THURSDAY, JUNE 29, 1911.

DYNAMICAL METEOROLOGY AND HYDROGRAPHY.

Dynamic Meteorology and Hydrography. By Prof. V. Bjerknes and different collaborators. Pp. 146+36A+30B+22C. (Washington, D.C.: Carnegie Institution, 1910.)

IN a lecture delivered at University College in May, 1910, Prof. Bjerknes outlined the methods, described characteristically as rational, by which he hoped to utilise synchronous meteorological observations for a more purely scientific purpose than the preparation of daily forecasts. The present work is the first instalment of a treatise prepared, in collaboration with Dr. J. W. Sandström, with such investigations in view, and is intended to present in an ordered and rational form the principles and development of meteorology and hydrography viewed from the point of view of a mathematical physicist. Bjerknes has realised the fact that economy of thought and labour are essential to advance in meteorological and hydrographic investigation, and although his book bears little actual resemblance to Lagrange's "Mécanique Analytique," we cannot help calling to mind that classical masterpiece of scientific economy in reading this volume.

The existing chaos in meteorological units has led Bjerknes, among others, to the conclusion that a thorough reform in this respect will go far towards making meteorological progress possible through the practical application of more advanced mathematical treatment than is at present customary. He begins therefore by introducing as suitable units for meteorological purposes the metre, the metric ton, or 10^6 grams, and the second, and calls this briefly the m.t.s. system. The metre and the ton are chosen on the ground that the centimetre and the gram are too small as units of length and mass for practical applications, in much the same way as the c.g.s. electrical units are in general unsuitable for the practical engineer. The atmosphere, however, resembles a thin plate, and although the vertical dimensions and motions are relatively small, they are nevertheless important. No combination of units will be appropriate for all cases, and Bjerknes himself departs in some cases from the rational derived units which follow from his scheme. It seems doubtful therefore if it is a wise plan to run the risk of discouraging the reader at the outset by the formal introduction of new units.

The first two chapters are introductory in character, and deal with the units used in the work and with gravity and the corresponding scalar, gravity potential. The unit of gravity potential on the m.t.s. system is called the dynamic decimetre, because it is equal to the work done in lifting unit mass against gravity through a height which is approximately equal to a decimetre. For practical application, however, the dynamic metre is taken, and this unit is fundamental in Bjerknes's work. Its great advantage is that the distance to which it corresponds agrees sufficiently closely with the metre, to make it suitable for expressing approximately *geometric* heights, and points at the same distance in dynamic metres from the earth's surface (sea-level) are on the same level surface of gravity. Bjerknes even makes out a case for publishing the results of geodetic determinations of "height" in dynamic metres, just as in a later chapter he emphasises the need for giving the corresponding values of pressure and temperature in the publication of the results of upper-air observations, instead of height and temperature, the quantities more frequently adopted at present.

Some care is needed to prevent confusion in connection with dynamic decimetres and metres. These are units of work and are invariable, but the heights, with which they correspond, vary with the locality inversely as the value of gravity.

The m.t.s. unit of pressure is the centibar, but here again it is found convenient to take as the practical unit the bar or the megadyne per square centimetre, and the graduation of the barometer in "millibars" is advocated. It seems necessary to proceed cautiously in this connection. It is proper and scientific to express atmospheric pressure in terms of the megadyne per square centimetre or the bar, and it is legitimate to take advantage of any practical device which will enable this to be done as easily as possible; but in using the mercury barometer we are primarily measuring a distance, and equal increments of height do not correspond with equal increments of pressure at different places, or under different conditions at the same place. Meteorologists ought to beware of adding another incongruity to the list of those which they ridicule frequently in a good-humoured way when they have become accustomed to the feeling that long usage has made the bonds too strong to be broken.

Chapter iii. deals with the specific volume and density of air and sea-water. Owing to the fact that the amount of water-vapour present in the atmosphere is a variable quantity, the "constant," R, in the equation $pv=RT$ is variable also, and this constitutes a real difficulty in the discussion of atmospheric changes. Bjerknes reduces the difficulty very considerably by adopting the artifice of keeping R constant throughout, and using in the equation, not the actual temperature T, but the virtual temperature τ, which is the temperature at which dry air would have the same density as the air under consideration. By another ingenious device he makes seven small tables for obtaining the density of sea-water from the temperature, salinity and pressure cover the same range as a quarter of a million pages of straightforward tabulation.

The next two chapters are concerned with the principles of hydrostatics and their application to the atmosphere in the case of constant temperature gradient and for adiabatic equilibrium. They contain an instructive set of diagrams showing for the same scale of height (measured in dynamic metres) the pressure, density, and specific volume of the atmosphere at different levels for the four cases, homogeneous atmosphere, dry atmosphere in adiabatic equilibrium, atmosphere with constant vertical

gradient of temperature 0·5° C. per 100 m., and isothermal atmosphere. Thus it is interesting to observe that at 20,000 m., for example, the pressures expressed in millibars are in the four cases 0, 10, 42, 79 respectively.

Chapter vi. is devoted to a consideration of the problem of determining the heights at given pressures or the pressures at given heights when the virtual temperatures at given pressures or at given heights are known. The method developed is applied to particular cases in which the observed quantities have been found from the records obtained by means of registering balloons. In calculating the height at which a given isobaric surface is to be found, the distances between consecutive isobaric surfaces are taken directly from the tables, so that the single process gives the entire representation of the field of pressure and mass. The ease and simplicity of the method suggest that meteorologists may find it preferable in their synchronous charts to represent the heights at which a standard isobaric surface is to be found instead of the pressures at a standard level. In chapter vii. such charts are drawn for different isobaric surfaces by using the results of the international ascents of registering balloons. Profile diagrams are also drawn showing the section, by a vertical plane, of the isobaric and isosteric (constant specific volume) surfaces, and of the equipotential and isopycnic (constant density) surfaces. In the equilibrium state no two of these surfaces intersect, and the number of tubes made by their intersections in actual cases is a measure of the departure from the equilibrium condition. This method of viewing the distribution is very suggestive, and deserves further development and application.

Chapters viii. and ix. are hydrographic counterparts of chapters vi. and vii., and complete the formal development presented in this volume, the remaining eighty pages being devoted to the tables necessary for the application of Bjerknes's methods. They will be found of great use in the discussion of the atmosphere as a fluid in three dimensions. They differ in some respects from the tables constructed five years ago by Sandström, and they cover a wider field. There are slight differences in the values for the distance between consecutive isobaric surfaces, which are no doubt due to the revision of Sandström's results.

The impression produced by a study of Bjerknes's book is that it does not contain new discoveries or throw much fresh light on individual atmospheric phenomena, but it presents what is fundamental in our knowledge of the physics of the atmosphere in a new way, and makes possible the application of methods which have hitherto been disregarded, because of the immense labour involved in dealing with even a single case. The temptation to pad the work with examples has been successfully resisted, and the cases discussed are confined to what is strictly necessary in the scheme of development.

The observations in the upper air obtained by means of kites and balloons have hitherto been little used in the synoptic representation of atmospheric conditions, and in the investigation of the dynamical problems which a three-dimensional knowledge was expected to elucidate. They have indeed achieved much in giving us definite knowledge in place of erroneous hypotheses, but ambitious minds naturally wish to turn them to practical use in daily forecasting. Laborious investigation is an essential preliminary to such an application, and Bjerknes, with his large, enthusiastic spirit, has taken up this work in a way which ought to secure him the active support of professional meteorologists. The book is excellently printed, and its form and style produce a sense of pleasure and satisfaction. There is an old rule about leaving the preface of a book until the remainder is completed. Apparently Bjerknes is taking this rule so literally that he is reserving the introduction, as well as the index, until the issue of the final volume.

E. GOLD.

THE JEWS.

The Jews: a Study of Race and Environment. By M. Fishberg. Pp. xix+598. (London and Felling-on-Tyne: Walter Scott Publishing Co., Ltd., 1911.) Price 6*s*.

IN order to elucidate the problem whether the Jews constitute a race or simply a nation, Mr. Fishberg discusses at considerable length certain physical characters, with the following results. Stature is not homogeneous among the Jews in every country, and its limits of variation are almost as large as are observed in European races generally; further, where the indigenous population is tall the Jews are also tall, and the reverse. It is also evident that the shortness of their stature can be attributed only to a slight extent to the influence of environment or to occupation. Jewish skulls are extremely rare in museums; indeed, there do not appear to be any data whatever for the ancient Hebrews; the cranial index of five skulls of the second century, found in Rome, varies from 75·1 to 83·4; of twelve skulls found in Basel in a cemetery dating from the thirteenth and fourteenth centuries two were dolichocephalic, while the remainder were brachycephalic, the total average being 84·6. The same variability occurs in other finds, but the skulls of most of the Sephardim—or Spanish and Portuguese Jews—are dolichocephalic.

Among the existing population it is found that in countries where the indigenous population is narrow-headed, as in Africa and Arabia, the Jews are dolichocephalic, and where broad-headedness prevails, as in Russia, Poland, and Hungary, the Jews are brachycephalic. The ancient Hebrews must have been either of the one type or the other, or a mixed race originally; the former alternative implies that for most of the Jews miscegenation must have occurred in later times. Although predominantly dark, fair Jews are found everywhere; even among the Sephardim, it appears that the blond type oscillates between 5 and 16 per cent., and between 25 and 50 per cent. are of the mixed types according to the country of birth. The suggestion that the blondness is a product of climatic conditions can be eliminated as worthless, as blond Jews occur everywhere. The combination of tall stature, blond-

ness, and dolichocephaly is not observed among the European Jews, but they have other physical traits of their non-Jewish neighbours.

Prof. F. von Luschan believes that the blond Jews of antiquity may have been the result of intermarriage with the fair "Amorites," but the bulk of the blondness, according to Fishberg, must have been acquired later by intermarriage with non-Jews. He also shows that the predominant type of Jewish nose is straight, nearly 60 per cent., the aquiline being only about 14 per cent. The character of the nostrils, to which Joseph Jacobs directed attention, is characteristic only of the latter type of nose, which von Luschan says should be termed Armenoid and not Jewish or Semitic. It is very commonly asserted that owing to social and religious causes the Jews have retained their "racial purity." Putting aside the dark Jews of India and Abyssinia, among whom proselytising has taken place, we read that in Gaul, Spain, Italy, and Hungary the Jews owned slaves, and records show that the Church has at various times taken measures to prevent them from converting their Christian slaves to their own faith; finally, the Church was compelled to forbid them to own slaves altogether. The descendants of white slaves have been fused with the rest of the Jews, and to-day, after several generations of liberty, they can be no longer recognised; but other causes have contributed to miscegenation. Fishberg supports the statement of Gumplowitcz that "the type or physiognomical character of a folk or social group is not anthropological but social"; he adds, "Mainly for this reason most of the Jews in eastern Europe, who are anthropologically of various types, deceive the casual observer into believing that they all present physiognomical homogeneity."

These conclusions, which he believes to be justified, dissipate the exalted notion of the "Chosen People," who claim that they can trace back their ancestry to their patriarch and progenitor Abraham, as well as the pseudo-scientific theory of the Anti-Semites of a "Jewish race," which is entirely alien in Europe, and incapable of assimilating European standards of morals and fair play. From all the historical evidence available, it appears that the Synagogue and the Church are both powerless to prevent intermarriage between Jews and Christians unless the State comes to their rescue. Such marriages are increasingly taking place; thus there is every indication that the social isolation of the Jew is coming to an end, and that in the near future all the real and alleged differences between Jews and Christians will completely disappear in progressive communities.

The author gives interesting information concerning the marriage-rate, birth-rate, and infant mortality among the Jews, and their pathological characteristics are discussed at length. There are practically no differences between Jews and Christians as regards the incidence of typhoid fever, scarlet fever, measles, diphtheria, &c. The so-called "tenacity of life" of the Jews is mainly dependent upon the great care Jewish mothers take of their children; they nearly always nurse them at the breast, and Jewesses only rarely go to work in factories after marriage. Their lesser liability to consumption is remarkable, perhaps because, being better adapted to city life and overcrowding by a long sojourn in the Ghetto, and by a process of natural selection, there were eliminated most of those who were predisposed to tuberculosis. The only pathological processes which are more frequent among Jews are the derangements of the nervous system.

"The Jew is the most nervous, and, in so far, the most modern of men. He is by the very nature of his diseases the forerunner, as it were, of his contemporaries, preceding them on that perilous path upon which society is urged by the excesses of its intellectual and emotional life, and by the increasing spur of competition."

Many other aspects of Jewish life are dealt with in this interesting and valuable study, such as the social, economic, and political conditions of the Jews. With regard to their future as a people—for we are no longer justified in speaking of a Jewish race—the author evidently subscribes to Ruppin's statement that "orthodoxy and poverty, assimilation and prosperity, are almost synonymous terms with the Jews."

A. C. HADDON.

ALCOHOLIC FERMENTATION.

Alcoholic Fermentation. By Dr. A. Harden, F.R.S. Pp. ix+128. (London: Longmans, Green, and Co., 1911.) Price 4*s.* net.

THE appearance of Dr. Harden's "Alcoholic Fermentation" will be warmly welcomed by those engaged in studying problems connected with yeast and the production of alcohol. Dr. Harden's own contributions to the question of alcoholic fermentation are so well known that one expects and finds in this small volume a good up-to-date general survey of the subject. The material is divided up into eight chapters, of which the first is devoted to historical introduction, whilst the next four deal with the properties of zymase and the theories which have been developed since Buchner's fundamental discovery of the dependence of fermentation on enzymes rather than on necessarily living organisms.

In dealing with the accelerating effects of phosphates, arsenates, and arsenites on the course of fermentation, Dr. Harden compares the ideas of von Lebedew and Iwanoff with his own conception of the constitution and function of the "hexosephosphate," which he formulates as the salt of a hexose-diphosphoric acid, whilst Iwanoff regards the substance as a triose-phosphoric acid, $C_3H_5O_2(PO_4H_2)$. Perhaps the strongest evidence in favour of the hexose-diphosphoric acid formula is afforded by the observation of Harden and Young, that when hydrolysed, fructose, as well as phosphoric acid is produced. The significance of the phosphate derivatives is such that one must welcome the synthetic production of phosphoric ester-acids of sugars and allied compounds now being effected by Contardi and Neuberg.

Some interest attaches to Neuberg and Pollak's synthesis of salts of monophosphoric acids of sucrose and glucose, as they have been isolated in analysable condition, and, though not of glucoside type, need to be hydrolysed before undergoing fermentation with yeast. In the case of the hexose-phosphate of alco-

holic fermentation, probably the aldehyde-group participates in the formation of the ester-acid. Dr. Harden remarks (p. 46),

"the identity of the products from glucose, mannose, and fructose may be explained by regarding the acid as a derivative of the enolic form common to these three sugars, or *by supposing that portions of two sugar molecules may be concerned in its production.*"

The "equation of alcoholic fermentation,"

$$2C_6H_{12}O_6+2PO_4HR_2=2CO_2+2C_2H_6O+2H_2O+C_6H_{10}O_4(PO_4R_2)_2,$$

whilst recording the experimental facts, scarcely affords an explanation of the formation of alcohol, as it is not obvious why, when one of two glucose molecules forms hexose-phosphate, the other should yield carbon dioxide and ethyl alcohol. Perhaps the part of the above quotation which the reviewer has put in italics furnishes a clue.

Chapter iv., dealing with Harden and Young's discovery of the coenzyme of yeast-juice and its remarkable properties, is of considerable interest, and the possibility of this containing the phosphate group referred to, though it is admitted that experiments have so far yielded only negative results. The next chapter is devoted to the action of inhibiting and accelerating agents on the enzymes of yeast-juice, whilst in chapter vi. the by-products of alcoholic fermentation are dealt with. The results of F. Ehrlich's brilliant work on the production of higher alcohols are clearly expounded, and production of aldehydes and glycerol referred to. It is a matter of interest that only living yeast appears to be capable of producing alcohols from the amino-acids, and even then only does so in presence of fermentable sugar. The discovery of zymase has furthered the solution of the fermentation problem, but the stability of the amino-acids in the absence of the living organism, and the superiority of yeast itself over preparations of its enzymes in effecting the conversion of hexoses into alcohol and carbon dioxide need further explanation.

The chemical changes involved in fermentation are dealt with in chapter vii., and the various explanations put forward at different times are recorded; the reader cannot fail to be struck with the small measure of success which has so far attended these efforts.

Chapter viii., on the "Mechanism of Fermentation," is rather condensed in comparison with the rest of the work; here, however, one departs somewhat from the biochemical aspect of the problem which has been treated by Dr. Harden in so successful a manner. J. T. H.

A CRITIC IN GEOLOGY.

L'Évolution des Théories géologiques. By Prof. S. Meunier. Pp. 366. (Paris: F. Alcan, 1911.) Price 3.50 francs.

THIS is one of the most useful works that Prof. Stanislas Meunier has given to his geological colleagues, and at the same time it will be appreciated by the general reader. The latter, however, must be constantly on his guard, lest he cry out, "A hit, a very palpable hit," every time that Prof. Meunier tilts against the theories of to-day. In an introduction intended to show the inexactitude of the works of nature when compared with the demands of mathematics, the author seems to include in the same order of things the forms of basalt columns and those of crystallised minerals; he rightly points out the irregularity of the former, but says of man (p. 12),

"à la place des formes toujours variées des objets naturels, il a inventé les formes géométriques . . . tetraèdre, cube, rhomboèdre . . . auxquels il rapporte les objets véritables."

Prof. Meunier doubts the conclusions of the chemist when he remarks, "De même, à la place des composés naturels, il à inventé des composés définis; oxydes, acides, sels," &c. All this is harmless Meunierism to the trained geologist, and will be taken in good part, like the author's rejection of the reality of the Ice age; and it is undoubtedly good for us to have the erroneous conclusions arrived at in the past by the "unanimity of geologists" pointed out as a warning for our later age.

The history of geological thought exhibits to us a science more cumbered by theory in its earlier stages than it is at the present day, and Prof. Meunier does well to begin with cosmogony, tracing the study from Moses to Sir George Darwin. The form of the earth and the nature of its interior are then discussed, with references in the main to French authors. But in succeeding chapters the literature of the world is freely drawn on, and is often criticised as freely. The chapter on mountain building is of special interest, though a more regular chronological arrangement would have aided the reader. The author hails with complete approval the views of Suess on horsts, and of Schardt and Termier on horizontal overfolds, and justice is done (p. 99) to Reyer's theory of gravitational sliding.

The chapter on earthquakes is still more injured by lack of systematic arrangement, and cannot be regarded as complete. In that on metamorphic theories we should have liked to find the names of Scrope and Darwin, both of whom had such clear views on foliated rocks; but Hutton, Lossen, Lehmann, and Michel Lévy are similarly passed over, and the chapter is a brief essay rather than a history. Rivers and glaciers are more adequately dealt with. The chapter on the latter concludes (p. 282) with the following amazing statement as to the striated pebbles found in boulder clays:—

"Or il est maintenant démontré que les stries . . . ne sont aucunement d'origine glaciaire et qu'elles dérivent entièrement du phénomène d'érosion réalisé dans la masse des éboulis par l'infiltration des eaux de pluie."

Has Prof. Meunier ever consulted an agriculturist as to the penetration of boulder-clay by rain, or has he seen the scratched blocks in a modern glacial deposit, newly revealed from Arctic ice? He continues the discussion when dealing with "théories sédimentaires," and asserts firmly (p. 301) that "pratiquement les glaciers ne strient pas de galets." French tourist steamers now penetrate the fjords of Spitsbergen, and Prof. Meunier should certainly ask one of these to land

him on the arid shores, strewn with striated boulders, of Tempel Bay or Cora Island.

The transport of boulders and striation of rock-floors by ice are, of course, fully admitted, and we have interesting references to Playfair, Perraudin, and de Charpentier. A short account of the origins of sedimentary rocks follows, in which, by a slip, fresh-water shell-limestones become included under "roches argileuses." This part of the book may be regarded as consisting of somewhat scattered notes, all of which have an interest for the professed geologist, but which do not systematically express the growth of geological opinion.

The absence of an index is astonishing. Perhaps the publisher quailed before the proper names, which are very imperfectly corrected in the text. We have Leibniz, Hitchkock and Hitchcok, Mayer-Aymar, Uscher, Revenier, Spalanzani, Moris Davis, d'Aubuisson de Voisin, and Deshays. One or two dates seem erroneous by about a century. G. A. J. C.

LEAD SMELTING.

The Metallurgy of Lead. By H. F. Collins. Edited by Sir W. C. Roberts-Austin, K.C.B., F.R.S. Second edition, thoroughly revised and enlarged. Pp. xx+538. (London: C. Griffin and Co., Ltd., 1910.) Price 21*s.* net.

WE welcome a revised and enlarged edition of this useful work, as the progress of metallurgy is now so rapid and great improvements have been made in smelting during the last decade. A too brief reference has been made to the physical properties of lead and that of its alloys, and much recent work has been overlooked, probably due to the aim of the author in making the work chiefly a compendium of information on lead smelting, which is here brought well up to date. Ore roasting has received the attention it deserves, and we are glad to find that pot roasting is clearly described, and the chemical reactions occurring in this novel process fully discussed, since a correct knowledge of the chemical changes that occur in any process often leads to advancement and discoveries. Useful data are given as to costs in the various modifications developed from the Huntingdon-Heberlein process.

The most suitable fuel for a given ore is here rightly considered, as well as the proper amount to be used in each case. But the twyer ratio and twyer efficiency are also of great significance, and it is a pity more attention has not been given to the pressure and volume of air supplied to each furnace.

The principles of blast-furnace lead smelting are clearly expressed, as the method of dealing with each constituent, according to its quantity, is essential for economic working. It is also equally important that the proper flux should be applied in order to produce the most suitable slag and to obtain the maximum quantity of metal. This is dealt with in a plain and lucid manner. A comprehensive description of modern furnaces with plentiful illustrations is a good feature in this edition, the parts being described in considerable detail. The important subject of water-jackets receives due attention as more refractory ores have now to be dealt with, necessitating greater height of jacket than formerly. It is shown that with increase of size of furnaces and amount of output larger forehearths are required and greater facilities for separating matter and slag. The treatment and disposal of slag are also given due prominence. Formerly the production of matte was considered a necessary evil, but it is now esteemed a desirable thing, since the lead is better reduced and the slag more free from lead and silver.

The various products of lead smelting are amply described, as well as the methods adopted for dealing with them at different works.

In chapter xi. examples of lead smelting in the chief European and American works form the subject of narration, and the following chapter deals with costs and losses.

As all lead ores carry silver and sometimes gold, it often becomes more profitable to work for their extraction than that of the lead itself. The author devotes about 100 pages to a consideration of this important subject. A valuable part of this section is the description of the methods of separating gold from zinc crusts.

In chapter xix. works assaying and analytical methods are dealt with.

In the following chapter the difficult subject of treatment of zinc-lead sulphides is considered, and various methods of separation discussed.

The last chapter deals with flotation processes, which have in recent years assumed great importance.

We consider this work a valuable contribution to the metallurgy of lead, in which so much new matter has been introduced, and it can be confidently recommended as a trustworthy guide to anyone who is interested in the subject.

THE TRISECTION OF AN ANGLE.

The Trisection of the Angle by Plane Geometry: Verified by Trigonometry with Concrete Examples. By Dr. J. Whiteford. Pp. 169. (Greenock: J. McKelire and Sons, Ltd.; Edinburgh and Glasgow: J. Menzies and Co., Ltd.; Cambridge: Bowes and Bowes, 1911.)

