermentation of Glucose by Yeast Juice: A. Harden and W. J. Young.—The Antagonistic Action of Calcium upon the Inhibitory Effect of Magnesium: S. J. Melrzer and J. Auer.—Studies on Enzyme Action, XI., The Hydrolysis of Raffinose. XII., Emulsin: Prof. H. E. Armstrong, F.R.S., and others.

ROYAL INSTITUTION, at 3.—The Animals of Africa: R. Lydekker, F.R.S.

ROYAL SOCIETY OF ARTS, at 8.—The Navigation of the Air: Prof. H. S. Hele-Shaw, F.R.S.

LINNEAN SOCIETY, at 8.—Altitude and Distribution of Plants in Southern Mexico: Dr. Hans Gadow, F.R.S.—The Anatomy of some Sapotaceous Seedlings: Miss Winifred Smith.—Notes on some Sponges recently collected in Scotland: Dr. N. Annandale.

CIVIL AND MECHANICAL ENGINEERS' SOCIETY, at 8.—Efficiency of Boiler Heating Surface: C. Humphrey Wingfield.

CHEMICAL SOCIETY, at 8.30.—The Condensation of Epichlorohydrin with Phenols: D. R. Boyd and E. R. Marle.—Rate of Hydrolysis of Chloroacetates and Bromoacetates, and of α-Chlorohydrin by Water and by Alkali, and the Influence of Neutral Salts on the Reaction Velocities. Preliminary Note: G. Senter.—A New General Method of Preparing Diazonium Bromides: F. D. Chattaway.—On the Probable Nature of the Impurity found in the Triphenylmethane Spectrum: W. N. Hartley.—The Absorption Spectrum of Triphenylmethane: A. G. G. Leonard.—The Constituents of Cyprus Origanum Oil. Isolation of a New Terpene (Origanene): S. S. Pickles.

INSTITUTION OF ELECTRICAL ENGINEERS, at 8.—High Speed Electrical Machinery: G. Stoney and A. H. Law.

FRIDAY, APRIL 3.

ROYAL INSTITUTION, at 9.—The Modern Motor Car: Lord Montagu of Beaulieu.

INSTITUTION OF CIVIL ENGINEERS, at 8.—Notes on the Foundations of an Indian Bridge: G. W. N. Rose.

SATURDAY, APRIL 4.

ROYAL INSTITUTION, at 3.—Electric Discharges through Gases: Prof. J. J. Thomson, F.R.S.

MONDAY, APRIL 6.

VICTORIA INSTITUTE, at 4.30.—History of the Spread of the North American Fauna: Prof. J. Logan Lobley.

ARISTOTELIAN SOCIETY, at 8.—Impressions and Ideas: H. Wildon Carr.

SOCIETY OF CHEMICAL INDUSTRY, at 8.—Considerations affecting the "Strength" of Wheat Flours: J. L. Baker and H. F. E. Hulton.—Note on Murexide as a *quondam* Dye Stuff and Printing Colour: W. Smith.

TUESDAY, APRIL 7.

ROYAL INSTITUTION, at 3.—The Egyptian Sudan: its History, Monuments, and Peoples, Past and Present: Dr. E. A. Wallis Budge.

ZOOLOGICAL SOCIETY, at 8.30.—A Monograph of the Chiropteran Genera Uroderma, Euchisthenes, and Artibeus: Dr. Knud Andersen.—On Certain Points in the Structure of the Cervical Vertebræ of the Okap and the Giraffe: Sir Ray Lankester, K.C.B., F.R.S.—Some Australian Spiders: H. R. Hogg.

INSTITUTION OF CIVIL ENGINEERS, at 8.—The King Edward VII. Bridge, Newcastle-on-Tyne: F. W. Davis and C. R. S. Kirkpatrick.

JUNIOR INSTITUTION OF ENGINEERS, at 8.—Purification of Water: George H. Hughes.

WEDNESDAY, APRIL 8.

ROYAL SOCIETY OF ARTS, at 8.—Technical Education in America: Sir W. H. Preece, K.C.B., F.R.S.

THURSDAY, APRIL 9.

ROYAL INSTITUTION, at 3.—The Animals of South America: R. Lydekker, F.R.S.

FRIDAY, APRIL 10.

ROYAL INSTITUTION, at 9.—The Carriers of Positive Electricity: Prof. J. J. Thomson, F.R.S.

ROYAL ASTRONOMICAL SOCIETY, at 5.

PHYSICAL SOCIETY, at 8.—An Experimental Investigation of the Nature of γ Rays: Prof. W. H. Bragg, F.R.S., and Mr. Madsen.—Experiments on Artificial Fulgurites: Miss D. D. Butcher.—Short-spark Phenomena: W. Duddell, F.R.S.

INSTITUTION OF MECHANICAL ENGINEERS, at 8.

SATURDAY, APRIL 11.

ROYAL INSTITUTION, at 3.—Electric Discharges through Gases: Prof. J. J. Thomson, F.R.S.

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