THE *Paralogistes pseudomathematicus* has become so rare, or possibly so shy, that it is a real pleasure to find that the species is not extinct. Alack! that De Morgan is not with us, to do justice to this latest attempt at solving one of the three famous problems that have been proved to be beyond the power of Euclidean constructions. The curious thing is that the author, in his introduction, gives two long quotations from De Morgan, in which he states the conditions of the problem with the utmost precision, except that he does not explicitly say that the trisection must be performed by a finite number of operations. It is here that Dr. Whiteford has come to grief, for his method is nothing more or less than successive approximations, each of which involves a Euclidean construction. It is only fair to add that the author is no vulgar paradoxer, and that his method, as an approximation, is sound, and leads to accurate values with a comparatively small number of

trials; thus in his examples he works to seven places of decimals, and we have not noticed a case in which more than seven trials are required. The one, unfortunately fatal, objection, is that he has ignored the conditions of the problem; it is as though the value of π were found from the perimeter of a regular polygon of 2^n sides. By taking n large enough, we can get by Euclidean construction a value as near π as we please; but it is needless to say that this is not what is meant by "squaring the circle" with rule and compass.

Dr. Whiteford's method is sufficiently ingenious to deserve a brief description. Let AP be an arc of a circle, of which AOB, COD are perpendicular diameters; then if through P a line PQRS be drawn cutting the circle in R, and the diameters CD, AB in Q, S, so that QS=AB, then the angle ROB is one-third of the angle AOP. This theorem was known to the Greeks, and, in fact, led to the invention of the conchoid of Nicomedes as an auxiliary curve for the trisection of the angle. If we take Q anywhere on CD and produce PQ to S, making QS=AB, the locus of S is a conchoid, and its intersection with AB gives the solution of the problem. Now Dr. Whiteford gives a construction for a point on AB, which is in no case very far from S, and thence obtains a sequence of points which have S for their limiting point. After translating his construction into trigonometry, he gives fifty-one worked-out examples, so variously distributed over the quadrant as to leave no doubt that his sequence does actually converge in every case, though, as might be expected, he makes no attempt to prove this fact.

It is easy to draw the obvious moral that it is waste of time to attack a mathematical problem without completely understanding what the problem is. However, this is perhaps ungracious; let us rather conclude by admitting that Dr. Whiteford has added one more to the fairly numerous approximate solutions of this celebrated problem. G. B. M.

LILIENTHAL'S WORK ON AVIATION.

Birdflight as the Basis of Aviation: a Contribution towards a System of Aviation, Compiled from the Results of Numerous Experiments made by O. and G. Lilienthal. By Otto Lilienthal. With a biographical introduction and addendum by Gustav Lilienthal. Translated from the second edition by A. W. Isenthal. Pp. xxiv+142+viii plates. (London: Longmans, Green, and Co., 1911.) Price 9s. net.

THE interest of this book lies chiefly in the biographical part. The two Lilienthals, born in the town of Anklam, were from childhood devoted to mechanics, and also to natural history. Otto gained practical knowledge as a mechanic in the works of Schuarlzkopf in Berlin, while his brother was educated as an architect. Watching the flight of the storks which abounded about their home seems to have given them their first taste for the problems which afterwards occupied so much of their attention.

One curious passage (p. 103) is here quoted. After a picturesque description of the storks following the harvesters to pick up field mice and such "small deer," and a reference to the high regard in which the birds are held by the farmers, we read:—

"Thus it is not to be wondered at if the farmers, above whose homesteads these birds with a span of two metres hold great flight meetings every year, evince great interest in the art of flight, though they do not wish it to be known, fearing ridicule. Nevertheless, from no other trade or profession have so many inquiries for light engines—for a secret purpose—reached the author, as from farmers."

The theoretical part of the book is not of any great value, and some of the diagrams (notably those on pp. 45 and 56, of the flow of a stream past an obstacle) are very far from representing the actual facts.

Lilienthal seems to have attached great importance to curved, as against plane, and flapping, as against fixed wings. Flapping wings are really the more efficient of the two, but not for the reasons given.

Difficulties of mechanical construction have hitherto prevented their adequate trial on a large scale, but it would be too much to say that they are impracticable.

The merit of the curved wing section now generally in use is not that it gives an increased lift or efficiency, but that the efficiency does not vary so rapidly with the change of inclination to the air current as happens when the surfaces are planes.

It is seldom that the enthusiasm, mechanical ability, knowledge, and money necessary for experiments in a new field are found in the possession of one and the same individual. Lilienthal had the two first, but was hampered as regards the others. This book, however, which is well translated, should be read as giving a very interesting account of the work of a typical "inventor" of the best class.

A. MALLOCK.

OUR BOOK SHELF.

A Systematic Handbook of Volumetric Analysis; or, the Quantitative Determination of Chemical Substances by Measure, Applied to Liquids, Solids, and Gases. By F. Sutton. Tenth edition. Revised throughout, with numerous additions, by W. L. Sutton and A. E. Johnson. Pp. xiv+621. (London: J. and A. Churchill, 1911.) Price 21s. net.

A BOOK that has been the standard text-book on its subject for nearly fifty years, and continues to enjoy that position, calls for little remark as edition after edition is issued. Every student of chemistry knows, or ought to know, his "Sutton," as he knows his "Fresenius," and it would therefore be superfluous to attempt to describe its character and scope. The author, being now eighty years old, has placed the preparation of this tenth edition entirely in the hands of the two editors named in the title. There seems to be every evidence that the editors have done their work thoroughly and judiciously. They say that a good deal of obsolete matter has been deleted, and we naturally turned to some of those classical methods that have served so well in the past, such as Bunsen's method of gas analysis, and have been almost wholly replaced, rather than superseded, by processes that are more suitable for technical work. But the

old method of making and graduating, as well as calibrating, gas burettes is retained, though the apparatus for graduating and etching them would probably be regarded as curiosities in a modern laboratory.

By means of a new setting, and a rather smaller though quite clear type for some paragraphs and sections, space has been economised, and the volume, with all its added matter, is practically of the same size as the last edition. The deletions have in no sense altered the character of the book as giving full practical instructions, but in some cases, where a suggested modification is of comparatively little importance, or an application of a process is of very restricted use, the editors give only a short statement and refer to the original description by the author. In many cases they have taken advantage of the assistance of experts who have had exceptional experience of various methods. All factors and numerical details have been recalculated according to the latest "International Atomic Weights." The section on weights and measures has been rewritten, using the data adopted at the National Physical Laboratory.

In short, the editors appear to have spared no trouble to maintain if they could not enhance the reputation of the book, and thus to merit the gratitude that the aged author expresses in his preface, and, we may add, the thanks of all those who are interested in the subject with which it deals.

The Influence of Strong, Prevalent, Rain-bearing Winds on the Prevalence of Phthisis. By Dr. W. Gordon. Pp. xiv+108. (London: H. K. Lewis, 1910.) Price 7*s.* 6*d.* net.

FOR many years Dr. Gordon, in a series of papers, has brought before the medical profession evidence that strong rain-bearing winds have a very definite influence on the prevalence of phthisis. He has now collected these papers, and, in a work bearing the above title, gives a complete account of his observations. He maintains, as a result of these observations, that in any situation exposed to rain-bearing winds, whether it be over a wide region or merely the side of a street, the mortality from pulmonary phthisis is high. He works this out specially for Devonshire, but takes Exeter streets at one extreme and the civilised world at the other, always coming to the same conclusion. In all this, however, he does not, by any means, ignore other factors, especially "soil" and poverty. Our author points out that this high mortality from consumption is not due merely to a depression of vitality, for it is found that the general death-rate is not affected in the same way as is the phthisical death-rate. Moreover, he is satisfied that the action of the rain-bearing wind is exerted directly on the person exposed to it and not indirectly, "either through closure of doors and windows against the wind or by it driving wet into the walls of the houses."

It is, of course, difficult to test the accuracy of Dr. Gordon's observations, but his figures certainly seem to prove that, taking female death-rates as offering a safer basis of inquiry, in the rural districts of Devonshire, swept by rain-laden winds, the mortality is higher than in those where the winds are dry. Dr. Gordon, not shirking the numerous criticisms that have been directed against his conclusions, has certainly made out a very strong case for the accuracy of his hypothesis. As dealing with one of the side-issues of the tuberculosis question, as opening up a new field of inquiry, and as affording a guide to those in search of places to which consumptives may be sent, although it is not designed for that special purpose, this work will be of very considerable value. The coloured charts on which the statistics are both based and recorded are exquisitely drawn and reproduced. We congratulate Dr. Gordon on the completeness of his work.

Die Naturwissenschaften in ihrer Entwicklung und in ihrem Zusammenhange. By Friedrich Dannemann. Erster Band, Von den Aufängen bis zum Wiederaufleben der Wissenschaften. Pp. viii+374. Leipzig: Wilhelm Engelmann, 1910.) Price 9 marks.

THIS is the first of four volumes designed to give a connected history of the development of all the sciences, with especial regard to their connection with each other. It deals with the earliest records of geometrical and arithmetical learning among the Egyptians and the Sumerian conquerors of Mesopotamia; proceeds to the Greeks from Thales to Aristotle; sketches the development of science in the Greek colonies, the two periods of Alexandrian learning, the Arabian era, and the decline of the Middle Ages; and finally describes the revival of learning in the fifteenth century.

In dealing with Babylon, the author makes some telling extracts from the Nippur tablets, which date back to between 2200 and 1350 B.C., to show that a decimal system of notation is used in the cuneiform inscriptions, without, however, the use of the zero circle, which was introduced by the Indians, and brought to Europe by the Arabs.

In a work like this one misses a description of the Egyptian orientations of temples and pyramids with regard to particular stars. The recent Cretan discoveries are not included, and Chinese observations are only briefly touched upon. But the book is written in a very entertaining style, and as it is plentifully supplied with references, it forms a useful guide-book through the historic development of the sciences.

A Course of Plane Geometry for Advanced Students. Part II. By C. V. Durell. Pp. xiv+358. (London: Macmillan and Co., Ltd., 1910.) Price 7*s.* 6*d.* net.

THE first part of this work, on the straight line and circle, has already been reviewed. The present volume, which treats of conics, shows the same merits of clearness, conciseness, and good judgment. For example, there is a fairly complete account of involution, which is by far the most powerful instrument for developing the properties of conics; and, in order to avoid, on one hand, a lack of rigour, and on the other a difficult theory, the author has frankly based his treatment on an algebraic foundation. Other chapters deal with homography in general, reciprocation and projection; there is even a brief outline of practical solid geometry, though this is too sketchy to be of much use. There are various historical notes, excellent diagrams, and a vast collection of exercises; altogether Mr. Durell's book may be recommended as a trustworthy, practical, and interesting text-book.

M.

The Phase Rule and its Applications. By Dr. Alex. Findlay. Third edition. Pp. xvi+356. (London: Longmans, Green, and Co., 1911.) Price 6*s.*

THE first edition of Dr. Findlay's book was reviewed in these columns on April 21, 1904 (vol lxix., p. 579), and the arrangement and general character of the work remain much the same as they were. In the second edition numerous additions were made to bring the information up to date, and though no changes of a fundamental nature have been made in the present edition, paragraphs have been added where necessary on the results of recent researches. In addition to this, the whole book has been subjected to careful revision.

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.]*

New Use for Eucalyptus.

THE following extract from a private letter deserves a wider publicity :—

W. T. THISELTON-DYER.

You may perhaps remember the work published in 1902 from this institution on "Eucalypts and their Essential Oils." Prior to this the eucalyptus oil industry was in a chaotic state in Australia, the New South Wales article being almost unmarketable. By working out the species on a basis as laid down in the work (*supra*)—that is, a natural one—many new products were discovered, such as geraniol, the active principle in the otto of roses; a dextro- and a lævo-turpentine corresponding to the American and French respectively; many eucalyptol oils (medicinal), in addition to those previously known; citral, from which ionone, the artificial perfume of violets, is made; citronellal, corresponding with the product obtained from the lemon grass of India; eudesmin and other products of unknown economic value at present.

The British pharmacopœia laid it down that no eucalyptus oil should be sold unless it contained not less than 50 per cent. eucalyptol, but such did not hold good for Australia; consequently *any* oils were sold for therapeutic purposes.

But recently, through our instrumentality, the Health Board has passed a regulation that the B.P. standard should obtain here; consequently there has been a "slump" in the oils thus disqualified, and so these became worthless. Naturally the distillers were very much put out with us, and some travelled so far as Victoria and Queensland to interview us and discuss the matter. But the hands of the clock could not be put back.

The now discarded oils have been classified by the chemist as phellandrene oils, and the particular gum trees yield them in larger quantity than any other oils, and the desideratum was to find an industrial avenue for their utilisation. Well, this is how it has come about. There are at certain large mining centres here millions of tons of "tailings," containing particles of minerals very finely divided, and the trouble in the past has been to extract these profitably, and many methods and patents have been adopted, but none satisfactorily.

At Broken Hill, our greatest mining centre, chemical investigation has been carried on for some time, and a complete series of essential oils of our own extraction and true to botanical names was forwarded for trial. The result was that the phellandrene oils yielded from 86 to 90 per cent. concentrates, the highest of any oil experimented with! Here indeed was a market. The demand for these particular oils has at once enormously increased; hundreds of tons are required, for the method will be introduced into U.S.A., Canada, Queensland, and through all Australia, South Africa, and wherever the industry obtains.

Its utilisation is the essence of cheapness, and the information on a sample that I brought from Broken Hill myself reads as follows :—Zinc concentrates; about Zn 47 per cent., Pb 10 per cent., Ag 15 oz.; recovered by eucalyptus oil ½ lb. per ton of concentrates.

When we started out on our research on eucalypts we little thought that the oil would play so important a part in mining. RICH. T. BAKER.

Technological Museum, Sydney, April 7.

The Date of the Discovery of the Capillaries.

THE discovery of the capillary blood-vessels being an event of such supreme importance in biology, it is highly desirable that the date of it should be accurately ascertained. It so happens that it is known for certain it was made in the year 1660 by Marcello Malpighi in the city of Bologna, and yet nearly every author gives the date of this discovery as 1661.

The latest statement of 1661 is in Prof. Miall's delightful little book "The History of Biology," in which in the useful chronological table we find :—

"1661. Passage of blood through capillaries observed by Malpighi." As justifying this date, he would doubtless point to the note at the head of the table :—("The date of a discovery is the date of its first publication when that is known.")

Now while in many cases this principle may be not only a convenient one, but the only one capable of application, yet in certain cases it is a principle not to be followed at all.

These cases are those in which we have evidence regarding both the date of a discovery and the date of its being made known.

For instance, the date of the *discovery* of the circulation of the blood by William Harvey is certainly earlier than 1628, the date of its publication.

We have the evidence of Harvey's own lecture notes, dated 1616, that he knew of the circulation and was teaching it at least twelve years before he published it. Only when we cannot find the true date of a discovery should we fall back on the date of its publication.

Now the discovery of the existence of the invisible capillaries was a very great thing, and it seems a pity that we should get into the habit of assigning it to one year later than it actually was made.

Sir Michael Foster's account in his "Lectures on the History of Physiology" is clearness itself. Speaking of Malpighi, we read :—"Here" (Bologna) "he resumed office as a Professor of Medicine, and in spite of domestic troubles and anxieties, pursued his researches to such good effect that he was able in the next year, 1660, to announce privately to Borelli his discovery of the structure of the lung, an account of which was published in the year following."

The published account alluded to is his "De pulmonibus observationes anatomicæ," which, after the manner of the time, is in the form of two letters to his friend G. A. Borelli, at Pisa.

In the second epistle he describes the circulation in the herniated lung of the living frog. He heads the description with these words, "Magnum certum opus oculis video"—"I see with my eyes a great, certain thing," not, as always translated, "a certain great thing," which is much feebler and not a true translation.

1660, then, and *not* 1661, was the date of the discovery of the blood-capillaries, within only three years of the death of Harvey in 1657. Harvey made their existence a logical necessity; Malpighi made it a histological certainty. As we still speak of the "rete mirabile Malpighii"—for no lapse of time can ever make that rete less wonderful—we might as well take the trouble to assign the discovery of it to its correct date, 1660. D. FRASER HARRIS.

The University, Birmingham, June 19.

The Osmotic Pressure of Colloidal Salts.

CONGO red and similar salts in aqueous solution cannot diffuse through an ordinary dialysing membrane. When the osmotic pressure is directly measured by an osmometer it is found to be about that which the kinetic theory would ascribe to the salt present if the molecules were completely un-ionised.

The solutions, on the other hand, are good conductors of electricity, and the specific molecular conductivity of the solutions employed is that of a solute 60 to 70 per cent. of the molecules of which are dissociated. There is thus, as Bayliss has pointed out,[1] an apparent conflict between the results obtained by different experimental methods.

Congo red is the sodium salt of a complex organic acid. Its ions, therefore, are of very unequal size, and as the membranes employed in the osmometer are permeable to

[1] Paper read at the meeting of the Biochemical Society, May 4.

ordinary salts, they may be assumed to be permeable to the sodium ion, while holding back the much larger organic ion. On the other hand, it is found in actual experiments that the sodium ion does not escape from the osmometer.

Many collateral results show that the membrane does not *mechanically* directly constrain the sodium ion from diffusing. Thus a membrane, even when deeply impregnated with congo red, will permit the passage of sodium sulphate. Biltz and von Vegesack,[1] in order to explain the results, assume that the sodium ion of congo red, because it can diffuse through the membrane (and in spite of the fact that it actually does not do so), therefore contributes nothing to the osmotic pressure. I find myself quite unable to accept this view.

Osmotic pressure is a measure of the total constraint imposed on the system solution and pure solvent by a membrane. To the organic ions, owing probably to their size, the membrane offers what may be called a mechanical constraint. The sodium ions, on which the membrane exerts no such direct mechanical constraint, do not escape, because they are held back by the electrostatic attraction of the negatively charged organic ions. When equilibrium is reached, the electrostatic pull inwards must balance the osmotic pressure, which tends to drive the sodium ions outwards. The total pressure borne by the membrane, therefore, is the sum of the osmotic pressure of undissociated molecules, of the organic ions, and of the sodium ions held back by their attraction to the organic ions.

On this view, the osmotic forces would produce at the membrane an average orientation of plus and minus ions, which should appear as a contact potential difference between the solution and the solvent. The magnitude of the electromotive force can be calculated in several ways, of which the simplest is as follows.

If E be the potential difference of the quasi-condenser formed by the ions, P the osmotic pressure, and c the concentration of the dissociated salt in gr. equivalents per c.cm., then the osmotic force acting outwards on one gr. equivalent of ions is $\frac{1}{c}\frac{dP}{dx}$, and the electrostatic pull inwards is $\frac{dE}{dx}q$, where q is the charge on one gr. equivalent. Since these balance one another, we have

$$\frac{dE}{dx} = \frac{1}{cq}\frac{dP}{dx},$$

putting $c = P/RT$ we have

$$\frac{dE}{dx} = \frac{RT}{qP}\frac{dP}{dx},$$

which on integration gives

$$E = \frac{RT}{q}\log\frac{P_2}{P_1}.$$

This expression differs from Nernst's well-known equation only in the absence of the terms representing the rate of diffusion of the ions.

From what is known of colloidal solutions, it is possible that, except at a high dilution, some of the positive electricity might be carried by complexes too large to penetrate the membrane. These would contribute either nothing at all, or something less than the amount given by an equal number of sodium ions, to the potential difference. Their presence, therefore, would cause the calculated values to exceed the observed values. W. B. HARDY.

[1] *Zeits. f. physik. Ch.*, 73, 481, 1910.

The Fox and the Fleas.

IN reference to the letters of Prof. Hughes in NATURE of March 23 and April 13, and his query as to whether the device adopted by foxes for divesting themselves of fleas is "instinctive," may I be permitted to give some particulars of a similar practice which has been observed in this country?

Foxes were introduced into Victoria from England in the early days of the colony, and are now plentiful even in the neighbourhood of Melbourne. Mr. P. R. H. St. John, of the Botanic Gardens, tells me that, whilst botanising or shooting in the neighbourhood of Point Cook during the 'eighties, he has on at least a score of occasions seen foxes enter the water with apparently the same object as the fox observed by Mr. Day.

Point Cook is situated on the west shore of Port Phillip Bay, and is about twenty miles from Melbourne. The surrounding country, being marshy, covered with saltbush, and of little agricultural value, was practically uninhabited, and a favourite hunting-ground for naturalists.

The procedure adopted by the fox was to retreat slowly into the shallow water (the beach being very level at that spot) until only the head was visible, and then it would disappear completely and rise to the surface about a yard away, and, leaving the water with a bound, the fox would rapidly reach the shore, shake itself like a dog, and make off into the bush. The time occupied by the whole operation, which was only attempted when the water was quite calm, would be about three or four minutes.

Mr. St. John, though never closer than about fifty yards, did not think that the foxes he observed held any wool or fur in their mouth (there were no sheep grazing in the locality), but he and his father, and various friends who accompanied him, had come to the conclusion that the object must have been to rid themselves of the fleas which were always to be found on those specimens which they shot.

It will be noticed that this manœuvre differs materially from that of the English foxes in that no wool or fur was used. This would suggest less call on the reasoning power of the fox, but on the other hand the deficiency was made up for by a final complete submersion and (there being no current) a side movement and a rapid escape from the water to dodge the dislodged and probably floating fleas.

The proverbial cunning of the race is surely to be seen in this adaptation of method to the conditions to be found on an uninhabited coast. HEBER GREEN.

Agricultural Chemistry Laboratory, The University of Melbourne, May 23.

Chemistry at the Forthcoming Meeting of the British Association.

MAY I direct attention to the following features in the provisional programme of Section B (Chemistry) at the British Association meeting in Portsmouth, beginning on August 30 under the presidency of Sir William Ramsay?

(*a*) Joint discussion with the section of agriculture on the part played by enzymes in the economy of plants and animals.

(*b*) Discussion on colloids (opened by Prof. Freundlich, Leipzig, with a contribution on the theory of colloids).

(*c*) Discussion on indicators and colour.

Many foreign chemists intend to be present—amongst others, Profs. Ostwald and Freundlich (Germany), Wegscheider (Austria), Gautier, Haller (France), Clarke, Barus (America), Righi (Italy), Pettersen, Euler (Sweden), Birkeland (Norway), Zeeman, Cohen (Holland)—and it is to be hoped that there will be a numerous attendance of British chemists to do honour to these and other distinguished guests. JAMES WALKER.

(*President, Section B.*)

Edinburgh, June 24.

Breath Figures.

LORD RAYLEIGH'S communication on breath figures (NATURE, May 25, p. 416) puts me in mind of an experiment—if I may call it so—we made when we were children. After breathing on a window-pane we wrote our names on the glass with the point of a finger. Now after having waited until the moist deposit had disappeared, and again breathing on the glass, the written characters became quite legible.

This seems quite to agree with Lord Rayleigh's explanation, grease on the fingers causing the phenomenon.

Delft, June 6. J. W. GILTAY.

THE SCOTTISH SURVEY MEMOIRS.[1]

THESE three memoirs mark an important change in the publications of the Scottish Geological Survey. The maps are now colour printed instead of being hand-coloured. This is an improvement for which all Scotch geologists will be profoundly grateful. The cost of the hand-coloured maps at their present outrageous prices is prohibitive to most private students. The solid and drift editions of the Blair Atholl sheet, for example, cost 2*l.* 7*s.* 6*d.*, and these precious maps may be ruined by a single day's use in the field in wet weather. Moreover, however carefully these hand-coloured maps may be revised they are always liable to suspicion, and occasional errors and omissions are inevitable. The colour-printed maps are in every respect a great improvement. They are cheap, the colours are clear and fixed, and the geologist is no longer perplexed by patches which are uncoloured or of which the colour is doubtful.

A useful innovation on two of the new maps is a series of vertical and transverse geological sections, which add greatly to their usefulness. One disadvantage of the Scottish maps compared with the new English series is their unwieldy size; they measure about two feet by two feet five inches, which is inconveniently large. This, however, is a detail which any purchaser of a map can remedy for himself, and will not detract from the congratulations of Scotch geologists to the officials of the Survey on having secured the boon of colour printing.

The three memoirs deal with two very different branches of Scottish geology. Sheet No. 71 comprises the districts around the Sleat of Skye. To the west it includes the eastern part of the Cainozoic volcanic series of Skye, with the gabbros of Blaven and the granophyre of Lord Macdonald's Forest; the eastern part of the sheet is occupied by the Archæan rocks, while a strip of Torridon sandstone with the southern end of the great thrust-planes of north-western Scotland traverse the middle of the map. The memoir on this district has been awaited with much interest, for many of the problems with which it deals are of wide importance. The area includes the well-known Archæan limestones to the east of Glenelg; it shows exceptionally well the relations between the Moine and Lewisian gneisses, and north of Glenelg Bay there is an interesting contact between the Torridon sandstone and the Moine gneiss.

The memoir marks one very important advance in the history of the Scottish Archæan geology. It has

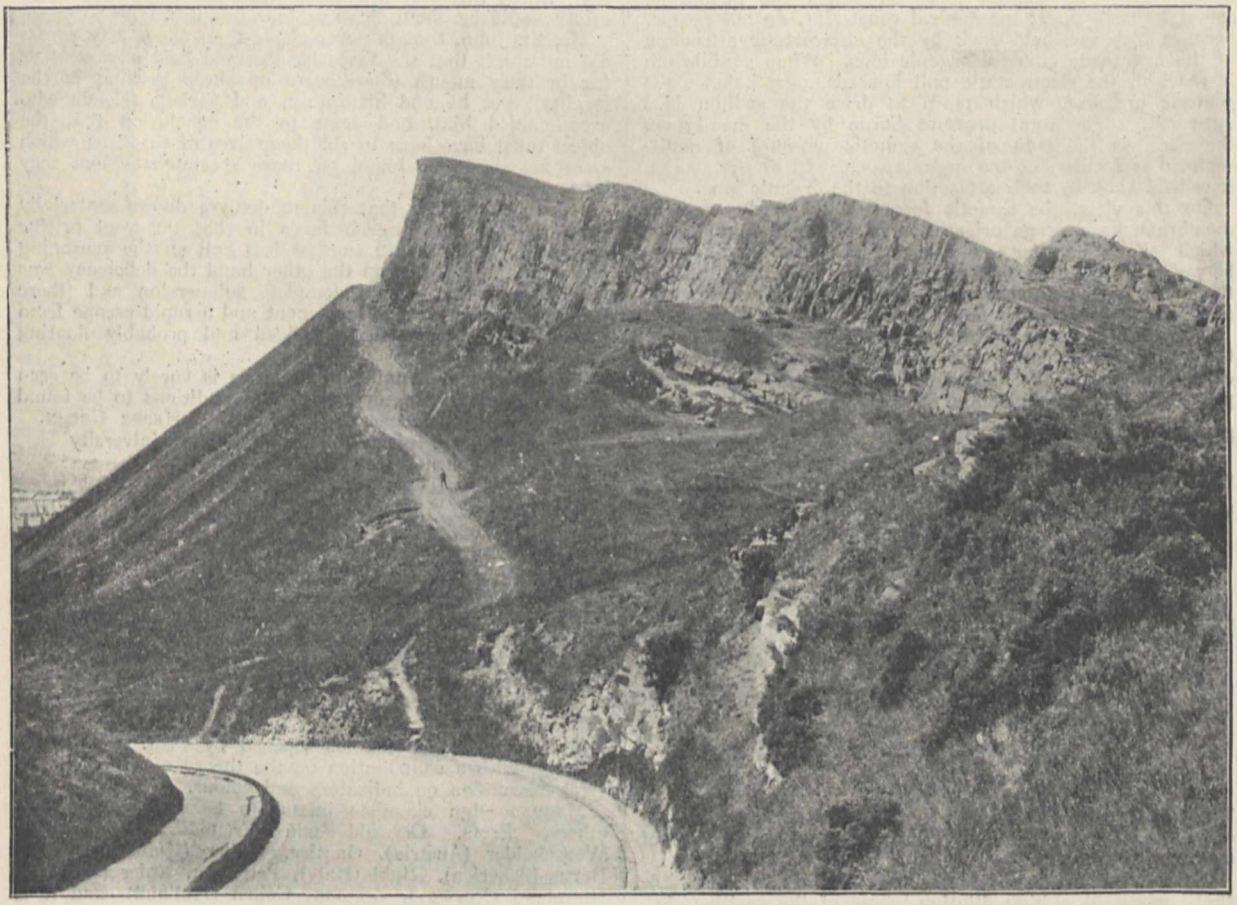

FIG. 1.—Intrusive Sheet of Teschenite, with Upper Old Red Sandstone in the Foreground, Salisbury Craigs, Arthur's Seat, Edinburgh. From "The Geology of the Neighbourhood of Edinburgh."

[1] The Geology of Glenelg, Lochalsh and South-East part of Skye. (Explanation of one-inch map 71.) By Dr. B. N. Peach, F.R.S., and others. With contributions by G. Barrow and others. Pp. x+206 and map. Price 3*s.* 6*d.* Memoirs of the Geological Survey, Scotland.

The Geology of the Neighbourhood of Edinburgh. (Sheet 32, with part of 31.) By Dr. B. N. Peach, F.R.S., and others. Contributions by Dr. J. Horne, F.R.S. and others, and Petrological Chapters by Dr. J. S. Flett. Second edition. Pp. xii+445+xii plates and map. Price 7*s.* 6*d.*

The Geology of East Lothian, including parts of the Counties of Edinburgh and Berwick. (Explanation of sheet 33, with parts of 34 and 41.) Second edition. Revised and re-written by C. T. Clough and others. With contributions on the Silurian Tableland by Dr. B. N. Peach, F.R.S., and Dr. J. Horne, F.R.S. Pp. x+266+xii plates and map. Price 4*s.* 6*d.* (Edinburgh: W. and A. K. Johnston, Ltd.; London: H.M. Stationery Office, Edward Stanford, and T. Fisher Unwin; Dublin: Hodges, Figgis and Co., 1910.)

been a widespread belief that the Moine gneiss is the metamorphosed eastern representative of the Torridon sandstone, a view supported by the high authority of Dr. Peach. The memoir does not accept that view, and leaves the decision somewhat uncertain. The Moine series is described on the map as of uncertain age, but it is placed below the Torridonian, from which it is separated by a series of igneous rocks, and it is placed just above the Lewisian. The guarded statements in the text and the association of the Moines in the explanation of the map with the Lewisians rather than the Torridonians, both suggest that the final conclusion of the Survey inclines strongly to the view that the Moines are pre-Torridonian. The relations between the Moine and the Lewisian gneisses is another problem on which there is a strong difference of opinion, and the neighbourhood of Glenelg yields important evidence on this question. The subject is carefully discussed in the text, and the conclusion is adopted that the Moines are a younger series, resting unconformably on the Lewisian, the junction being marked in places by a basal conglomerate.

The problems dealt with in this memoir are of unusual variety, for the area includes a wide band of the Torridonian, the Cambrian limestones with their interesting metamorphic structures south of Broadford in Skye, a varied series of Mesozoic rocks, ranging from the Trias to the Upper Cretaceous, and the eastern part of the famous Cainozoic volcanic series of central Skye.

The two other memoirs are both new editions, and describe better known and more accessible areas. The memoir on sheet 32 is issued as a new edition of "The Geology of Edinburgh." This edition is necessarily enlarged, and is now a work of 450 pages with twelve excellent plates, a coloured map of Arthur's Seat, and other illustrations. The new edition contains many important alterations, for its predecessor was issued fifty years ago. The subject of most general interest in this sheet is the ancient volcano of Arthur's Seat. The work of the Survey has confirmed many of the conclusions of Sir A. Geikie, especially his explanation of the basic lavas of Calton Hill as a part of the volcanic platform of Arthur's Seat, which has been faulted westward. Prof. Bonney's separation of the sill of Salisbury Crags, now identified as teschenite, from the other igneous rocks is accepted, and Prof. Judd's theory that the volcanic rocks of Arthur's Seat all belong to one series of eruptions is fully established. The sedimentary rocks have also undergone great changes; the Craigmillar sandstones that underlie the volcanic rocks, are transferred to the Old Red Sandstone, a view first suggested by Goodchild, who held that their lithological characters were inconsistent with the climatic conditions that prevailed in the area during Carboniferous times. This argument has now been established by Dr. Traquair's identification of some fossil fish remains which were first found by Dr. Peach.

The geology of the country to the west of Edinburgh has undergone even greater changes. When that part of the sheet was mapped in 1859 there was no oil shale mining in the district; the discovery of the West Lothian oil shales and the development of the mineral oil industry has all happened since the first edition was issued. There is also much fresh

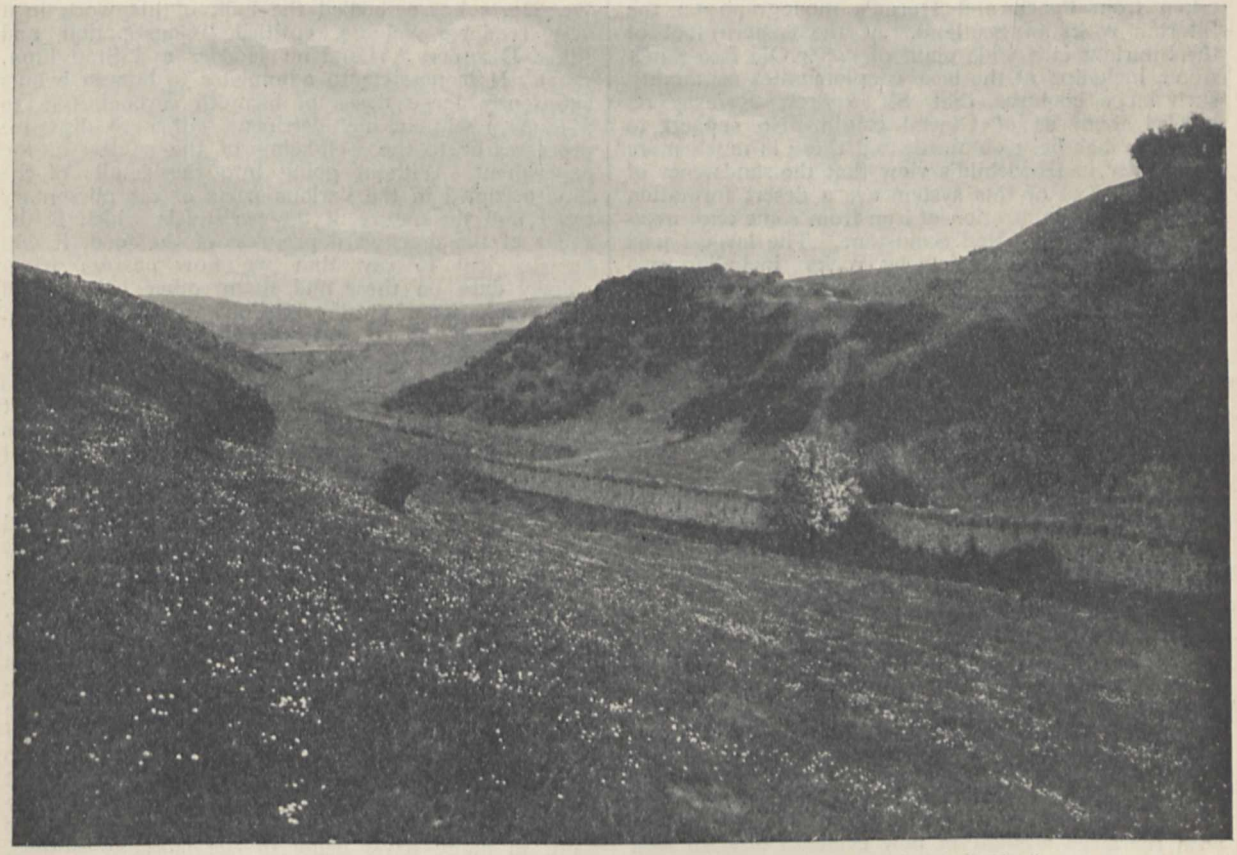

FIG. 2.—Typical Dry Valley joining Spott Burn, above Spott. From "The Geology of East Lothian."

evidence as to the coal supply of the area, and the memoir quotes the estimate of Dr. Dixon and Mr. John Gemmell that, at the present rate of consumption, there is sufficient coal in seams of one foot or more in thickness to last for another two thousand years.

The Edinburgh area is rich in fossils, and the interesting palæontological sketch and the tables by Dr. Lee are among the most useful contributions in the volume. There is a detailed bibliography by Mr. Tait. One remarkable omission from the literature of the areas is the absence of reference in any of the Survey memoirs to Bertrand's papers on the structure of the Scottish oil shale.

The third memoir deals with the geology of East Lothian, the district to the east of Edinburgh. Its geology includes part of the Silurian tableland of the Southern Uplands, of which the account is mainly taken from Peach and Horne's monograph on the Silurian rocks of Scotland. At the eastern foot of the Silurians is a wide plain of upper Old Red Sandstone, including at the base conglomerates containing such large boulders that Sir Andrew Ramsay regarded them as of Glacial origin. No support to this view has been obtained, and there is much more probability in Goodchild's view that the sandstones of the upper part of this system are a desert formation stained by the infiltration of iron from some once overlying beds of New Red Sandstone. The largest part of this sheet is occupied by rocks including two varied igneous series; the first consists of the lavas of the Calciferous sandstone series, and their associated necks, including trachytes, banakites, and mugearites, and the rare hornblende trachy-dolerites —to use that misleading term—known as kulaites. Bass rock is a neck belonging to this division, and the exposure of some fresher samples from it enables its rock to be identified as a phonolite-trachyte. The second igneous series includes the quartz-diabase, teschenite, and essexite, intrusive into the Carboniferous limestone series. The lowlands contain a varied series of Glacial deposits and some dry valleys described by Prof. Kendall and Mr. Bailey, cut during the recession of the ice (see Fig. 2).

Mr. Bailey contributes an interesting summary of the history of the scenery, and shows there is good reason to believe that the Midland Valley of Scotland originated as a true rift-valley, and that the scenery, though greatly modified during Glacial times, is mainly due to pre-Glacial denudation.

The areas described in these publications are of especial importance in Scottish geology owing to their varied problems, and the Geological Survey is to be congratulated on these valuable maps and memoirs, with the large amount of new evidence now so well placed at the public disposal. J. W. G.

PHYSIOLOGICAL APPLICATIONS OF RADIOGRAPHY.

IT is a matter of common knowledge that the introduction of X-ray examinations of patients was a boon and a blessing both to patients and surgeons. The localisation of foreign metallic objects, such as bullets and needles, and the exploration of fractured bones and disorganised or dislocated joints, have been thus rendered both easy and certain.

It may not, however, be so generally known that it is also possible to render visible the movements of certain internal organs, which are sufficiently opaque to cast their shadow on the photographic plate or the fluorescent screen; it need scarcely be pointed out that in this way much more accurate information can be obtained of the movements of the heart and diaphragm than what was previously inferred from the examination of the cadaver, or the inspection of the exposed parts in anæsthetised animals.

Notable among the recent achievements in this direction are researches which have for their object the investigation of the digestive canal. Cannon's work in the Harvard laboratory a few years ago showed that in animals the journey of a meal mixed with bismuth salts can be followed with a nicety never before experienced. Valuable as this pioneer work was, it is comparatively unimportant from the human and practical point of view, when compared with the investigations which, by similar means, are possible in man. Here Dr. Hertz and his colleagues at Guy's Hospital have done yeoman service; and Dr. Hertz has embodied the bulk of his work in a very readable volume, entitled "Constipation and Allied Disorders" (London: Hodder and Stoughton, 1909). It is possible to administer to human beings sufficiently large doses of bismuth carbonate (2 to 6 ounces) without any detriment either to digestive processes or to the well-being of the subject of the experiment. Without going into the details of the time occupied in the various parts of the alimentary tract, and the nature of the peristalsis which is the cause of the downward progress of the food, it will be sufficient to say that we now possess trustworthy data on these and many other points, and the events from swallowing onward to defæcation have been examined and registered.

We have been led into these references by a reprint now before us by Dr. A. C. Jordan, who holds the office of Medical Radiographer to Guy's Hospital. It is entitled "Radiographic Demonstration of Lane's Ileal Kink," and this, to the non-medical reader, will not convey much. When man adopted the upright posture, the advantages he gained were, to a certain extent, counterbalanced by some disadvantages and a liability to certain troubles. One of these is that the abdominal viscera either drop, or tend to drop. The stomach, for example, has its greater curvature in the pelvis when a man stands upright, and the transverse colon (a part of the large intestine) hangs in a great loop, the middle of which accompanies the stomach into the pelvis. Mr. Arbuthnot Lane has shown that Nature attempts to diminish these changes of position of the viscera by the formation of adhesions, which form supplementary mesenteries to hold them up. But this attempt at a remedy is not entirely adequate, and kinks in the bowel may be produced, which lead to obstruction, giving rise to pain, to many days' delay in the passage of food, and severe constitutional changes, due to the absorption of toxic materials from the intestine. A part of the intestine called the ileum is particularly apt to be kinked in this way, and its surgical treatment will relieve the patient of all symptoms. A bismuth meal and subsequent radiographic examination will reveal the situation of the kink, and so the surgeon knows exactly where to cut down, and the patient has only to suffer from a comparatively small abdominal wound.

We may take such work as an admirable example of the practical and beneficent application of the X-ray method to structures which are neither bones nor foreign objects such as bullets. The members of the Guy's Hospital staff responsible for these results are to be heartily congratulated on the outcome of their researches, and the public at large owe them a deep debt of gratitude in addition.

SIR RUBERT BOYCE, F.R.S.

THE news of the premature death of Sir Rubert Boyce, at the age of forty-eight, will come as a shock to many, not only at home, but throughout the tropical world. A bare record of his scientific work would give but little idea of what his achievements really were. His rare abilities were of a practical nature, and took shape eventually in the initiation and organisation of manifold activities. He was educated in London, Heidelberg, and Paris, and after taking his medical degree in 1889 he devoted himself to research work, mainly on the pathology of the nervous system, under Sir Victor Horsley, at University College, and in 1893 was appointed professor of pathology at the then University College, Liverpool. Soon afterwards he was asked to take up the position of bacteriologist to the city of Liverpool, which he held until his death.

In 1902 Sir Rubert Boyce was elected a Fellow of the Royal Society. He was a member of the Royal Commission on Sewage Disposal, and for a period of five years he supervised the researches conducted for the Commission at Liverpool. In 1904 he was appointed a member of the Royal Commission on Tuberculosis, and on the day of his death he was to have signed the final report of the Commission.

During these years his powers of organisation were being put into practice, and to mention one project only, his part in the transformation of University College into the University of Liverpool is a well-known fact. While this and many other achievements—for in each he took a most active part—represent an amount of work and energy that can only be appreciated by those who know the manifold difficulties and the dead weight of opposition that has to be removed before such objects can be successfully carried through, yet they were still to be followed by even greater things.

Sir Rubert Boyce had established a close relationship, often indeed a warm friendship, with those other great organisers who mould the destiny of the great commercial world of Liverpool. He was never tired of telling the commercial community that science was not merely an academic pursuit, but was intimately connected with the carrying on of their business. Whilst he preached that science was not merely an academic pursuit, his practice was a proof of it. One of the most remarkable and devoted of his friendships was with one of the most striking of the great personalities of Liverpool—the late Sir Alfred Jones. Sir Alfred himself was a man of great practical organising genius, and the great organising powers of Sir Rubert Royce now found their full scope in association with this untiring orginator of ideas. It was in 1898 that he, together with Sir Alfred Jones, founded the Liverpool School of Tropical Medicine, which rapidly became known throughout the whole world, both scientific and non-scientific, for its work. Now also at his initiative commenced that remarkable series of expeditions which, apart from their scientific side, fired the imagination of all residents in the tropics.

Tropical medicine was forced on the ear of the public, and their help and that of the governors in the tropical dependencies was enlisted, in securing that the conditions in the tropics should be improved. The improvement in the last ten years has been great, but the work has really only begun. Sir Ronald Ross had at this time been conducting his anti-malarial campaign, but there was more to be done, and Sir Rubert, not content with having founded a great school, himself actually went into the field to see matters at first hand.

In 1905 an outbreak of yellow fever occurred at New Orleans. He quickly availed himself of the opportunity, offered by the American authorities, to take part in the campaign. He then laid the foundation of that experience which was to bear fruit later. At the same time, at the request of the British Government, he visited British Honduras, where also yellow fever had broken out. In 1906 the first symptoms of the illness that eventually proved fatal occurred. In 1909 again, at the request of the Government, he visited the West Indian Islands to investigate yellow fever, and in 1910 he made his last expedition to West Africa, where an epidemic of yellow fever had occurred.

Not content simply with official reports of these expeditions, he determined to impress the importance of these subjects, of which yellow fever was only one, on the public. The result was in two short years three popular works, "Mosquito or Man," "Health Progress and Administration in the West Indies," and "Yellow Fever and its Prevention," stating in clear and forcible language the bearing of scientific results on the health and prosperity of the community. The success of these works was immediate, and the name of Sir Rubert Boyce became a household work to every European in the tropics. But even this was not enough; he must do something to remedy the state of affairs revealed, and the formation of the Bureau of Yellow Fever at Liverpool marks the last of his many practical works. It is as a great scientific organiser that Sir Rubert Boyce will take his place, and when the history of tropical medicine comes to be written, his will be a foremost and revered name.

In tropical medicine it may well be said that he found the passion of his life. The founding of the school may be regarded as the culminating effort of his practical genius, but his actual experience of tropical medicine in the field, in his visits to the tropics, so impressed his imagination that it is impossible to think he ever would have forsaken it; and, very shortly before his death, which he knew might take him at any moment, he declared that his one desire in life was to do some work to alleviate the condition of those who lived in the tropics. His methods came as a sharp electrical shock to those accustomed to more sedate ways. Financial difficulties seemed to present to him no obstacle, once he had seen that the end was desirable; his unrivalled success in collecting funds from the most unpromising quarters was well known, and he will be sorely missed not least by those who suffered gladly in this way at his hands.

His care and thought for those who worked with him were often unsuspected, but those who did their work thoroughly found that they were not forgotten in the race, and there are many in various parts of the world who can testify to his generous help.

His many activities often aroused keen antagonisms, and to many perhaps his personal qualities were quite unknown. But those who knew him in his private life, who had enjoyed his hospitality, or had further had the privilege of his friendship, found in him a warm, generous, and noble spirit.

J. W. W. S.

SCIENCE AND CORONATION HONOURS.

OWING to the necessity of going to press earlier than usual last week no reference was made to the list of Coronation honours. There is, however, little to record; for though the list is very long, the services which men of science render to the State are but scantily represented in it. From a national point of view this disregard of scientific work must be considered as unenlightened policy. A title does not

usually add much to the distinction of the man of science upon whom it is conferred, but it indicates that the State regards his work as worthy of public honour and encouragement. No greater services can be rendered to the nation than those represented by contributions to natural knowledge, but judging from the list of honours they are least esteemed. The reason is probably that men of science of distinguished eminence are as unknown in the political world as most of the names in the list are unknown outside particular circles. It is apparently necessary to apply science to some art or profession before the State can understand its value. Many members of the medical profession are rightly included in the honours list, and we offer all of them our congratulations. Education also receives some recognition. We notice in the list the names of the following Fellows of the Royal Society :—

Dr. W. Osler, Regius professor of medicine in the University of Oxford, has been made a baronet; Dr. A. J. Evans, honorary keeper of the Ashmolean Museum, has been knighted; the Hon. C. A. Parsons, C.B., has been promoted to K.C.B., and the same title has been conferred upon Major Ronald Ross, professor of tropical medicine in the University of Liverpool, Vice-Admiral A. M. Field, lately hydrographer of the Navy, and Prof. J. A. Ewing, director of naval education. Mr. R. E. Froude, superintendent of the Admiralty Experimental Works; and Prof. A. W. Reinold, late professor of physics in the Royal Naval College, Greenwich, and Colonel H. C. L. Holden, superintendent, Royal Gun and Carriage Factories, Woolwich Arsenal, have been created C.B.'s. Dr. J. Rose Bradford, secretary of the Royal Society, has been appointed a K.C.M.G.

Omitting representatives of medicine in its various branches, other names familiar to many of our readers are :—

Sir John Rhys (Privy Councillor); Sir Boverton Redwood (Baronetcy); Dr. A. W. W. Dale, Vice-Chancellor of the University of Liverpool, Mr. G. H. Ryan, president of the Institute of Actuaries, Dr. J. E. Sandys, Public Orator in the University of Cambridge, and Prof. R. P. Wright, lately professor of agriculture and principal of the West of Scotland Agricultural College (Knighthoods); Prof. M. E. Sadler, professor of education, University of Manchester (C.B.); Dr. R. A. Falconer, president of the University of Toronto, Mr. H. N. Ridley, Director of Gardens and Forests, Straits Settlements, and Dr. T. Zammit, Government analyst, Public Health Department, Malta (C.M.G.'s).

NOTES.

IT is now an open secret that the intentions of Parliament for the investigation and cultivation of the local fisheries are being greatly delayed by the apparent reluctance of the Board of Agriculture and Fisheries to cooperate with the Development Fund Commissioners. Questions asked in the House of Commons during the last few months have elicited replies which show that a carefully drafted application, made more than a year ago, by the Lancashire and Western Counties Fisheries Committee, containing definite proposals for the improvement of the local fisheries, has not yet been submitted to the commissioners. On June 20 Sir E. Strachey, replying to Mr. N. Buxton and Mr. Whitehouse, assured the House of Commons that the Board is not neglecting the fisheries. It has applied to the Development Fund Commissioners for a loan of 50,000*l*., and an annual grant of 8000*l*. for the purpose of coast patrol vessels. It is also asking for a sum of money to enable a special commission to investigate the condition of the inshore fisheries. The secretary to the Board should also have stated that, during the last nine years, two Departmental Committees have made exhaustive reports with regard to the inshore fisheries, and that the Board has now full control of the staff, funds, and resources for fishery investigation enjoyed by the Marine Biological Association until about a year ago. Further, it was not made clear that the subjects mentioned by Mr. Buxton—the investigation of the shell-fisheries and the pollution of tidal waters, the scientific investigation of the territorial water fisheries, and the organisation of the research societies—have all been considered by the fishery committees wherever these things are important enough to require consideration. The urgent need of the present time is that the Development Commissioners should assist the local committees in the prosecution of investigation and cultivation of the inshore fisheries.

THE annual report of the Society for the Astronomical Study of Ancient Stone Monuments, Cornwall Branch, shows increasing membership and funds. The report consists mainly of a paper read by Mr. Henry Thomas, one of the secretaries, reviewing observations made at Boscawen-un, Tregaseal, Wendron, and Boskednan circles. In each case the typical circle "does not constitute or comprise in itself a system, but that it is rather the centre of a system, and that the number of stone monuments and barrows which stand at various distances and in various directions, but all within sight of the circle, were not erected and constructed in those positions by mere accident" is "one thing about which there can be no division in our opinions." The circles are never exactly alike, and it seems that not one of those examined is a true circle. It is confessed that no rule has been found to explain the varying distances between the stones in a circle. The apparent irregularity suggests the direction in which a rule might be found, namely, testing the astronomical use of each stone from all available view-points. The next meeting of the society is announced to be held at Rosemoddress Circle, St. Buryan, on June 30.

THE late Prof. His, of Leipzig, conceived the idea of establishing in each country a central institute which should have for its chief aim the organisation and the coordination of biological research in its own territory, and serve as a means of cooperation with similar institutions in other countries. In other words, his far-reaching scheme implied the establishment of a regular organised army to attack the problems of living matter, which are being assailed at present only by the wasteful methods of guerilla warfare. During the last decade this proposal has been put to a practical test in the United States and Europe (excepting Great Britain) by the establishment, or the recognition, of certain institutions as centres for coordinating researches upon the brain, under the direction of the "Brain Commission" of the International Association of Academies. The success already attained in this domain of biology has encouraged others to follow in the footsteps of the neurologists. During Whit-week a conference was held in the zoological laboratory of the University of Utrecht for the purpose of founding an International Embryological Institute. Austria, Belgium, England, France, Germany, and Holland were represented at the meeting by workers in the domain of vertebrate embryology; and letters were received from Switzerland and the United States in support of the scheme adumbrated by the conveners of the meeting. Prof. R. Bonnet, of Bonn, was elected first president of the institute, and it was decided that the first aims of the new institution should be (1) the collection of complete series of well-preserved embryos of every mammalian order, and (2) a more intimate cooperation between embryologists, for the purpose of attaining a uniformity in nomenclature and the solution of the special difficulties in this field of investigation.

THE German Emperor has conferred the Order of the Crown, Second Class, upon Sir Ernest Shackleton.

DR. SVEN HEDIN has been elected a correspondant of the Paris Academy of Sciences in the section of geography and navigation.

THE death is announced, in his fifty-fifth year, of Dr. E. B. Voorhees, the director since 1896 of the New Jersey Agricultural College experiment station, and the president, since 1901, of the New Jersey State Board of Agriculture. He had written and lectured extensively on agricultural chemistry and allied subjects.

AT the meeting of the Association Internationale de l'Institut Marey held on June 6th, the resignation of Prof. Kronecker as president was received. The members of the association elected Prof. Charles Richet as president, and Dr. Augustus D. Waller as vice-president. The Institut Marey is under the patronage of the Associated Academies. It is situated in the Parc des Princes, Boulogne-sur-Seine, Paris, and contains laboratories, library, and living rooms for the accommodation of workers. The acting director is Dr. Lucien Bull.

THE Royal Institute of British Architects has awarded the King's gold medal for the promotion of architecture to Dr. W. Dörpfeld, director of the German Archæological Institute, Athens. Owing to Dr. Dörpfeld's serious illness, he was unable to receive the medal in person at the meeting of the institute on June 26, and he has had to abandon his projected visit to this country, in the course of which he was to receive an honorary degree at Cambridge, and speak at a special meeting of the Hellenic Society on July 4.

THE President of the Local Government Board has authorised the following special researches to be paid for out of the annual grant voted by Parliament in aid of scientific investigations concerning the causes and processes of disease:—(1) A research into the causes of premature arterial degeneration in man, by Dr. F. W. Andrewes; (2) an inquiry by Dr. J. H. Thursfield into the causes of death in measles; (3) a comparison by Prof. Nuttall, F.R.S., of the number and kind of fleas found on rats; (4) a continuation by Dr. C. J. Lewis of his investigation into the degree of prevalence and the characteristics of micro-organisms known as non-lactose fermenters in the alimentary canal of infants; (5) an investigation into the same subject by Dr. D. M. Alexander; (6) an inquiry by Dr. Graham Smith into the incidence of non-lactose fermenters in flies in normal surroundings and in surroundings associated with epidemic diarrhœa; (7) a study by Dr. F. A. Bainbridge of the anærobic bacteria in the alimentary canal of infants; (8) an investigation by Dr. Graham Smith into the possibility of pathogenic micro-organisms being taken up by the larva and subsequently distributed by the fly.

THE council of the Royal Society of Arts has decided to make the following awards in connection with the prize offered for the best portable apparatus or appliance for enabling men to undertake rescue work in mines or other places where the air is noxious:—a gold medal to Mr. H. A. Fleuss, for the apparatus submitted by Messrs. Siebe, Gorman and Co.; a gold medal to Mr. W. E. Garforth, in recognition of his efforts to perfect and to secure the adoption of rescue apparatus in mines; a silver medal for the "Draeger" apparatus submitted by Mr. Richard Jacobson; a silver medal for the "Meco" apparatus submitted by the Mining Engineering Company. Of the apparatus submitted to the committee appointed to report upon the subject, four depended on the supply of compressed oxygen, one on the provision of air evaporated from liquid air, and one on the production of oxygen from "oxylith." The principal points of difference, apart from the fundamental principles on which the apparatus are constructed, appear in the comparative lightness and convenience of carriage, and in the arrangements for enabling the wearer to breathe either by the use of a helmet or by means of mouthpieces of various construction. The committee does not consider that the liquid-air apparatus sent in is as yet sufficiently perfect to justify its adoption in preference to the older systems, under which oxygen is supplied from a receptacle containing the gas in a state of compression.

THE annual report of the committee of the Research Defence Society is a record of good work accomplished during the past year. The total number of members and associates, which was about 3360 a year ago, is now about 4600, showing an increase of 1240, as against an increase of 840 in the previous year. There are now twenty-five branches, and this number is expected to be increased in the autumn. Since June of last year more than ninety addresses or lantern-lectures connected with the society have been given in different parts of the kingdom. The following pamphlets and leaflets have also been published:—(1) report of annual general meeting, 1910; (2) Malta fever; (3) sleeping sickness; (4) experiments on dogs; (5) In Memoriam, Louis Pasteur; (6) the facts of the case; (7) experiments during 1909; (8) humanity and science, by the Bishop of Ely; (9) plague in India, by Colonel Bannerman; (10) friends of animals, by Major Marjoribanks; (11) a question of ethics, by Major Marjoribanks; (12) the case presented by the anti-vivisectionists, by Prof. Schäfer. The quantity of literature distributed has greatly increased during the year. Five hundred copies of Colonel Bannerman's pamphlet have just been supplied to the Government of Eastern Bengal and Assam. The total number of pamphlets and leaflets distributed during the year was more than 150,000. A book is in the press giving a full account of the evidence before the Royal Commission. Of course, with all this increase of work, there has been a considerable increase of expenditure, and the committee earnestly appeals to all members and associates of the society to enlist their friends, and thus to extend still further the society's useful work. The honorary secretary, to whom in great measure the success of the society is due, is Mr. Stephen Paget, 21 Ladbroke Square, W.

IN No. 5 of vol. v. of *The American Museums' Journal*, Prof. H. F. Osborn gives an account of an important extension of the American Museum of Natural History, New York, which is to be undertaken shortly. This is nothing less than the erection of a new eastern façade, similar in general character to the southern façade, but somewhat simpler in design. It will contain a second main entrance to the building. When this addition is completed, it will permit of the installation of an extensive ethnographical and also a zoological series arranged geographically. It is also contemplated to arrange a gallery illustrative of the sequence of human evolution; while eventually it is intended that astronomy, geography, and oceanography should be included in the exhibition series.

THE Museo Nacional of Buenos Ayres publishes in vol. xx. of its *Annales* two papers by M. Florentino Ameghino, one entitled "Observations au sujet des notes

du Dr. Mochi sur le paléoanthropologie Argentine," the second, "L'Age des formations sédimentaires tertiares de l'Argentine en relation avec l'antiquité de l'homme." In the first, while admitting Dr. Mochi's services to the cause of prehistoric archæology, the writer, whose paper is fully illustrated by drawings of skulls, conducts a lively criticism of Dr. Mochi's views. This is renewed in the second paper, in which he arrives at the conclusion that the presence of Archtotherium in the quaternary deposits of North America furnishes an additional proof of the immense antiquity of the Pampean and other ancient formations in Argentina, which contain the *débris* of animals of the same group.

IN the study of the native languages of the American continent, Mr. A. L. Kroeber, in a paper entitled "Phonetic Constituents of the Native Languages of California," contributed to vol. x. of the publications on American archæology and ethnology of the University of California, has opened up new ground. Hitherto some of the most valuable grammatical study of these tongues has been conducted by ethnologists untrained in phonology. Recently, however, the principles and methods of phonetic research established by European scholars have been applied to the languages of the American Indians, and in this paper the results, already promising, are discussed. This investigation will, it is hoped, not only assist in the study of those Californian dialects which have not been as yet examined, but will help to solve the fundamental problem, whether the linguistic families of America possess any underlying or general features peculiar to themselves as a class.

THE Somerset Archæological and Natural History Society has resumed work on the Meare Lake village, under the control of Messrs. A. Bulleid and H. St. George Gray. Besides various late-Celtic relics similar to those already discovered, Mound 7 has produced a class of objects hitherto not found elsewhere, including a number of worked and polished shoulder-bones of animals, the blade-bones being in some cases ornamented in the dot-and-circle pattern. Kimmeridge shale is rather plentiful for a substance imported from Dorset. Little bronze has so far been found, the objects including finger-rings, an awl, and a rivet. Some much-corroded iron objects, such as a knife and chisel, have been unearthed. Human remains are scarce, only two pieces of skull-bone having been found. Pottery is plentiful, and of a type differing in design from that found at the Glastonbury Lake village. As is evident from the number of bones of various kinds, the people occupying this site lived largely on meat. They possessed an ox and horse of a small type, a large variety of dog, and remains of the beaver and otter have been discovered. The relics which have been up to this time found are open to inspection at a temporary museum on the site, whence later on they will be removed to the County Museum at Taunton Castle.

The Edinburgh Medical Journal for June (vi., No. 6) is a centenary number dedicated to the memory of Sir James Y. Simpson, "to whose genius and benevolence the world owes the blessings derived from the use of chloroform for the relief of suffering." It includes a number of portraits and other illustrations, and articles on his life and work by his daughter, Miss Eve Simpson, Sir Alexander Simpson, Sir Halliday Croom, Dr. Berry Hart, and others. Not only did he introduce chloroform, but in addition the uterine sound, mechanical dilatation of the cervix uteri, and various obstetric and gynæcological operations. He was a great and lovable man, and also engaged in the pursuit of many archæological problems.

LIVINGSTONE COLLEGE, Leyton, E., was founded in order to give elementary medical training to missionary workers, and judging by the matter contained in the Coronation number of its year-book, just issued, appears to be admirably fulfilling its functions. Among the achievements of old students may be noted the action of the Rev. E. W. T. Greenshield, who rescued the entire shipwrecked crew of a Dutch whaler in which he was sailing, and for this he has been decorated by the Queen of Holland; whilst in Assam an old student, a missionary of the Baptist Missionary Society, has discovered a new mosquito, henceforth to be known as the *Culex pettigrewii*.

HIDES and skins coming from some parts of the world, *e.g.* Siberia, China, Persia, and Asia Minor, are liable to be infected with anthrax, and those handling them are liable to infection. Many methods have been suggested for treating the skins so as to destroy the anthrax spores without damaging the material, but none is satisfactory. In a valuable report to the Leathersellers' Company, Dr. Constant Ponder discusses the incidence of anthrax amongst those engaged in the hide, skin, and leather industries, and has investigated various processes proposed for the sterilisation of anthrax spores. Among these, a process recently introduced by Mr. Seymour-Jones has been tested. It consists in soaking the skins for twenty-four hours in a solution containing 1 per cent. of formic acid and 1 in 5000 of mercuric chloride, after which the skins are treated with a strong brine solution. The method has no deleterious action, the skins can be perfectly tanned afterwards, and it is generally efficient in destroying anthrax spores. Probably a slightly increased amount of mercuric chloride would be an advantage.

AFTER a long period of quiescence, plague has once more appeared among the rats in the Port of London. As mentioned in a note in NATURE of June 22 (p. 562), plague-infected rats have been found for three years in succession in the port, viz. in the West India, the South-West India, and the Royal Albert, Docks. The present site of the infection is a wharf on the banks of the Thames at Wapping, less than a mile from the Tower Bridge. Twelve dead rats were found at this wharf, of which four at least were plague-infected. The existence of plague in wharves and warehouses, which are not inhabited at night, may be regarded with comparative equanimity so long as it does not spread to the rats in the plexus of mean streets which lie behind. The real cause for anxiety is the steadily widening area over which plague-infected rats have now been found. The fact that no cases of human plague have lately been recorded in England is not of much significance, because the period for human infection is only now commencing, coinciding as it does with the increase of the rat-fleas. A writer in *The Times* of June 17 in an able article thus summarises the occurrence:—"While the recurrence in the Port of London of an infection which has been already noted in three successive years can be regarded without excitement, it has its serious aspects. It cannot be too strongly urged that the mere presence of plague in England among rats, in however limited a form, may become a matter of sinister importance. If the Wapping outbreak marks a slowly widening circle of infection, it would be in exact accord with Indian experience, for plague has sometimes taken months, or even years, to pass through the rats of a single village. So long as the rats are infected, there must always be some danger to mankind."

THE second number of vol. iv. of the Journal of the Federated Malay States Museums contains four papers, by

Mr. C. B. Kloss and other naturalists, on local mammals and birds.

WE have to acknowledge the receipt of the report of the Field Museum of Natural History, Chicago, for 1910, in which it is stated that a steady development of that institution is in progress, with a continued increase of its utility as an educating centre. A marked extension took place during the year in the anthropological department. The report contains several illustrations, among which attention may be directed to a photograph of a group of three gorillas recently added to the exhibition series.

POULTRY-BREEDERS should be interested in an article on the inheritance of fecundity in domesticated fowls, contributed by Dr. Raymond Pearl to the June number of *The American Naturalist*. The article is so full of technicalities that it is difficult to give a summary of the conclusions intelligible to the ordinary reader. The author is however, of opinion that different degrees of fecundity are inherited by fowls, although it is extremely difficult, if not impossible, to isolate and develop a strain with great egg-laying capacity. It is further stated that the inheritance is probably in complete "accord with Johannsen's concept of genotypes." It may be added that the "genotype," or "pure line theory," is discussed in a second article in the same issue by Dr. J. A. Harris, who is disposed to doubt its validity.

VOL. xiii. of the *Rapports et Procès-Verbaux* of the International Council for the Exploration of the Sea contains the administrative report of the eighth year (1909–10) of the international cooperation and the proceedings of the ninth meeting of the council, which was held in Copenhagen in September, 1910. Special interest attaches to the presence at this meeting as guests of the Deputy-Commissioner of Fisheries for the United States of America, Dr. Hugh M. Smith, and the Inspector-General of Fisheries for France, M. Fabre Domergue. It would be of the very greatest value to the success of the investigations if the area to be explored could be extended to the waters of the North Atlantic, with the cooperation of the French and American Governments. The reports, which are appended to the proceedings of the meeting, are of considerable importance, although the general report on plaice fisheries, which it is hoped will bring to a head much of the most important work which has been carried out in connection with the investigations, is not yet available. Dr. Hoek gives a summary account of the quantitative distribution of the eggs and larvæ of the gadoids in the North Sea, and Prof. D'Arcy Thompson furnishes a second report on the later stages of these fishes. The flat fishes are similarly treated by Dr. Ehrenbaum and Dr. A. T. Masterman.

THE REV. HILDERIC FRIEND has reported to the director of Kew Gardens the discovery of two new annelids in earth received from Peru. The first is an Enchytræid, *Fridericia peruviana*, Friend, the other being a new species of Trigaster. It differs from the known species in its small dimensions, as well as in the position of the gizzards, the hearts, and the intestine, and is named *Trigaster minima*, Friend. This worm has the gizzards in segments 9, 10, 11, the principal hearts are in 12–15, and the intestine begins in 19, while the length is 15 mm., as compared with 250 mm. in *Trigaster lankesteri*, Benham.

IN NATURE of May 11 (p. 356) attention was directed to the proposal of the Bombay Natural History Society to start an investigation into the mammals of British India. Mr. N. Annandale writes from Calcutta to point out that a real zoological survey, in which the more obscure groups of animals (which have no less scientific value than the mammals) were included, would cost a great deal more than 2000*l*., for which an appeal was made, although preliminary work has been done as regards certain groups. He refers to Colonel Alcock's recent memoir on the fresh-water crabs, which it is hoped will be followed shortly by others on different groups of terrestrial and aquatic organisms.

IN *The Journal of Economic Biology* (vol. vi., No. 2) Mr. E. E. Green presents an enumeration of several species of Coccidæ, with diagnoses of those new to science, collected on rubber plants in Ceylon. *Lecanium viride* was the most important found on *Hevea brasiliensis*, but as it occurred chiefly on young trees it was amenable to treatment by spraying. A new species, *Inglisia castilloae*, was perhaps the most dangerous, as it spread from the Castilloa to tea shrubs in the vicinity, but it did not attack the closely adjacent Hevea trees. Another of the new species is a lac insect that spread thickly on a Landolphia vine. A second item of interest to entomologists is supplied by the article in which Mr. H. Maxwell-Lefroy offers advice on the training of British entomologists, with special reference to students prepared to take service in British colonies or possessions. He insists particularly on the desirability of infusing a more "economic" character into the student's training.

THE interesting account of his botanical expedition to Lower Siam communicated by Mr. H. N. Ridley is continued in *The Gardener's Chronicle* (June 17 and 24). Many new or remarkable plants were collected near Kanga, in the province of Perlis. Three species of Holarrhena, small apocynaceous shrubs, a Dischidia, and a dwarf Lastræa are new to science; *Cycas siamensis*, characterised by its curved white stems, and a swollen-stemmed balsam, *Impatiens mirabilis*, were particularly striking as they grew on the limestone hills, and the orchid *Dendrobium crumentatum*, which flowers simultaneously over a whole area, was observed on its flowering day. Further north, near Setul, several Australian types were discovered, the most remarkable being a new species of Thysanotus, a liliaceous genus confined to Australia except for one Philippine species. The author concludes that the boundary between the Malayan and Burmese flora is unusually distinct, and lies near the town of Alorstar in Kedah.

A PRELIMINARY study of the flora on different grass plots, with the object of ascertaining whether a botanical criterion of their value as pasture lands can be evolved, is reported in the Scientific Bulletin (No. 2) of the Royal Agricultural College, Cirencester. A complete catalogue of species was first compiled, and then the species were arranged under the three groups of grasses, Leguminosæ, and general plants according to their relative abundance. Data were thereby obtained for a comparison of the proportion of valuable grasses and leguminous plants to the less valuable and worthless species. Thus it was found that where the bottom grasses were luxuriant only nineteen species in all were recorded, whereas the total number of species exceeded fifty on the poor lands. Also generalisations are deduced from the growth of allied species; thus *Bromus erectus* was strongest on the dry oolitic soil, while *Holcus lanatus* predominated on wet areas.

IN an interesting report on the "Barometer in Jamaica," Mr. Maxwell Hall discusses the determination of the differences of height between pairs of stations in Jamaica from meteorological observations, and he calculates certain tables for use in the application to this problem of a form of Laplace's formula slightly different from that usually

adopted. Mr. Hall finds differences in the values obtained for the height according to the time of day and the season of the year at which the observations of pressure, temperature, and humidity are made. The values are generally larger near midday and in summer than at other times and seasons, a result not altogether surprising. The temperature enters into the determination of height through the expression $\int_{z_1}^{z_2} \frac{dz}{T}$, and there is clearly room for error if this is taken to be $(z_2-z_1)/T_M$ where $T_M=\frac{1}{2}(T_1+T_2)$ and T_1, T_2 are the temperatures at the lower and upper stations respectively. Mr. Hall elaborates an empirical method for correcting the value of T_M obtained in this way, in order to eradicate the differences found. In this connection it may be mentioned that recent determinations of heights in the Tyrol have furnished results closely agreeing with the values obtained by levelling. In these cases, however, mean values were used, and an intermediate station was available. Mr. Hall uses the value 60,159 feet in the hypsometric formula, instead of 60,369 feet, the value adopted in the International Tables, but does not state his reason for preferring the smaller value.

IN *The Electrician* for June 9, Dr. R. Beattie describes a method of determining the coefficients in the Fourier series for a curve, which should extend the use of such series amongst those who have not had a mechanical analyser at command and have been unwilling to go through the laborious process of determining the coefficients arithmetically. It will be remembered that the latter process consists in measuring the ordinates of the curve at regular intervals, multiplying these by the sines or cosines of certain angles, and taking the mean of the products. Dr. Beattie's suggestion is to measure the ordinates on scales graduated so as to read the products direct, and thus reduce the work to addition. Once the necessary scales are available the method will, we anticipate, be used extensively.

THE Department of Commerce and Labour, Coast and Geodetic Survey, Washington, has issued a volume of "Directions for Magnetic Measurements," by Mr. Daniel L. Hazard, of the Division of Terrestrial Magnetism. This extends to 131 pages, and contains instructions for the absolute observation of the magnetic elements with instruments of the various types used by the Coast and Geodetic Survey. The instruments are described with illustrations, and there is a discussion of the determination of the several constants. This is followed by a series of "directions for operating a magnetic observatory," which includes an account of Eschenhagen magnetographs and the methods of standardising the curves. At the end there are a series of tables intended to assist in the reduction of the absolute observations, which include some particulars of the diurnal inequalities recorded at the observatories belonging to the Coast and Geodetic Survey.

THE U.S. Coast and Geodetic Survey's "Results of Magnetic Observations made . . . between July 1, 1909, and June 30, 1910," gives in about seventy pages an account of a year's work in terrestrial magnetism in the United States. Observations were made at 241 stations, including a number previously occupied, so that numerous secular change data were obtained. A good many magnetic observations were also made at sea by the Survey's vessels. Two-thirds of the space is devoted to descriptions of the stations occupied. The situation of some of these seems a little unusual. Several, for instance, are in cemeteries, the exact site being marked by small pillars dated and lettered U.S.C. and G.S., the coordinates of which in some cases are given in terms of the distances from adjacent tombstones. If the absence of iron can be relied on, and sentiment does not count, it cannot be denied that a good deal can be said in favour of the practice, but one rather wonders how it strikes the average unscientific American.

THE June issue of *Terrestrial Magnetism and Atmospheric Electricity* contains particulars of comparisons of magnetic instruments made by observers of the Carnegie Institution, Washington, between 1905 and 1910, at a number of stations in North and South America, Asia, Australia, and Europe. It also gives voluminous lists of data which the editor, Dr. Bauer, has received from a number of observatories in response to a request for information as to the exact times of commencement of fifteen magnetic disturbances which occurred between 1906 and 1909. The object is to settle a controversy which took place recently in the columns of NATURE as to the rate of propagation of these disturbances round the earth. A further list of data is to appear in the next number of the magazine. The discussion by Dr. Bauer will be awaited with interest. In a reference to the meeting of the International Meteorological Committee, held last September in Berlin, the removal of atmospheric electricity from the domain of the Commission on Terrestrial Magnetism is adversely criticised. A reference to the "passing of the Kew Magnetic Observatory" leads to the statement that "the testing and standardising of magnetic instruments is shortly to be turned over to the National Physical Laboratory." This seems rather in want of explanation.

A CORRESPONDENT asks where he could obtain a portable and very sensitive instrument with which to measure the acceleration of gravity. In reply to the inquiry, Dr. C. Chree has been good enough to provide the following information:—"The determination of *absolute* values of g (acceleration of gravity) with high precision is an attempt very rarely made. For a good many years past relative determinations have almost all been made with half-second pendulums. The half-second pendulums originally obtained for the Indian Survey, which were swung at Kew in 1903, are described in Major Lenox Conyngham's paper on the subject (Roy. Soc. Proc., vol. lxxviii., 1906, p. 241) as 'made by E. Schneider, of Vienna, after Col. von Sterneck's design.' He also says: 'The clock belonging to the apparatus was constructed by Strasser and Rohde, of Glashütte; its pendulum, made by Riefler, of Munich, is of invar.' At the present moment Prof. Helmert, of Potsdam, is considered the leading authority on the subject. Of late years pendulums of invar have been tried at Potsdam, as temperature uncertainties in the field are amongst the most troublesome. The usual procedure is to swing the pendulums at a base station—*e.g.* the observatory at Potsdam—where g is supposed to be known, and thence to deduce its value at any other place where the pendulums are subsequently swung."

MESSRS. CASSELL AND CO., LTD., have commenced a reissue of Mr. W. F. Kirby's well-known "Butterflies and Moths of Europe," to be completed in thirty-two weekly parts. Part i. appeared on May 25.

THE Admiralty has ordered from Messrs. Newton and Co., of 3 Fleet Street, London, ten sets of X-ray apparatus to be supplied to the new battleships for service afloat. We understand that these will make altogether thirty complete installations that this firm alone has recently supplied to the ships of the Royal Navy.

OUR ASTRONOMICAL COLUMN.

ASTRONOMICAL OCCURRENCES FOR JULY:—

July 2. 18h. 0m. The Sun in Apogee.
22h. 0m. Jupiter stationary.
3. 13h. 0m. Mercury in superior conjunction with the Sun.
4. 21h. 21m. Jupiter in conjunction with the Moon (Jupiter 0° 8′ N.).
7. 4h. 0m. Venus at greatest elongation, 45° 29′ E.
8. 2h. 10m. Mercury in conjunction with Neptune (Mercury 2 19′ N.).
11. 18h. 19m. Uranus in conjunction with the Moon (Uranus 4° 28′ N.).
14. 9h. 0m. Neptune in conjunction with the Sun.
19. 7h. 31m. Mars in conjunction with the Moon (Mars 2° 0′ S.).
20. 11h. 11m. Saturn in conjunction with the Moon (Saturn 3° 33′ S.).
,, 18h. 0m. Uranus at opposition to the Sun.
24. 14h. 42m. Neptune in conjunction with the Moon (Neptune 5° 29′ S.).
26. 20h. 0m. Mercury in conjunction with the Moon (Mercury 4° 6′ S.).
28. 9h. 18m. Venus in conjunction with the Moon (Venus 5° 47′ S.).
29. 2h. 0m. Mercury in conjunction with α Leonis (α Leonis 0° 9′ S.).
,, 13h. 0m. Jupiter at quadrature to the Sun.

REDISCOVERY OF WOLF'S COMET.—A telegram from the Kiel Centralstelle announces the rediscovery of Wolf's comet, by Prof. Max Wolf, on June 19. The position of the comet at 12h. 4·9m. (Königstuhl M.T.) was

R.A. = 18h. 46m. 16s., dec. = 13° 28′ N.,

and its magnitude was 15. The position is about 15m. west of ζ Aquilæ. According to the continuation of the ephemeris published by M. Kamensky in No. 4505 of the *Astronomische Nachrichten*, the comet will move in a north-westerly direction until July 15, when it will turn south again. Its calculated magnitude for July, September, and October is about 12·2, but from the observation the actual magnitude is, at present, somewhat fainter than the calculated.

MARS.—Observations of Mars were commenced at the Juvisy Observatory during the clear mornings of April, and several well-known features were seen. The south polar cap was seen to be surrounded by a dark belt, which certainly had the appearance of an objective phenomenon. Mare Sirenum was seen on April 24 as a diffuse spot descending from the polar cap and fading gradually towards the bright limb of the planet. The central region to the north was seen to have the accustomed yellowish-orange hue, and Titan was vaguely, but surely, seen. These observations when the apparent diameter of the planet was only 6″ show that useful observations will be possible considerably before the opposition, which takes place on November 25. The account of these early observations, in the June number of *L'Astronomie*, is illustrated by a drawing made by M. Quénisset at 16h. 20m. on April 24.

In *La Nature* (No. 1986, June 17) Dr. Mascart has an interesting illustrated article, in which he discusses the present state of the vexed question concerning the reality of the Martian canals. The general result is that the question is, as yet, by no means decided, but there is a hope that the laboratory experiments being carried on by MM. Chapeau and Danjon may do something to elucidate this difficult question further.

THE PROBLEM OF THE SOLAR MOTION.—Continuing the discussion with Prof. Comstock concerning the proper motions of faint stars, Dr. H. E. Lau publishes some interesting results, accruing from the Copenhagen measures of the Engelhardt stars, in No. 4502 of the *Astronomische Nachrichten*.

He finds that the mean proper motion of tenth-magnitude stars is 3″ per century at the most, and that it is smaller in the Milky Way than outside it. For the position of the apex he obtains A = 290°, D = +44°, and finds that the proper motions of tenth-magnitude stars indicate a greater R.A. and declination than those of the brighter stars, but the reality of this difference is still doubtful. A reduction of the measures shows that the mean parallax of these stars of the tenth magnitude lies between two and three thousandths of a second of arc, and that the error of Newcomb's precession constant does not exceed 0·1″ per century.

THE FORMS OF SPIRAL NEBULÆ.—The forms of spiral nebulæ is a matter of moment in any investigation concerning cosmical evolution, and any attempt to find some general law which these early systems follow is therefore of interest. Such a research is described by Herr Von E. v. d. Pahlen in No. 4503 of the *Astronomische Nachrichten*.

The author has studied photographs of many spiral nebulæ taken at the Lick and the Isaac Roberts Observatories, and has attempted to find general equations to their curves. Among other nebulæ, he has considered M. 33, Trianguli, M. 74, Piscium, and M. 51, Canum Venatici. In each case an Archimedian spiral was tried, but it was found that a logarithmic spiral could be found which better fitted the chief branches of the observed spirals. The agreement of the calculated and observed curves is shown by a number of graphs, and all are satisfactory except the second branch of M. 51, in which there appear several discordances. The paper also discusses the probable generation of such curves as are observed in these objects.

THE SPECTROSCOPIC BINARY *o* PERSEI.—*o* Persei is of special interest as a spectroscopic binary because, as occurs in one or two other cases, the calcium lines H and K do not appear to participate in the general variations of the radial velocity. In discussing the Allegheny observations of this star, Mr. F. C. Jordan pointed out that his value for the velocity of the centre of the system did not agree with the one obtained earlier by Vogel from the Potsdam observations, and suggested the possibility of a systematic personal error in the latter.

To clear up this point, Dr. Ludendorff has made new measures of the spectra, and finds that, although there is a marked difference between Vogel's measures and his own, yet it remains probable that the difference between Jordan and Vogel is to some extent real; possibly a third, as yet unconfirmed, body is included in the system. As the spectrum of *o* Persei is difficult to measure, further investigations will have to be made to settle this interesting point (*Astronomische Nachrichten*, No. 4500).

THE COAL-DUST QUESTION IN THE UNITED STATES AND IN AUSTRIA.[1]

THE first explosion that seems to have attracted attention to coal dust in the United States occurred at Pocahontas mine in 1884. Very little attention was paid to the subject for some years afterwards, until explosions began to occur in the western region "in shallow mines in which firedamp had never been found before the explosions, and was not found after them." Although the majority of these were not of a serious character, they gave rise to much uneasiness; but when what might be called the *black* year of 1907, with a death-roll of "1148 men killed by mine explosions," had run its course, uneasiness gave way to consternation. In 1908 Congress "made an appropriation" for the investigation of mine explosions, which became available on July 1; the United States Geological Survey was entrusted with the work, and an experimental station, which had, in the interim, been erected at Pittsburg, was officially opened on December 3 of the same year.

Experiments which, in the bulletin before us, are described as a preliminary series, have been made with the object of determining "the quantity or density of the finest size of coal dust necessary to propagate an explosion."

1 "The Explosibility of Coal Dust." By George S. Rice, with chapters by J. C. W. Frazer, Alex Larsen, Frank Haas, and Carl Scholz. United States Geological Survey, Bulletin 425. Pp. 186. (Washington: Government Printing Office, 1910.)

Abstract of the Reports on the Austrian Coal-dust experiments conducted at the Rossitz experimental station 1908–1909 by k. k. Oberbergkommissär, Dr. Czaplinski, and Werksdirektor Jicinsky. Pp. 36. (London: The Colliery Guardian Company, Limited, 1911.)

The apparatus employed is similar to that at Altofts and Liévin. It includes a cylindrical gallery 6 feet 4 inches in diameter by 100 feet long, closed by means of a block of concrete at one end; with a cannon embedded in the concrete, from which shots can be fired for the purpose of raising and igniting the dust; with small glass windows at intervals of 6 feet 8 inches apart on one side; with arrangements for fixing paper diaphragms so as to isolate certain portions of its interior when experiments with fire-damp are undertaken, and so on.

The coal dust is prepared by grinding and screening coal of the following composition:—

	Per cent.
Moisture	1·94
Volatile combustible	35·11
Fixed carbon	57·73
Ash	5·22
	100·00
Sulphur	1·25

The method of conducting the experiments, and the records of their results, are both so similar to those that have been described in two previous reviews,[1] that it would be supererogatory to describe them in this place, more especially as they occupy very little space in the volume before us, and are, as has been said, mostly of a preliminary character.

The remainder of the volume is devoted to a history of the subject, in which our author has done ample justice to the work of his predecessors; to dissertations on "The Humidity of Mine Air," "Remedies for Coal Dust," "Tentative Conclusions on the Dust Problem," and "Special Features in Dust Explosions," written by the author himself, and includes special chapters on "Laboratory Investigations of the Ignition of Coal Dust," by J. C. W. Frazer; "Coal Dust Investigations at European Testing Stations," by Axel Larsen; "Exhaust Steam as a Preventive of Dust Explosions," by Frank Haas; and "Use of Steam and Water Sprays at Oklahoma Mines," by Carl Scholz.

All these subjects have already been investigated and commented upon by other earlier writers, and as there is nothing specially new or original in the articles before us, they need not further detain us in this place. The fact that the "selected bibliography" occupies twelve and a half pages, and that the titles of no fewer than two hundred and four of the papers and articles mentioned in it contain either the word "coaldust," or in some cases simply "dust" and "dusty," as applied to mines, explosions, and experiments, is an indication of the growing interest with which the subject is, and has for some time past been, regarded. Finally, considering the source from which the present report has emanated, it is perhaps almost superfluous to add that it is furnished with a complete index.

The Austrian experiments are being carried out under the auspices of the Vienna Permanent Firedamp Committee, which decided to resume them in 1908 after an interval of several years, during which operations at the experimental gallery at Babitz, near Segengottes, had been suspended. The ostensible object of this new series is "to ascertain the conditions under which coal dust—especially that of the Rossitz district—can be caused to explode even in the absence of firedamp, and to test the means hitherto employed, or proposed, for minimising or preventing coal-dust explosions, chief among them being water curtains, wet and dustless zones, and dry stone-dust zones." "Experiments with coal dust in conjunction with explosive gases are also in contemplation."

The Babitz gallery differs from the others previously referred to, first, in being built partly in masonry and partly in brick work, with an arch of the same materials overhead, and a level floor; and, secondly, in being wholly underground. Its depth under the surface is 2 metres at one end and 21·6 metres at the other. The thickness of cover increases at a fairly uniform rate from the shallower end to a distance of rather more than two-thirds of the whole length, where it attains 7 metres, and thereafter more irregularly to the deeper end. Its length is 293·7 m., and its other dimensions are:—at its deeper end, 1·3 m. wide at the sole, 1·4 m. wide at the spring of the arch, 1·74 m. high, and its sectional area 2·2 square metres; and at its shallower end, 2·4 m. high and 3·4 square metres in sectional area.

Travelling communication is established with its interior by means of three shafts, one sloping downwards to a point 1·7 metres distant from its deeper end, provided with stairs and ladders, and with a strong door both at its top and bottom; a second, sloping downwards to a point 82 metres distant from the bottom of the first, also provided with stairs and ladders, and with a strong door at its top and bottom; and a third, at its shallower end, provided with a ladder only, and with its top capable of being closed by means of balks of timber.

The space between the bottom of the deepest shaft and the end of the gallery nearest it (called the explosion chamber) is built of concrete, and is 1·7 m. long, measured in the direction of the axis of the gallery, 1·3 m. wide, and 1·82 m. high. Its open side next the gallery can be closed by means of a paper diaphragm pasted to a wooden frame fixed on the periphery of the gallery, and coal dust and firedamp can be admitted to its interior through two pipes, one for firedamp the other for coal dust, which extend down into it from the surface. At distances of 47·8 and 88·2 metres respectively from the explosion chamber, two other pairs of pipes constitute similar links of communication between the surface and the gallery. One pipe of each pair serves for the introduction of coal dust, the other as an open passage in which a shaft with a circular disc fixed to its lower end, which is in, and just below the roof of, the gallery, can be made to revolve rapidly by means of hand mechanism at the surface. The coal dust, introduced through the two pipes just referred to, falls upon the two corresponding revolving discs, and is disseminated in the surrounding air by the centrifugal force imparted to it by the motion of the discs; that similarly introduced into the explosion chamber passes immediately into the interior of a small vertical fan, made to revolve by means of an electric motor, and is thus disseminated through the air in the chamber in a similar manner.

The gallery is lighted by means of shielded incandescent electric lamps standing in niches in the walls, and is ventilated by means of an electric fan fixed in the shaft farthest from the explosion chamber. The fan is capable of exhausting 20 cubic metres of air per minute from the interior of the gallery.

The coal dust employed in the experiments is collected in the screening sheds (?) and in the workings, and only the most suitable kinds are taken. Amongst these, the finest leaves a residue of 3·8 per cent. on a sieve with 3480 meshes, and the coarsest a residue of 19·5 per cent. on a sieve with 1160 meshes per square centimetre. Its composition is as follows:—

	Per cent.
Moisture	0·58 to 4·5
Volatile matter	19·20 to 22·8
Ash	9·17

When an experiment is about to be made, coal dust is strewn about in the gallery, or placed on a series of seven narrow shelves equally spaced above each other, supported horizontally (and transversely as regards the gallery) in rectangular wooden frames suspended at intervals of 5 m. apart, or laid on slanting laths fastened to the walls, or disseminated in the air by means of the fan in the explosion chamber and the revolving discs previously mentioned, or brought into the sphere of action by any one or any combination of these means.

The explosives employed for disturbing and igniting it are cartridges of gelatine dynamite from 150 up to 300 grams, "for the most part hanging free," and fired electrically with 1-gram caps; or 300 grams of black powder placed loosely in a mortar with a bore of 450 mm. long and 27 mm. in diameter, tamped with paper, and fired with a fuse. In some cases the dynamite charges are fired in the mortar.

No account is given as to the position in which the dynamite cartridges are hung, either as regards their height above the floor or their horizontal distance from the end of the gallery or chamber; nor can we gather where, or at what height, or at what angle from the hori-

[1] NATURE, February 9, 1911, vol. lxxxvi., p. 223.

zontal, if any, the barrel of the mortar usually stands when a charge is fired from it, or whether there are two mortars, one in the explosion chamber, the other movable to any other desired position. The only reference we can find in this connection is to *a* mortar "on the floor of the gallery," fired in this particular instance at a distance of 20 m. from the explosion chamber (p. 26).

An attempt has been made to measure pressure by means of a spring indicator. We say "attempt," because the curves reproduced on pp. 19 and 22 are of identical construction with, and indistinguishable in this respect from, those obtained by the present writer with a similar contrivance in the small Royal Society gallery (1877–8). We put these curves aside at the time (although we still possess them) as altogether untrustworthy, as we were of opinion that the first impulse given to the piston was due to the initial explosion of firedamp, and its subsequent vibrations to the combined action of the momentum of the moving parts and the resilience of the spring, and not to those of the air in the gallery; and we consider the curves now before us to be of quite as little value as our own.

The length to which the flame extends is ascertained by placing a series of sulphur matches set in wooden blocks at intervals of 1 m. apart along the walls of the gallery, and observing how many of them have been burnt.

A bottle filled with water, suspended neck downwards at a distance of 10 m. from the explosion chamber, with its loosely fitting cork attached by a string to the nearest hanging frame, serves the purpose of collecting a sample of the afterdamp. When the hanging frame moves under the impulse of the blast, the cork is displaced, the water runs out, and the air and gases take its place.

The audible and visible phenomena produced by an explosion are stated to be a shock "followed by a return shock after an interval of not more than two seconds"; the shock expels a column of air from the terminal shaft (the one farthest from the explosion chamber), opens the door at the top of the intermediate shaft (when the door at its bottom, which opens *into* the gallery, has been removed), and expels a cloud of "smoke" (? dust-laden air), followed, when the explosion is violent, by a flame several yards in length; the return shock opens the iron door at the explosion chamber, closes the door at the top of the intermediate shaft, and fresh air rushes in at the shafts at both ends of the gallery. Immediately afterwards, "thick, dense, blackish-grey afterdamp" is expelled from the terminal shaft by the fan. The frames with shelves are usually torn away and shattered; and on one occasion the door at the top of the intermediate shaft, together with portions of its frame, was thrown to a distance of 30 m.

Passing over the accounts of tentative and preliminary experiments, both with suspended cartridges of dynamite and with black powder fired from the mortar, we may take the following as fairly typical examples of the best results with both kinds of explosive:—

(1) With suspended cartridges of dynamite.

With 32·5 k. of dust strewn over a length of 90 m. from the chamber, and with dust being disseminated in the air by the distributing fan in the chamber and by the revolving discs at 47·8 and 82·8 m. from the latter, the length of flame in the gallery was 124 m. and that in the intermediate shaft 24 m.

In another explosion, with a strewing of 90 m., conducted, presumably, under the same conditions as the last, but not so specified, the length of flame was 118 m.; the maximum pressure is stated to have been 1·38 atmosphere, and the duration of the explosion 0·013 second.

(2) With 300 grams of black powder fired in the mortar without tamping, when both discs and the distributing fan were at work, and 30 k. of dust "employed" (some of it probably strewn on the floor?), the length of the flame was 147 m. (p. 25).

With even the finest dust, containing 2·2 to 4·5 per cent. of moisture, only relatively slight explosions and short flames could be obtained with either dynamite or black powder; but with even coarse dust, containing only 0·7 to 1·7 per cent., strewn over a distance of 88·2 m., flames up to 147 m. were produced.

In the second series of experiments, which were made after a new door, that could not be opened by the explosion, had been fixed at the bottom of the intermediate shaft, and a third revolving disc placed at a distance of 120 m. from the chamber, a flame of 200 m. in length was obtained in one of the experiments with a charge of 250 grams of dynamite and with 129 grams of coal dust per cubic metre (containing 13·3 per cent. of ash, 0·45 of moisture, and 19·2 of volatile matter), disseminated over a distance of 120 yards. This coal dust left 12·2 per cent. on a sieve with 3480 meshes per square centimetre.

Under the same conditions, except that the dust contained 7·55 per cent. of moisture, no explosion took place.

Coal dust containing 14 per cent. of ash gave violent explosions with flames 150 m. in length, whereas that containing 47·9 per cent. did not explode.

Coal dust mixed with increasing proportions of Roman cement continued to explode until the mixture contained 63·3 per cent. of the latter. The suggested and highly probable explanation of this apparent anomaly is that the cement dust falls more quickly than the coal dust, and leaves the mixture remaining suspended in the air purer than it would otherwise be.

The influence of wet zones, and what are designated "water curtains," was also investigated. "The wet zones were formed by sprinkling in the usual way just before shot-firing, and were intensified at intervals by water curtains" (p. 34). The "usual way" is probably that described on p. 11, that is, by means of hose pipes attached to branches of a supply pipe laid along the floor of the gallery. The water curtains, which consist in sprays of water issuing upwards, downwards, and across the gallery at right angles to its longer axis from perforations or nozzles in pipes fixed on its periphery, are stated to have produced little effect on the length of the flame (p. 35).

A wet zone of 60 m. extinguishes an explosion even when a dry-dust explosion produced under the same conditions extends to 137 m. in the absence of the water. "With wet zones 36 to 57 m. long, the flame projected beyond them failed to ignite the dust in the immediately adjoining second coal-dust zone in which the third atomiser (revolving disc) was in operation."

In comparing the foregoing results with those obtained in the galleries at Altofts and Liévin, it should be borne in mind that the coal dust employed was collected at the screens and in the workings, that it, consequently, contained indefinite proportions of coarse and fine particles, and that it is lower in volatile matter than the coals employed in the two galleries named.

These less favourable conditions seem to account for its apparently lower inflammability and its greater sensitiveness with regard to increasing proportions of uncombined moisture.

From *a priori* considerations as to the nature of combustion, it might have been thought that the two following propositions could have been accepted as axiomatic, namely, that, *caeteris paribus*, (1) the finer the dust, the greater the proportion of volatile combustible matter, the drier the air and the higher its pressure and temperature, and the less the proportion of mineral matter and moisture (combined and uncombined) the more inflammable the dust; and (2) conversely, with all the conditions reversed. As it is, most of them have been verified by the results of all the recent quantitative experiments, including an excellent series on the laboratory scale by Prof. Bedson and Mr. Widdas.[1]

The results of the experiments made by the Prussian Firedamp Commission[2] seemed to contradict the second condition as to the influence of increase in the proportion of volatile matter, in regard to which they make the following remarks on p. 31:—

(3) "Bei einem Gehalte an flüchtigen Bestandtheilen von 18 bis 22 pCt. scheint die Flammenverlängerung am grössten zu sein" (vi., 4, 9, 10, 11).

(4) "Mit einem höheren Gehalte an flüchtigen Bestandtheilen tritt wieder eine entschiedene Abnahme der Flammenverlängerung ein, selbst bei ganz feinem Staube" (vi., 13, 14, 15, 18, 19, 20, 21, 22). "Es bleiben gleichwohl diese gasreichen Kohlen ohne Ausnahme noch sehr

[1] Transactions of the Institution of Mining Engineers, vol. xxxix. Part V. (1910).

[2] Anlagen zum Haupt-Berichte der Preussischen Schlagwetter-Commission, Band IV. Table VI. Pp. 35 (1886).

gefährlich, wenn dieselben hinreichend feinen Staub liefern; falls dieses aber nicht stattfindet—und dieser Fall scheint in der That recht häufig vorzukommen—bieten dieselben wenig Gefahr" (vi., 23, 24, 25).

"Hiernach haben unsere Versuche die früher verbreiteten Ansichten in diesem Punkte bestimmt widerlegt."

In this case, also, the coal dust was taken from the screens or from the mines, and employed without any previous sifting or preparation of any kind. It was thus of the same character as that employed in the Austrian gallery, and therefore subject to the same drawbacks. In by far the larger number of trials the strewing in the gallery was only 10 m. in length, and the charge of explosive was invariably 230 grams of black powder.

It is therefore undoubtedly useful to have some of the more exact numerical data established by the recent experiments in regard to even a few classes of coal, such as the limit of explosibility with decreasing volatile matter, on the one hand, and with increasing incombustible mineral matter on the other, although it is quite certain that both of these limits must necessarily be profoundly modified by the presence of more or less firedamp in the air, and by the higher temperature, lower capacity for heat, and more active oxidising properties of the oxygen in the air under the compression existing in the condensed wave of an explosion in the workings of a mine.

But it requires very little consideration of the number of natural factors that vary to show that even the most elaborate series of experiments that could possibly be carried out can only touch the outer fringe of the subject.

In these circumstances it is to be hoped that in accepting the loan of the experimental tube and other appliances at Altofts from the colliery owners, and in constituting themselves and others into a committee for the purpose of making experiments with them, the Royal Commission on Mines will confine its attention to a few very definite objects, and will, before everything else, including even the treatment of dust in the main haulage ways, bear in mind that the true solution of the coal-dust question lies in the prevention of explosions by the honest application of well-known means, that is to say, of means applied in such a manner as would, in the opinion of the present writer, who examined the scenes of the explosions in both Whitehaven and Hulton Collieries, undoubtedly have saved the lives of 480[1] men in 1910, and not in the slipshod way in which the law has hitherto allowed.

The siren song of the inventors, vendors, and advocates of rescue appliances which, it is said, have never yet saved a single life after an explosion, but have been the means of losing many; the trumpetings of those who are clamouring for the establishment of "zones," and even the counsels of those who beseech us to have mice and little birds ready to test the afterdamp, seem to have almost completely distracted attention from the real point at issue for several years past. Even the Royal Commission on Mines seems to have allowed itself to become entangled, not only in the Circean alliance referred to above, but to some extent also in a Charybdic whirlpool of supposed palliative suggestions.

As has been often said before, great explosions occur exclusively in dry and dusty mines, and are invariably begun either by the intentional detonation of an explosive (shot-firing) or by the accidental ignition and explosion of a certain volume of inflammable gas. If the coal dust lying within a certain radius of the one presumed centre of disturbance or the other were always rendered sufficiently damp beforehand to prevent it from being raised up into the air by the subsequent blast, a great explosion would be impossible in any mine. One efficient means of attaining this end consists in spraying water from the nozzle of a flexible hose attached to the branch of a water-main or to a tank on wheels containing water and compressed air. The means is, therefore, "not in heaven"—neither is it beyond the sea—"but is very nigh"—is, in fact, already in use in many of our mines.

If the Royal Commission on Mines were only strong enough and independent enough, it would specify categorically *in what manner* (by means of pipes or water-tanks) and *to what extent* (distance or radius, and quantity per unit of area) water must be applied in the case of shot-firing in order to render the operation quite safe, and (shall we also add?) in the presence of accumulations of inflammable gas; it would insist with all the weight of its Royal authority that the regulations which it recommends be placed upon the Statute Book and be rigidly enforced in the practice of every dry and dusty mine working coal with, say, 12 per cent. of volatile matter and upwards, whatever may be the nature of its roof and floor; and it would add in the way of serious and impressive advice to all engaged in mines of this class words of similar import to those employed by the great Hebrew lawgiver in similar circumstances:

"And thou shalt teach them diligently unto thy children,
And shalt talk of them when thou sittest in thine house,
And when thou walkest by the way,
And when thou liest down and when thou risest up.
And thou shalt bind them for a sign upon thine hand,
And they shall be as frontlets between thine eyes,
And thou shalt write them upon thy posts, and on thy gates."

W. GALLOWAY.

[1] Whitehaven Colliery, May 11, 136; Pretoria Pit, Bolton, December 21, 344.

ENTOMOLOGICAL PAPERS.

AMONG a batch of papers received from the Entomological Bureau of the U.S. Department of Agriculture, perhaps the most generally interesting is one, by Mr. F. C. Bishopp, on the distribution of the Rocky Mountain spotted-fever tick (*Dermacentor venustus*). Now that the fever is known to be principally, if not exclusively, transmitted to man by the tick, the determination of the distributional area of the latter has become a matter of importance. Western Montana is the district where the disease occurs in its most virulent form, but it is also met with, although in a less severe type, in parts of Idaho, Wyoming, Utah, and Nevada, and these areas coincide to a great extent with the maximum abundance of the tick, the whole range of which includes parts of Washington, Montana, Oregon, Idaho, Wyoming, Nevada, Utah, Colorado, and a small tract in New Mexico. In its earlier stages the tick infests small mammals, but later on migrates to the larger domesticated species, and it is in districts where the latter abound and brush-wood is plentiful that it attains its maximum development. Unfortunately, the disease appears to be spreading.

In a second pamphlet Mr. T. L. Patterson records the results of investigations into the habits of the larvæ of certain flies of the family Sarcophagidæ in relation to the pernicious gipsy moth (*Porthetria dispar*). As a rule, the sarcophagid maggots feed only on decomposing pupæ of the moth, but consignments from Europe and Japan suggest that the larvæ of some of the flies may be truly parasitic on the pupæ, in which case it is hoped that an additional means of controlling the ravages of the moth may be obtained.

Other pamphlets deal with the "asparagus-miner" (*Agromyza simplex*), insects affecting stored grain, and the one-spray method of checking the codling-moth and the plum-weevil.

According to the report of the Dominion entomologist, Dr. C. G. Hewitt, issued in the annual Report on Experimental Farms for 1909–10, Ottawa, a new Destructive Insect and Pest Bill was introduced during the period under review into the Canadian Parliament. The necessity for such legislation, owing to the rapidly increasing volume of foreign trade, was pressing, as it was essential to provide means against the introduction, or reintroduction, of such pernicious species as the San José scale and woolly aphis, and the brown-tail and gipsy moths. The brown-tail moth, introduced some years ago, is still the most important enemy against which the Entomological Department has to fight, and it is essential that every possible means should be taken to prevent its spread, as otherwise the financial and other losses caused by its devastations will be appalling. It is satisfactory to learn that there were no serious injuries caused during the year by insects harmful to cereal crops, which form the staple of Canadian agriculture.

Interesting observations on the duration of life in *Samia cecropia*, a common American moth, are recorded by Mr.

Philip Rau in vol. xix., No. 2, of the Transactions of the Academy of Science of St. Louis. The cecropia resembles the emperor and lappet moths, which belong to the same family, in taking no nourishment in the adult condition, but whereas the females of the two latter die immediately after oviposition, while the males perish in the act of sexual intercourse, this is not the case with the cecropias, the males living, on an average, a little more than nine days after separating from the females, although the majority of the latter die before all the eggs are deposited. Moreover, unlike those of the European species, the female cecropias do not remain in a torpid condition for days or weeks previous to fertilisation. As the prolongation of the life of the males after sexual intercourse is useless, it cannot be an adaptation for the good of the species, and it is therefore suggested that such longevity may be a survival from a time when it was beneficial.

The inheritance of polymorphism in the American yellow butterfly, *Colias philodice*, is discussed by Prof. J. H. Gerould in the May number of *The American Naturalist*. In this species the female is dimorphic, the ground-colour of the wings being either yellow or white; the yellow phase is in most places the more abundant, although the albinistic phase is dominant in inheritance. Males differ by the narrower black marginal band on the fore-wings, which is usually free from light spots. Since the colour-pattern of the female obtains in those species of the genus where there is no sexual difference in this respect, it is inferred that this represents the primitive type, which seems to survive in the northern *C. nastes*, the ground-colour of which is dull greenish-yellow suffused with brown. In the author's opinion, "the yellow ground-colour and the solid black marginal band [of *philodice*] probably arose by mutation in an undifferentiated *nastes*-like or white stock, and at once became dominant in the male, while the original colours and colour-pattern remained dominant in the female." Passing southwards and westwards, we enter the realm of *C. eurytheme*, a species with an orange ground-colour and very complicated polymorphism, which probably represents the supreme degree of specialisation.

Two species of Thysanura—a Mediterranean bristle-tail (*Thermobia domestica*) and an apparently new spring-tail (*Proisotoma ultonica*)—are added to the fauna of Ireland by Prof. G. H. Carpenter in *The Irish Naturalist* for May. The Rev. F. D. Morice continues his notes on British saw-flies (Tenthredinidæ, &c.) in the May issue of *The Entomologist's Monthly Magazine*.

The division of labour among ants, with special reference to the view that the smaller forms of workers are more active than their larger brethren, is discussed by Miss E. N. Buckingham in vol. xlvi., No. 18, of the Proceedings of the American Academy of Arts and Sciences. As the result of observation, it has been found that in the case of *Camponotus americanus* the males do not perform the chief duties of the nest, but that the queens may take a share of such duties when the colonies are small. The great bulk of the labour is, however, performed by the small and medium-sized workers. In the genus Pheidole, where the intermediate forms have probably been eliminated, all the work is done by small ants. As a general rule, it appears that big ants, like queens, are more active in small than in large colonies. The general inactivity of the big workers and soldiers is an advantage to the colony, as they are not exhausted by labour, and are thus always available for purposes of defence.

Dr. E. Goeldi is communicating a very interesting series of articles on ant-colonies to *Himmel und Erde*. In the May number he illustrates the manner in which the various kinds of ants inhabiting the flooded lands of Amazonia make their nests in trees, so as to be above the water-level, figuring the long, pendant, skein-like nests of *Azteca barbifex*, the torpedo-like structure formed by a species of Camponotus, and the sheet-like *papier-maché* nest of *A. trigona*. Fungus-growing ants are likewise described, with striking illustrations of the crater-like elevations, leading to the subterranean chambers, to be seen in sandy districts of certain parts of America. To these the ants bring fragments of leaves from long distances, and, after storing them in the subterranean chambers, use them as hot-beds for the cultivation of the mycelium stage of the fungus *Rhozites gongulophora*. Whether the fungus, in its fully developed state, ever reaches the surface through one of the entrance-tubes is a moot point.

In No. 1830 of the Proceedings of the U.S. National Museum, Mr. J. C. Crawford continues his descriptions of new Hymenoptera. The types of several of the fifteen species named were forwarded by correspondents of the Bureau of Entomology, and as these species are of interest in connection with economic entomology, the descriptions were published at the earliest possible date.

Attention may be directed to the description by Mr. J. H. Keys in the June number of *The Entomologist's Monthly Magazine* of a new species of British weevil (*Barypithes duplicatus*), on account of the apparent absence of any allusion as to what constitutes the type. It is even left uncertain whether a spot between Broadstairs and Margate, Blean Woods, Kent, or some other place is the type-locality.

R. L.

THE ROTHAMSTED EXPERIMENT STATION.

THE Society for Extending the Rothamsted Experiments met at Harpenden on June 16, and has issued the following report:—

During the past year the work of the Rothamsted Experimental Station has been considerably extended, more particularly in its investigation of the effect upon the fertility of the soil of heating and treatment with antiseptics which destroy the larger organisms there present. A special assistant has been retained to deal with the investigation of greenhouse soils, which, despite their richness in manure, have become "sick" and unable to carry crops. The same factor appears to be concerned in the sickness of the soils of sewage farms, and this question is also under investigation. The examination of the life-history of the larger organisms in the soil has been undertaken in the Rothamsted Laboratory by Mr. T. Goodey, who was appointed for that purpose to a Mackinnon studentship by the Royal Society.

Papers on this question have been published during the year, also on the ammonia content of the atmosphere, on the weeds of arable land in relation to the soils, on the nutrition of plants by non-nitric sources of nitrogen, and on the experimental error attaching to field trials. The Board of Agriculture has also published on behalf of the station an exhaustive report (207 pp. plus 56 maps and figures) on the soils and agriculture of the south-east of England.

Through this additional work the expenditure of the station has exceeded its income by 1000*l*., and a deficit of 1300*l*. has now accumulated.

The Development Commissioners have promised, through the Board of Agriculture, a grant of 2000*l*. for the current year's work, and it is hoped that some such assistance of the kind will be continued in order to provide for the further extension of the work of the station.

To this end it has become necessary (1) to take a lease of the home farm and so secure further land for experiment, (2) to erect additional laboratory accommodation.

It is estimated that 6000*l*. will be required for these purposes, and on the appeal of the society the following subscriptions have already been received or promised:—Duke of Devonshire, P.C., 300*l*.; Lord Iveagh, 200*l*.; Mr. A. Brassey, 100*l*.; Sir J. T. Brunner, Bart, P.C., 300*l*.; Mr. E. H. Carlile, M.P., 52*l*. 10*s*.; Mr. J. F. Mason, M.P., 500*l*.; Mr. R. Mond, 200*l*.; Capt. J. A. Morison, M.P., 500*l*.; Mr. W. Morrison, 100*l*.; Dr. Hugo Muller, F.R.S., 100*l*.; Sulphate of Ammonia Committee, 50*l*.; Sir J. Wernher, Bart., 250*l*.; Mr. J. Martin White, 100*l*.; Sir A. Henderson, Bart., 10*l*. 10*s*. Total, 2763*l*.

At this critical period in the development of agriculture and agricultural science, the Society for Extending the Rothamsted Experiments appeals most earnestly for further assistance to equip Rothamsted—the pioneer among the experimental stations of the world, with a seventy-year history of continuous experiment upon the same land, an institution also which has hitherto been entirely dependent upon private generosity—in a manner adequate to deal with its new responsibilities.

RADIO-TELEGRAPHY.[1]

THE practical application of electric waves to the purposes of wireless telegraphic transmission over long distances has continued to extend to a remarkable degree during the last few years, and many of the difficulties which at the outset appeared almost insurmountable have been gradually overcome—chiefly through the improved knowledge which we have obtained in regard to the subject generally and to the principles involved.

The experiments which I have been fortunate enough to be able to carry out on a much larger scale than can be done in ordinary laboratories have made possible the investigation of phenomena often novel and certainly unexpected.

Although we have—or believe we have—all the data necessary for the satisfactory production and reception of electric waves, we are yet far from possessing any very exact knowledge concerning the conditions governing the transmission of these waves through space, especially over what may be termed long distances. Although it is now perfectly easy to design, construct, and operate stations capable of satisfactory commercial working over distances up to 2500 miles, no really clear explanation has yet been given of many absolutely authenticated facts concerning these waves. Some of these hitherto apparent anomalies I shall mention briefly in passing.

Why is it that when using short waves the distances covered at night are usually enormously greater than those traversed in the daytime, whilst when using much longer

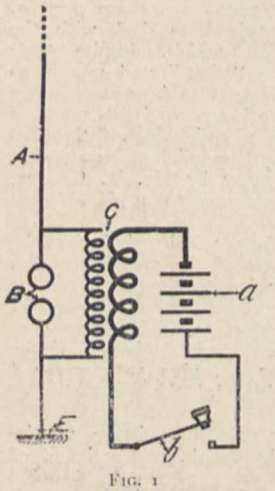

FIG. 1

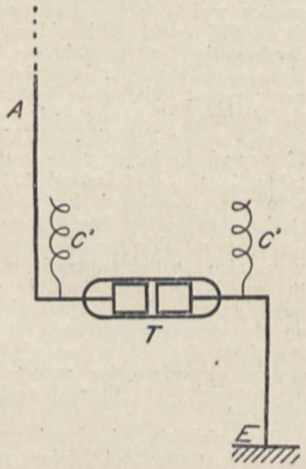

FIG. 2.

waves the range of transmission by day and night is about equal, and sometimes even greater by day?

What explanation has been given of the fact that the night distances obtainable in a north-southerly direction are so much greater than those which can be effected in an east-westerly one?

Why is it that mountains and land generally should greatly obstruct the propagation of short waves when sunlight is present, and not during the hours of darkness?

The general principles on which practical radio-telegraphy is based are now so well known that I need only refer to them in the briefest possible manner.

Wireless telegraphy, which was made possible by the fields of research thrown open by the work of Faraday, Maxwell, and Hertz, is operated by electric waves which are created by alternating currents of very high frequency induced in suitably placed elevated wires or capacity areas. These waves are received or picked up at a distant station on other elevated conductors tuned to the period of the waves, and the latter are revealed to our senses by means of appropriate detectors.

My original system as used in 1896 consisted of the arrangement shown diagrammatically in Fig. 1, where an elevated or vertical wire was employed. This wire sometimes terminated in a capacity, or was connected to earth through a spark gap.

[1] Discourse delivered at the Royal Institution on Friday, June 2, by Commendatore G. Marconi.

By using an induction coil or other source of sufficiently high-tension electricity, sparks were made to jump across the gap; this gave rise to oscillations of high frequency in the elevated conductor and earth, with the result that energy in the form of electric waves was radiated through space.

At the receiving station (Fig. 2) these waves induced oscillatory currents in a conductor containing a detector, in the form of a coherer, which was usually placed between the elevated conductor and earth.

Although this arrangement was extraordinarily efficient in regard to the radiation of electrical energy, it had numerous drawbacks.

The electrical capacity of the system was very small, with the result that the small amount of energy in the aërial was thrown into space in an exceedingly short period of time. In other words the energy, instead of giving rise to a train of waves, was all dissipated after only a few oscillations, and, consequently, anything approaching good tuning between the transmitter and receiver was found to be unobtainable in practice.

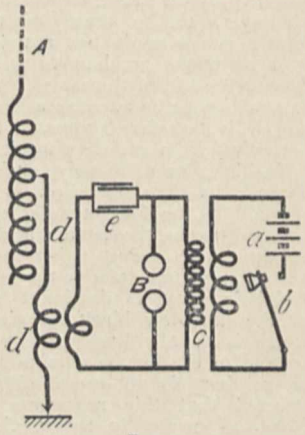

FIG. 3.

Many mechanical analogies could be quoted which show that in order to obtain syntony the operating energy must be supplied in the form of a sufficient number of small oscillations or impulses properly timed. Acoustics furnish us with numerous examples of this fact, such as the resonance produced by the well-known tuning-fork experiment.

Other illustrations of this principle may be given, *e.g.* if we have to set a heavy pendulum in motion by means of small thrusts or impulses, the latter must be timed to the period of the pendulum, as otherwise its oscillations would not acquire any appreciable amplitude.

In 1900 I first adopted the arrangement which is now in general use, and which consists (as shown in Fig. 3) of the inductive association of the elevated radiating wire with a condenser circuit, which may be used to store up a considerable amount of electrical energy and impart it at a slow rate to the radiating wire.

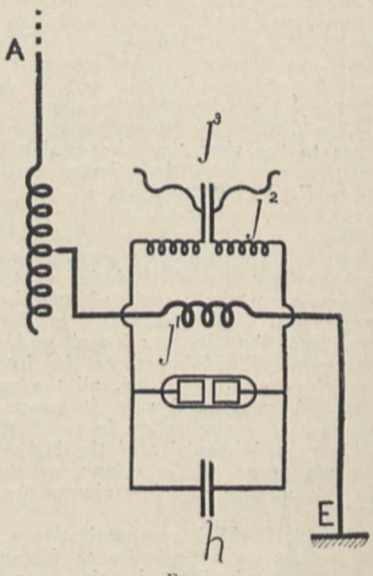

FIG. 4.

As is now well known, the oscillations in a condenser circuit can be made to persist for what is, electrically, a long period of time, and it can be arranged, moreover, that by means of suitable aërials or antennæ these oscillations are radiated into space in the form of a series of waves, which through their cumulative effect are eminently suitable for enabling good tuning or syntony to be obtained between the transmitter and receiver.

The circuits, consisting of the condenser circuit and the elevated aërial or radiating circuit, were more or less closely coupled to each other. By adjusting the inductance

in the elevated conductor, and by the employment of the right value of capacity or inductance required in the condenser circuit, the two circuits were brought into electrical resonance, a condition which I first pointed out as being essential in order to obtain efficient radiation and good tuning.

The receiver (as shown in Fig. 4) also consists of an elevated conductor or aërial connected to earth or capacity through an oscillating transformer. The latter also contains the condenser and detector, the circuits being made to have approximately the same electrical time period as that of the transmitter circuits.

At the long-distance station situated at Clifden in Ireland, the arrangement which has given the best results is based substantially upon my syntonic system of 1900, to which have been added numerous improvements.

An important innovation from a practical point of view was the adoption at Clifden and Glace Bay of air condensers composed of insulated metallic plates suspended in air at ordinary pressure. In this manner we greatly reduce the loss of energy which would take place in consequence of dielectric hysteresis were a glass or solid dielectric employed. A very considerable economy in working also results from the absence of dielectric breakages, for, should the potential be so raised as even to produce a discharge from plate to plate across the condenser, this does not permanently affect the value of the dielectric, as air is self-healing, and one of the few commodities which can be replaced at a minimum of cost.

Various arrangements have been tried and tested for obtaining continuous or very prolonged trains of waves, but it has been my experience that, when utilising the best receivers at present available, it is neither economical nor efficient to attempt to make the waves too continuous. Much better results are obtained when groups of waves (Fig. 5) are emitted at regular intervals in such a manner that their cumulative effect produces a clear musical note in the receiver, which is tuned not only to the periodicity of the electric waves transmitted, but also to their group frequency.

In this manner the receiver may be doubly tuned, with the result that a far greater selectivity can be obtained than by the employment of wave-tuning alone.

In fact, it is quite easy to pick up simultaneously different messages transmitted on the same wave-length, but syntonised to different group frequencies.

So far as wave tuning goes, very good results—almost as good as are obtainable by means of continuous oscillations—can be achieved with groups of waves, the decrement of which is in each group 0·03 or 0·04, which means that about thirty or forty useful oscillations are radiated before their amplitude has become too small to affect perceptibly the receiver.

The condenser circuit at Clifden has a decrement of from 0·015 to 0·03 for fairly long waves.

This persistency of the oscillations has been obtained by the employment of the system shown in Fig. 6, which I first described in a patent taken out in September, 1907. This method eliminates almost completely the spark gap and its consequent resistance, which, as is well known, is the principal cause of the damping or decay of the waves in the usual transmitting circuit.

The apparatus shown in Fig. 6 consists of a metal disc *a* having copper studs firmly fixed at regular intervals in its periphery and placed transversely to its plane. This disc is caused to rotate very rapidly between two other discs *b* by means of a rapidly revolving electric motor or steam turbine. These side discs are also made slowly to turn round in a plane at right angles to that of the middle disc. The connections are as illustrated in the figure. The studs are of such length as just to touch the side discs in passing, and thereby bridge the gap between the latter.

With the frequency employed at Clifden, namely, 45,000, when a potential of 15,000 volts is used on the condenser, the spark gap is practically closed during the time in which one complete oscillation only is taking place, when the peripherical speed of the disc is about 600 feet a second. The result is that the primary circuit can continue oscillating without material loss by resistance in the spark gap. Of course, the number of oscillations which can take place is governed by the breadth or thickness of the side discs, the primary circuit being abruptly opened as soon as the studs attached to the middle disc leave the side discs.

The sudden opening of the primary circuit tends to quench immediately any oscillations which may still persist in the condenser circuit; and this fact carries with it a further and not inconsiderable advantage, for, if the coupling of the condenser circuit to the aërial is of suitable value, the energy of the primary will have practically all passed to the aërial circuit during the period of time in which the primary condenser circuit is closed by the stud filling the gap between the side discs, but after this the opening of the gap at the discs prevents the energy returning to the condenser circuit from the aërial as would happen were the ordinary spark gap employed. In this manner the usual reaction which would take place between the aërial and the condenser circuit can be obviated, with the result that with this type of discharger and with a suitable degree of coupling the energy is radiated from the aërial in the form of a pure wave, the loss from the spark-gap resistance being reduced to a minimum.

I am able to show a resonance curve taken at Clifden, which was obtained from the oscillations in the primary alone (Fig. 5).

An interesting feature of the Clifden plant, especially from a practical and engineering point of view, is the regular employment of high-tension direct current for charging the condenser. Continuous current at a potential which is capable of being raised to 20,000 volts is obtained

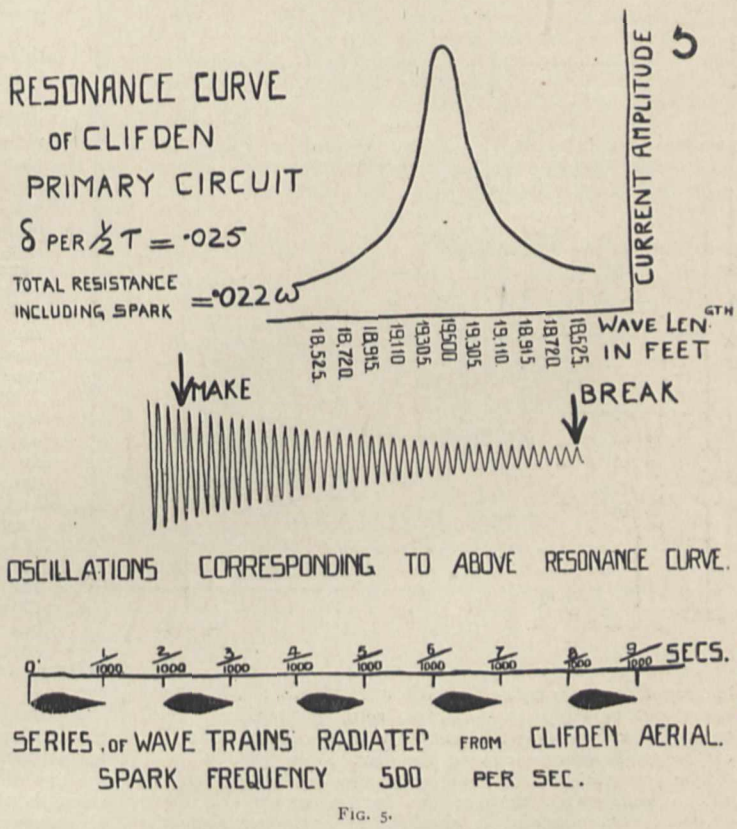

FIG. 5.

by means of special direct-current generators; these machines charge a storage battery consisting of 6000 cells all connected in series, and it may be pointed out that this battery is the largest of its kind in existence. The capacity of each cell is 40 ampere hours. When employing the cells alone, the working voltage is from 11,000 to 12,000 volts, and when both the direct-current generators and the battery are used together the potential may be raised to 15,000 volts through utilising the gassing voltage of the storage cells.

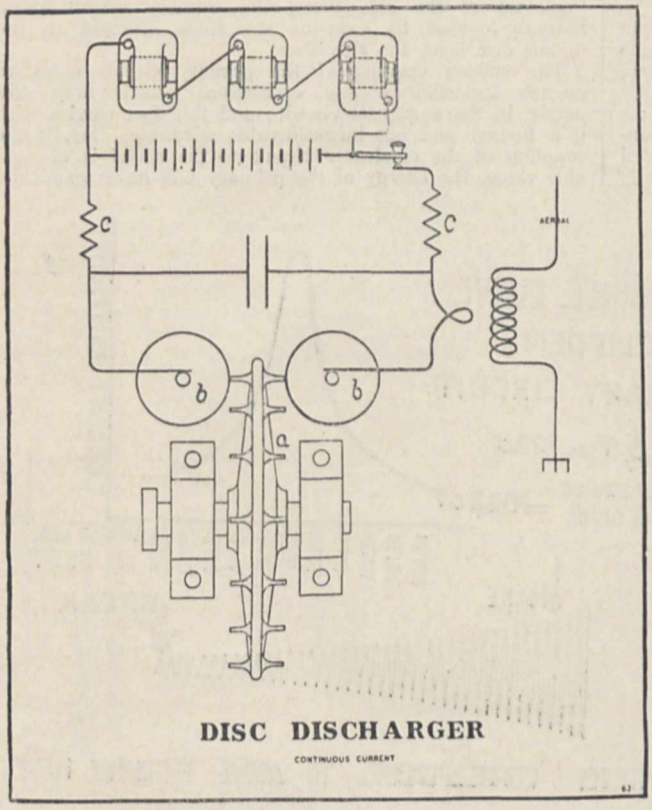

FIG. 6.

For a considerable portion of the day the storage battery alone is employed, with a result that for sixteen hours out of the twenty-four no running machinery need be used for operating the station with the single exception of the small motor revolving the disc.

The potential to which the condenser is charged reaches 18,000 volts when that of the battery or generators is 12,000. This potential is obtained in consequence of the rise of potential at the condenser plates, brought about by the rush of current through the choking or inductance coils at each charge. These coils are placed between the battery or generator and the condenser *c*, Fig. 6.

No practical difficulty has been encountered either at Clifden or Glace Bay in regard to the insulation and maintenance of these high-tension storage batteries. Satisfactory insulation has been obtained by dividing the battery into small sets of cells placed on separate stands. These stands are suspended on insulators attached to girders fixed in the ceiling of the battery-room. A system of switches, which can all be operated electrically and simultaneously, divides the battery into sections, the potential of each section being low enough to enable the cells to be handled without inconvenience or risk.

The arrangement of aërial adopted at Clifden and Glace Bay is shown in Fig. 7. This system, which is based on the result of tests which I first described before the Royal Society in June, 1906,[1] not only makes it possible to radiate efficiently and receive waves of any desired length, but it also tends to confine the main portion of the radiation to any desired direction. The limitation of transmission to one direction is not very sharply defined, but nevertheless the results obtained are exceedingly useful for practical working.

In a similar manner, by means of these horizontal wires, it is possible to define the bearing or direction of a sending station and also limit the receptivity of the receiver to waves arriving from a given direction.

The commercial working of radio-telegraphy and the widespread application of the system on shore and afloat in nearly all parts of the world have greatly facilitated the marshalling of facts and the observation of effects. Many of these, as I have already stated, still await a satisfactory explanation.

A curious result which I first noticed more than nine years ago in long-distance tests carried out on the ss. *Philadelphia*, and which still remains an important feature in long-distance space telegraphy, is the detrimental effect produced by daylight on the propagation of electric waves over great distances.

The generally accepted hypothesis of the cause of this absorption of electric waves in sunlight is founded on the belief that the absorption is due to the ionisation of the gaseous molecules of the air affected by the ultra-violet light, and as the ultra-violet rays which emanate from the sun are largely absorbed in the upper atmosphere of the earth, it is probable that that portion of the earth's atmosphere which is facing the sun will contain more ions or electrons than that which is in darkness, and therefore, as Sir J. J. Thomson has shown,[1] this illuminated or ionised air will absorb some of the energy of the electric waves.

The wave-length of the oscillations employed has much to do with this interesting phenomenon, long waves being subject to the effect of daylight to a very much lesser degree than are short waves.

Although certain physicists thought some years ago that the daylight effect should be more marked on long waves than on short, the reverse has been my experience; indeed, in some Transatlantic experiments, in which waves about 8000 metres long were used, the energy received by day at the distant receiving station was usually greater than that obtained at night.

Recent observation, however, reveals the interesting fact that the effects vary greatly with the direction in which transmission is taking place, the results obtained when transmitting in a northerly and southerly direction being often altogether different from those observed in the easterly and westerly one.

Research in regard to the changes in the strength of the received radiations which are employed for telegraphy across the Atlantic has been recently greatly facilitated by the use of sensitive galvanometers, by means of which the strength of the received signals can be measured with a fair degree of accuracy.

In regard to moderate power stations such as are

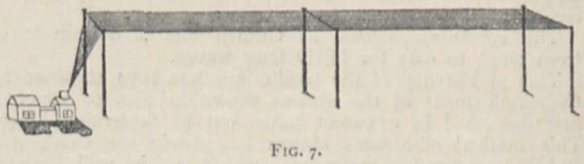

FIG. 7.

employed on ships, and which, in compliance with the International Convention, use wave-lengths of 300 and 600 metres, the distance over which communication can be effected during daytime is generally about the same, whatever the bearing of the ships to each other or to the land stations, whilst at night interesting and apparently curious results are obtained. Ships more than 1000 miles away, off the south of Spain or round the coast of Italy,

[1] "On Methods whereby the Radiation of Electric Waves may be mainly confined," &c. Proceedings of the Royal Society, A. vol. lxxvii., 1906.

[1] See *Philosophical Magazine*, August, 1902, ser. 6, vol. iv., p. 253, J. J. Thomson, "On some Consequences," &c.

can almost always communicate during the hours of darkness with the Post Office stations situated on the coasts of England and Ireland, whilst the same ships when at a similar distance on the Atlantic to the westward of these islands, and on the usual track between England and America, can hardly ever communicate with these shore stations unless by means of specially powerful instruments.

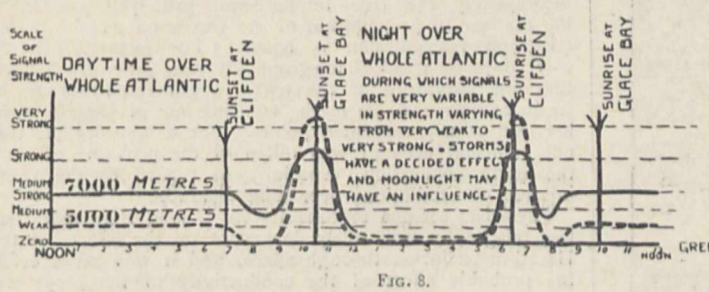

FIG. 8.

It is also to be noticed that in order to reach ships in the Mediterranean the electric waves have to pass over a large portion of Europe and, in many cases, over the Alps. Such long stretches of land, especially when including very high mountains, constitute, as is well known, an insurmountable barrier to the propagation of short waves during daytime. Although no such obstacles lie between the English and Irish stations and ships in the North Atlantic *en route* for North America, a night transmission of 1000 miles is there of exceptionally rare occurrence. The same effects generally are noticeable when ships are communicating with stations situated on the Atlantic coast of America.

Although high-power stations are now used for communicating across the Atlantic Ocean, and messages can be sent by day as well as by night, there still exist periods of fairly regular daily occurrence during which the strength of the received signals is at a minimum. Thus in the morning and the evening, when, in consequence of the difference in longitude, daylight or darkness extends only part of the way across the ocean, the received signals are at their weakest. It would almost appear as if electric waves in passing from dark space to illuminated space, and *vice versa*, were reflected and refracted in such manner as to be diverted from the normal path.

Later results, however, seem to indicate that it is unlikely that this difficulty would be experienced in telegraphing over equal distances north and south on about the same meridian, as, in this case, the passage from daylight to darkness would occur more rapidly over the whole distance between the two stations.

I have here some diagrams which have been carefully prepared by Mr. H. J. Round. These show the average daily variation of the signals received at Clifden from Glace Bay.

The curves traced on diagram No. 8 show the usual variation in the strength of these Transatlantic signals on two wave-lengths, one of 7000 metres and the other of 5000 metres.

The strength of the received waves remains, as a rule, steady during daytime.

Shortly after sunset at Clifden they become gradually weaker, and about two hours later they are at their weakest. They then begin to strengthen again, and reach a very high maximum at about the time of sunset at Glace Bay.

They then gradually return to about normal strength, but through the night they are very variable. Shortly before sunrise at Clifden the signals commence to strengthen steadily, and reach another high maximum shortly after sunrise at Clifden. The received energy then steadily decreases again until it reaches a very marked minimum a short time before sunrise at Glace Bay. After that the signals gradually come back to normal day strength.

It can be noticed that, although the shorter wave gives on the average weaker signals, its maximum and minimum variations of strength very sensibly exceed that of the longer wave.

Diagram 9 shows the variations at Clifden during periods of twenty-four hours, commencing at 12 noon, throughout the month of April, 1911, the vertical dotted lines representing sunset and sunrise at Glace Bay and Clifden.

Diagram 10 shows the curve for the first day of each month for one year from May, 1910, to April, 1911.

I carried out a series of tests over longer distances than had ever been previously attempted in September and October of last year between the stations at Clifden and Glace Bay, and a receiving station placed on the Italian ss. *Principessa Mafalda*, in the course of a voyage from Italy to the Argentine (Fig. 11).

During these tests the receiving wire was supported by means of a kite, as was done in my early Transatlantic tests of 1901, the height of the kite varying from about 1000 to 3000 feet. Signals and messages were obtained without difficulty by day as well as by night up to a distance of 4000 statute miles from Clifden.

Beyond that distance reception could only be carried out during night time. At Buenos Aires, more than 6000 miles from Clifden, the night signals from both Clifden and Glace Bay were generally good, but their strength suffered some variations.

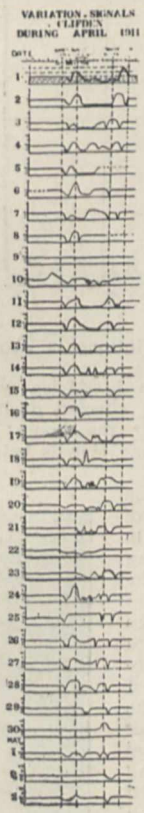

FIG. 9.

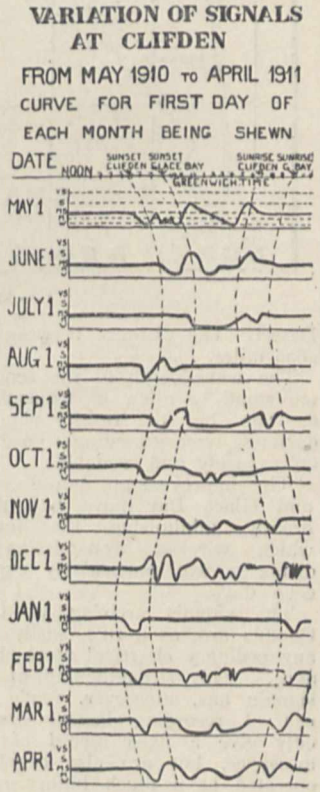

FIG. 10.

It is rather remarkable that the radiations from Clifden should have been detected at Buenos Aires so clearly at night time and not at all during the day, whilst in Canada the signals coming from Clifden (2400 miles distant) are no stronger during the night than they are by day.

Further tests have been carried out recently for the

Italian Government between a station situated at Massaua in East Africa and Coltano in Italy. Considerable interest attached to these experiments in view of the fact that the line connecting the two stations passes over exceedingly dry country and across vast stretches of desert, including parts of Abyssinia, the Sudan, and the Libyan

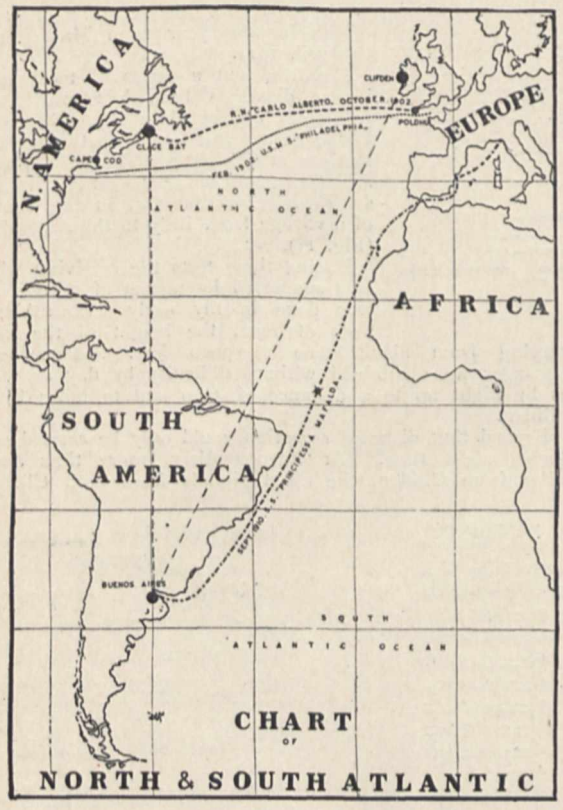

FIG. 11.

Desert. The distance between the two stations is about 2600 miles.

The wave-length of the sending station in Africa was too small to allow of transmission being effected during daytime, but the results obtained during the hours of darkness were exceedingly good, the received signals being quite steady and readable.

The improvements introduced at Clifden and Glace Bay have had the result of greatly minimising the interference to which wireless transmission over long distances was particularly exposed in the early days.

The signals arriving at Clifden from Canada are, as a rule, easily read through any ordinary electrical atmospheric disturbance. This strengthening of the received signals has, moreover, made possible the use of recording instruments which not only give a fixed record of the received messages, but are also capable of being operated at a much higher rate of speed than could ever be obtained by means of an operator reading by sound or sight. The record of the signals is obtained by means of photography in the following manner. A sensitive Einthoven string galvanometer is connected to the magnetic detector or valve receiver, and the deflections of its filament caused by the incoming signals are projected and photographically fixed on a sensitive strip, which is moved along at a suitable speed (Fig. 12). On some of these records, which I am able to show, it is interesting to note the characteristic marks and signs produced amongst the signals by natural electric waves or other electrical disturbances of the atmosphere, which, on account of their doubtful origin, have been called "X's."

Although the mathematical theory of electric wave propagation through space was worked out by Clerk Maxwell more than fifty years ago, and notwithstanding all the experimental evidence obtained in laboratories concerning the nature of these waves, yet, so far, we understand but incompletely the true fundamental principles concerning the manner of propagation of the waves on which wireless telegraph transmission is based. For example, in the early days of wireless telegraphy it was generally believed that the curvature of the earth would constitute an insurmountable obstacle to the transmission of electric waves between widely separated points. For a considerable time not sufficient account was taken of the probable effect of the earth connection, especially in regard to the transmission of oscillations over long distances.

Physicists seemed to consider for a long time that wireless telegraphy was solely dependent on the effects of free Hertzian radiation through space, and it was years before the probable effect of the conductivity of the earth was considered and discussed.

Lord Rayleigh, in referring to Transatlantic radiotelegraphy, stated in a paper read before the Royal Society in May, 1903, that the results which I had obtained in signalling across the Atlantic suggested "a more decided bending or diffraction of the waves round the protuberant earth than had been expected," and, further, said that it imparted a great interest to the theoretical problem.[1] Prof. Fleming in his book on electric-wave telegraphy gives diagrams showing what may be taken to be a diagrammatic representation of the detachment of semi-loops of electric strain from a simple vertical wire (Fig. 13).

As will be seen, these waves do not propagate in the same manner as does free radiation from a classical Hertzian oscillator, but instead glide along the surface of the earth.

Prof. Zenneck[2] has carefully examined the effect of earthed receiving and transmitting aërials, and has endeavoured to show mathematically that when the lines of electrical force, constituting a wave front, pass along a surface of low specific inductive capacity—such as the earth—they become inclined forward, their lower ends being retarded by the resistance of the conductor to which they are attached. It therefore would seem that wireless telegraphy as at present practised is, to some extent at least, dependent on the conductivity of the earth, and that the difference in operation across long distances of sea compared to over land is sufficiently explained by the fact that sea water is a much better conductor than is land.

The importance or utility of the earth connection has been sometimes questioned, but in my opinion no practical

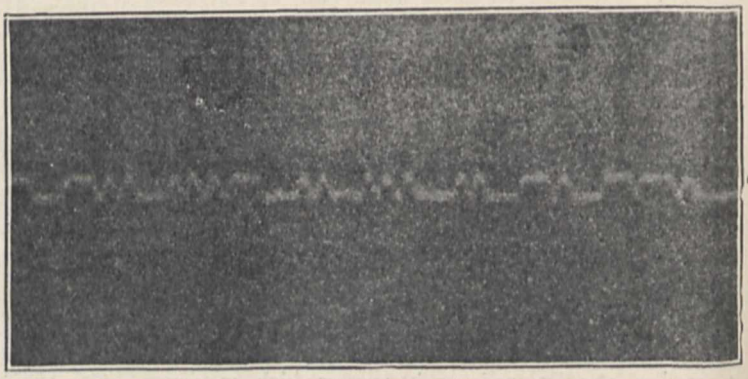

FIG. 12.

system of wireless telegraphy exists where the instruments are not in some manner connected to earth. By connection to earth I do not necessarily mean an ordinary

[1] Proceedings of the Royal Society, vol. lxxii., May 28, 1903.
[2] See J. Zenneck, *Annalen der Physik*, 23. 5. p. 846, September, 1903. *Physikal Zeitschrift*, No. 2, p. 50; No. 17, p. 553.

metallic connection as used for wire telegraphs. The earth wire may have a condenser in series with it, or it may be connected to what is really equivalent, a capacity area placed close to the surface of the ground. It is now perfectly well known that a condenser, if large enough, does not prevent the passage of high-frequency oscillations, and therefore in this case, when a so-called balancing capacity is used, the antenna is for all practical purposes connected to earth.

I am also of opinion that there is absolutely no foundation in the statement, which has recently been repeated, to the effect that an earth connection is detrimental to good tuning, provided, of course, that the earth is good.

Certainly, in consequence of its resistance, what electricians call a bad earth will damp out the oscillations, and in that way make tuning difficult; but no such effect is noticed when employing an efficient earth connection.

In conclusion, I believe that I am not any too bold when I say that wireless telegraphy is tending to revolutionise our means of communication from place to place on the earth's surface. For example, commercial messages containing a total of 812,200 words were sent and received between Clifden and Glace Bay from May 1, 1910, to the end of April, 1911; wireless telegraphy has already furnished means of communication between ships and the shore where communication was before practically impossible. The fact that a system of imperial wireless telegraphy is to be discussed by the Imperial Conference now holding its meetings in London shows the supremely important position which radio-telegraphy over long distances has assumed in the short space of one decade. Its importance from a commercial, naval, and military point of view has increased very greatly during the last few years as a consequence of the innumerable stations which have been erected or are now in course of construction on various coasts, in inland regions, and on board ships in all parts of the world. Notwithstanding this multiplicity of stations and their almost constant operation, I can say from practical experience that mutual interference between properly equipped and efficiently tuned instruments has so far been almost entirely absent. Some interference does without doubt take place between ships in consequence of the fact that the two wave-lengths adopted in accordance with the rules laid down by the International Convention are not sufficient for the proper handling of the very large amount of messages transmitted from the ever-increasing number of ships fitted with wireless telegraphy. A considerable advantage will be obtained by the utilisation of a third and longer wave to be employed exclusively for communication over long distances.

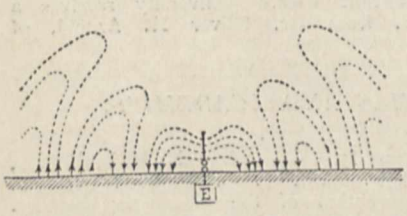

FIG. 13.

In regard to the high-power Transatlantic stations, the facility with which interference has been prevented has to some extent exceeded my expectations. At a receiving station situated at a distance of only eight miles from the powerful sender at Clifden, during a recent demonstration arranged for the Admiralty, messages could be received from Glace Bay without any interference from Clifden when this latter station was transmitting at full power on a wave-length differing only 25 per cent. from the wave radiated from Glace Bay, the ratio between the maximum recorded range of Clifden and 8 miles being in the proportion of 750 to 1.

Arrangements are being made permanently to send and receive simultaneously at these stations, which, when completed, will constitute in effect the duplexing of radio-telegraphic communication between Ireland and Canada.

The result which I have last referred to also goes to show that it would be practicable to operate at one time on slightly different wave-lengths a great number of long-distance stations situated in England and Ireland without danger of mutual interference.

The extended use of wireless telegraphy is principally dependent on the ease with which a number of stations can be efficiently worked in the vicinity of each other.

Considering that the wave-lengths at present in use range from 200 to 23,000 feet, and, moreover, that wave-group tuning and directive systems are now available, it is not difficult to foresee that this comparatively new method of communication is destined to fill a position of the greatest importance in facilitating communication throughout the world.

Apart from long-distance work, the practical value of wireless telegraphy may perhaps be divided into two parts, (1) when used for transmission over sea, (2) when used over land.

Many countries, including Italy, Canada, and Spain, have already supplemented their ordinary telegraph systems by wireless telegraphy installations, but some time must pass before this method of communication will be very largely used for inland purposes in Europe generally, owing to the efficient network of landlines already existing, which render further means of communication unnecessary; and therefore it is probable that, at any rate for the present, the main use of radio-telegraphy will be confined to extra-European countries, in some of which climatic conditions and other causes absolutely prohibit the efficient maintenance of landline telegraphy. A proof of this has been afforded by the success which has attended the working of the stations recently erected in Brazil on the Upper Amazon.

By the majority of people the most marvellous side of wireless telegraphy is perhaps considered to be its use at sea. Up to the time of its introduction, ships at any appreciable distance from land had no means of getting in touch with the shore throughout the whole duration of their voyage. But those who now make long sea journeys are no longer cut off from the rest of the world; business men can continue to correspond at reasonable rates with their offices in America or Europe; ordinary social messages can be exchanged between passengers and their friends on shore; a daily newspaper is published on board most of the principal liners giving the chief news of the day. Wireless telegraphy has on more than one occasion proved an invaluable aid to the course of justice. a well-known instance of which is the arrest which took place recently through its agency of a notorious criminal when about to land in Canada.

The chief benefit, however, of radio-telegraphy lies in the facility which it affords to ships in distress of communicating their plight to neighbouring vessels or coast stations; that it is now considered indispensable for this reason is shown by the fact that several Governments have passed a law making a wireless telegraph installation a compulsory part of the equipment of all passenger boats entering their ports.

THE PROPOSED TEACHERS' REGISTRATION COUNCIL.

IT would seem from the recently published Parliamentary Paper (Cd. 5726), entitled "Further Papers relating to the Registration of Teachers and the proposed Registration Council," that the formation of the much desired Teachers' Council, with which will rest the responsibility of preparing a Register of Teachers, will not be long delayed.

The papers include a summary of proceedings at the conference of November, 1909, convened by the Federal Council of Secondary School Associations in conjunction with other important educational associations; the alternative proposals discussed in Parliament in 1906, and other minutes and important data concerning the formation of such a council of teachers. The most important section, however, is that containing a report by Sir Robert Morant, secretary to the Board of Education, upon three informal conferences held recently at the Board of Education to discuss the whole matter, together with the outline of a scheme for the formation of a Teachers' Council.

This scheme lays great emphasis upon the question of the unification of the teaching profession, and makes provision for full representation upon the council of the universities of England and Wales. On this point Sir Robert Morant says:—

"From the point of view of a council which is to be, above all things, representative of the whole teaching profession, it is obvious that there must be a university group just as much as an elementary group and a secondary group. To speak of a professional council of the teaching profession without a full inclusion of the universities would obviously be absurd."

"Now the number of universities in England and Wales is eleven, and it is obvious that it would be quite impossible for these eleven universities to combine as an electoral college to name (say) five or six individuals to represent them, collectively, on such a council as is here in question, and the only conceivable method of meeting the case is that each of the eleven should have one representative.

"If, then, this group is to be composed of eleven members, this must be equally so in regard to the other three groups, according to the principle already proposed and accepted. . . . The council would thus be composed of four groups, each having eleven members."

The four groups which are each to be represented by eleven members are the university, elementary, secondary, and technological and specialist. In defining the last-named group, Sir Robert Morant remarks:—

"From some of the difficulties that have specially arisen in respect of that part of the scheme, it would seem that its nomenclature is, in some senses, inappropriate, and that what is really in question, on this side, is the need of representation of what may be called 'specialist teachers' (as well as technological teachers), as contrasted with what are usually regarded as teachers in the field of general education, or as 'general practitioners,' as was suggested at my second conference."

"It would therefore seem essential that the Teachers' Council, to be really representative of the whole profession, must comprise a representation of university teachers just as much as of elementary teachers, of secondary teachers, and of technological and specialist teachers; a council composed of these four elements would, in fact, be *representative of the whole teaching profession*, which otherwise would not be the case."

Again to quote the secretary of the Board of Education:—

"It will probably, however, be the case, from the very fact that the council will comprise representatives of widely different points of view as belonging to widely different branches of the profession, that its deliberations will best be managed under the chairmanship of someone not identified with any one of the several branches or sections; and from this point of view it would probably be desirable that the Order in Council should provide one vacancy for a chairman, to be chosen by the council from outside their numbers, who would doubtless be a man of distinction and possessing the characteristics requisite in an effective president of a body of this kind, whose deliberations would constantly be upon matters in which divergent interests and opposing points of view would frequently occur."

"This would bring the total number of the council to forty-five—a large body, but by no means too large to represent adequately the whole of so vast and important a profession as the teaching profession, nor, on the other hand, too large for arriving at effective decisions on the points likely to come before it, seeing that many of the more technical points would first have been thrashed out in special committees, and in meetings of one or more special committees meeting together, before coming before the council to be decided finally."

Mr. Runciman appends a note to the report signifying his agreement, and requesting Sir Robert Morant to have a draft made, as soon as possible, of an Order in Council on the lines outlined above.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The Harkness scholarship for 1911 has been awarded to Mr. T. C. Nicholas and Mr. J. Romanes. The Frank Smart prizes have been awarded to Mr. S. R. Price (botany) and Mr. S. T. Burfield (zoology).

Mr. C. T. R. Wilson has been reappointed demonstrator of experimental physics for a period of five years from Michaelmas, 1911.

Mr. F. T. Brooks has been appointed senior demonstrator of botany, and Mr. D. Thoday junior demonstrator of botany, both for two years ending September 30, 1913.

WE learn from *The Times* that Mr. Robert Christison, of Burwell Park, Lincolnshire, and late of Lammermoor, Queensland, has telegraphed to Sir William MacGregor, the Governor of the State of Queensland and Chancellor of the University of Brisbane, his willingness to contribute a further 1000*l.* (having already given 1000*l.*) for the foundation of a chair for tropical and sub-tropical agriculture.

IT is announced in *Science* that Mr. Morton P. Plant has offered to give an endowment of 200,000*l.* for the woman's college which is to be established at New London, Conn.; it is a condition that the name shall be changed to the Connecticut College for Women. From the same source we learn that the General Educational Board has made public a list of its latest grants for colleges and schools, amounting in all to 126,800*l.* All the gifts to colleges are conditional and are applied to endowment only. Other gifts may be applied to current expenses. The grants include:—

College	Appropriation £	To be raised £
Converse, Spartansburg, S.C. ...	10,000	20,000
Drury, Springfield, Mo....	15,000	65,000
Franklin, Franklin, Ind.	15,000	65,000
Franklin and Marshall, Lancaster, Pa.	10,000	45,000
Huron, Huron, S.D.	20,000	20,000
Pennsylvania, Gettysburg, Pa. ...	10,000	30,000
Totals	80,000	245,000

Science also states that Brown University receives a bequest of 17,000*l.* from Dr. Oliver H. Arnold, of Providence.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society June 15.—Sir Archibald Geikie, K.C.B., president, in the chair.—Prof. T. G. **Brodie**: Croonian lecture: A new conception of the glomerular activity. All the more recent work upon the kidney has proved conclusively that Ludwig's explanation of the glomerular function, viz. that the glomerulus is a filtering mechanism, is incorrect. The structural details of this highly characteristic portion of the renal apparatus strongly suggest that in some way or other the blood pressure is made use of in the work of the glomerulus. Having excluded filtration in this connection, there is yet another way in which it could be directly utilised, viz. in setting up a pressure-head by means of which the watery part of the urine could be driven through the very long and narrow tubule. In reference to this side of its activity, it is suggested that the glomerulus be termed a "propulsor." An approximate calculation of the pressure-head necessary to drive the fluid along the tubule during the height of activity proves that one about equal to that present within the glomerular capillaries is required. Evidence of the action of a high intra-tubular pressure is at once obtainable from the microscopic examination of a kidney after activity. The capsules of Bowman are greatly distended and approximately spherical in shape, the glomeruli are moderately enlarged and no longer fill the capsular spaces. The tubules are straightened out, stretched, and possess a conspicuous lumen. All these changes are exaggerated by any procedure which favours the action of this intra-tubular pressure, such as a high arterial blood pressure, obstruction to the outflow of urine from the ureter, or the stripping of the capsule from the kidney. Further, the kidney during activity is tense and hard, and distends its capsule to the utmost. This conception of the glomerular function affords a complete explanation of the existence of a firm and inextensible capsule surrounding the kidney, as also of such phenomena as the maximum ureter pressure, the dependence of the rate of discharge of urine from the kidney upon the general blood pressure, and the degree of dilatation of the renal arterioles, &c. Applying

this theory to the study of the action of diuretics in animals in which the blood pressure has been lowered so far that propulsion can no longer occur, we obtain evidence as to the parts of the renal tubules acted upon by these different substances.—A. R. **Cushny**: The action of Senecio alkaloids and the causation of hepatic cirrhosis in cattle. Various species of Senecio (ragwort) have been shown to induce fatal poisoning in cattle and horses in South Africa, Canada, and New Zealand. The alkaloids of one of these species were isolated by Watt, and their pharmacological examination shows that they induce the same symptoms as the entire plant. The Senecio species in this country proved non-toxic, except the common groundsel (*S. vulgaris*), and extracts from the ragwort grown in Canada, where the plant is poisonous, proved devoid of action also. This may, however, be due to the season at which the plant was gathered.—G. **Buchanan**: Note on developmental forms of *T. brucei* (*pecaudi*) in the internal organs, axillary glands, and bone-marrow of the gerbil.—Captain W. B. **Fry**: A preliminary note on the extrusion of granules by trypanosomes.

Physical Society, June 9.—Prof. H. L. Callendar, F.R.S., in the chair.—W. **Mason**: The Lüders' lines on mild steel. Previous investigations have shown that Lüders' lines on specimens of mild steel and wrought iron, strained in tension, are inclined at about 50° to the axis of pull. For tests in compression the information available is not precise, and though the angle of the lines with the direction of the compression is commonly understood to be about 40°, some doubt has been thrown on this point. The author had found previously that the lines are well developed on the surface of mild steel tubes. Since it was easy to obtain a compressive stress of practically uniform distribution in tubes under end pressure, while at the same time a hoop tensile stress could be induced by internal fluid pressure, the author confined his attention to the lines on tubular specimens. These were of mild steel, either hot or cold drawn, and most of them were annealed. The Lüders' lines on the outer surface appeared at the yield point indicated by the extensometer, *i.e.* their appearance coincided with the commencement of the large "yield" strain. In all cases where there were lines on the inner and outer surfaces of a tube, an inner and outer line, and also the ends of these lines, were found to be radially opposite, showing that the lines were traces of surfaces or canals of disturbance which passed through the tube wall, and indicating, moreover, that the disturbance spread spirally onwards, and not outwardly from a line initially formed on the more severely stressed inner surface. The conclusion is drawn that the Lüders' surfaces have the same, or approximately the same, inclination to an axis of simple pull or simple push. With stresses of opposite sign at right angles to each other, the lines and surfaces are more inclined to the stress of greater intensity, and with equal intensities the surfaces are at about 45°.—Prof. S. P. **Thompson**: A new method of harmonic analysis by averaging selected ordinates. Assume with Fourier that the curve representing any periodic single-valued function of x may be expressed by the harmonic series

$$y = A_1 \sin x + A_2 \sin 2x + A_3 \sin 3x + \ldots\ldots + B_1 \cos x + B_2 \cos 2x + B_3 \cos 3x.$$

Then to find the coefficient of any term, A_n or B_n, it suffices—subject to a limitation stated below—to measure off on the curve $2n$ equidistant ordinates over one period, that is, spaced at successive intervals apart of π/n. Then, having reversed the sign of every alternate ordinate, the simple algebraic mean of them gives the coefficient sought. For cosine-coefficients the first ordinate must be taken at the origin, while for sine-coefficients the first ordinate must be taken at a point $\frac{1}{2}\pi/n$ from the origin. The process is much facilitated by the use of templates of transparent celluloid having equispaced vertical lines engraved upon them. They are laid down on the curve, and the values of the selected ordinates are thus readily measured off. For analysis of valve-motions, of alternating-current curves, of tidal observations, and diurnal magnetic variations, the method presents certain advantages, as it requires no multiplication of ordinates by sines or cosines.—Prof. S. P. **Thompson**: Demonstration of the subjective nature of the difference tone. Two tuning-forks of frequencies 3328 and 3584 were sounded loudly. On striking the second the difference tone was heard, but while the notes from the two forks seemed to come in a definite direction from an external source, the difference tone seemed to be located in the ear itself.—Sir George **Greenhill**: Spinning tops and gyroscopic apparatus. A 52-inch Otto bicycle wheel was shown mounted on an axle with ball bearings, and spun by hand with the point in a small cup, to serve as a spinning top visible to a large audience. The gyroscopic apparatus was made of an ordinary 28-inch bicycle wheel, the axle screwed into a stalk of a short length of rifle barrel, suspended from a lug on a bicycle hub; the hub is fastened to an iron bracket, which is bolted to the under side of a beam or sleeper, large enough to absorb vibration, and resting on two step ladders. The wheel is spun by hand, and the axle is projected to obtain any desired gyroscopic motion, undulating, looped, or with cusps. The wheel can be detached by unscrewing the pin through the lug, and can then be used like the large wheel as a spinning top, or as the "Top on the top of a Top" described in Maxwell's "Life." Put the wheel out of balance by a bar through the spoke and hold the axle, and it will serve as a pendulum, making oscillations however large, or complete revolutions, and the effect may be investigated of varying the angle of the axle with the vertical.—Prof. H. N. **Allen**: A model illustrating the passage of a light wave through quartz. If a crystal is so cut, and a wave sent through it in such a way as to avoid separation of the two component waves by double refraction, it is easy to construct models showing how a vibration gradually alters in form as it passes through the crystal. The model exhibited illustrates the passage of a wave originally plane polarised through a crystal which rotates the plane of polarisation of light sent along its axis (quartz).—Prof. A. **Anderson** and J. E. **Bowen**: The measurement of contact differences of potential. The paper describes two methods of measuring the contact differences of potential of pairs of metals. The first, or deflection, method depends on the property which a radio-active source has of destroying a field of electrostatic force in air, and the second, or null, method on the possibility of determining by means of such a source whether such a field exists between two plates at zero potential. Measurements were made on ten different metals, and it was found that both methods gave practically the same results provided that the time which was allowed to elapse between the two measurements was sufficiently small. The addition law was verified.—A. **Johnstone**: A short table of circular and hyperbolic functions for complex values of the argument.

Zoological Society, June 13.—Mr. E. T. Newton, F.R.S., in the chair.—H. G. **Plimmer**: Report on the pathological examination of rats caught in the Regent's Park and in the society's gardens. Five hundred rats had been examined between January 1 and May 17, all in a precisely similar manner. The spleen, lungs, glands, and blood were examined microscopically, and from any animal which looked in any way unhealthy cultures were made. The results were summarised as follows:—5 rats were caught in the park, and 495 in the gardens; 283 of these were males and 217 females. Three rats had tubercle, 10 had tapeworm cysts in the liver, 49 had *Trypanosoma lewisi* in their blood, 2 had empyema (not tubercular), 1 had a tumour of the lower jaw (the result of an old injury), and 1 had pleuritis and hydrothorax (not tubercular). Bacteria were found in 71 rats: in 40 in the lungs and in 31 in the spleen. Saccharomycetes were found in the lungs of 16 rats. Fleas were found on 4 rats, and lice on 3 rats. The general condition of the rats was very good, and in none was anything at all suspicious found.—Dr. R. E. **Drake-Brockman**: Antelopes of the genera Madoqua and Rhynchotragus found in Somaliland. The author made general remarks on all the dik-diks, and gave a short account of the species and subspecies, including the description of a new form.—Hon. Paul A. **Methuen**: An amphipod from the Transvaal. A detailed description of a new fresh-water gammarid of the genus Eucrangonyx found in caves in the Transvaal.—R. **Lydekker**: Three African animals. The first specimen was the skull of a

Somali rhinoceros, a race for which the author adopted the name *Rhinoceros bicornis somalicus*, Potocki. A klipspringer skull from northern Nigeria, characterised by its great width and the peculiar form of the lacrymal bone, was described as the type of a new race, *Oreotragus saltator porteusi*. Finally, a gazelle from Algeria was referred to a new species, *Gazella hayi*, agreeing approximately in size with *G. dorcas*, but distinguished by the much straighter and non-lyrate horns, each of which carried only about a dozen rings. The face-markings were approximate to those of *G. cuvieri*.—C. E. **Hellmayr**: A contribution to the ornithology of western Colombia. This memoir was based on a collection made by Mr. M. G. Palmer in 1908 and 1909, which, though numbering hardly 700 specimens, was of considerable interest and contained many rare species, and also furnished information of importance to students of zoogeographical problems.—Angel **Cabrera**: Subspecies of the Spanish ibex. The author dealt with the geographical distribution of, and the differences between, the various races, and described a new subspecies from the Sierra de Gredos, the type-specimen of which was in the Madrid Museum.

Linnean Society, June 15.—Dr. A. B. Rendle, F.R.S., vice-president, in the chair.—Miss H. M. **Cunnington**: The anatomy of *Enhalus acoroides*, Rich.—Prof. **Imms**: The life-history of *Croce filiformis*, Westw.—Papers on insect collections from the islands of the Indian Ocean, communicated by Prof. J. Stanley Gardiner. Eight papers were brought forward, four dealing with various groups of Hymenoptera, one with Lepidoptera, and three with Diptera. The first was by Prof. J. J. **Kieffer**, on parasitic Hymenoptera of the family Cynipidæ, or gall-wasps. This family appears to be poorly represented in the Seychelles; only eight species (all new) were found, none belonging to the gall-forming section of the family, but all to the zoophagous sections; their size as compared with that of many zoophagous Cynipidæ in other parts of the world is very small. The second paper was by the same author, dealing with the group of small and minute parasitic Hymenoptera known as Proctotrupoidea. A rich material of these was obtained, representing seven of the families into which the super-family Proctotrupoidea is divided, and consisting of sixty-six species, all new to science. These insects are very incompletely known, and several of the genera enumerated in the paper are also new. The third paper was on the bees obtained by the expedition to the Seychelles and Aldabra in 1908–9, by Prof. T. D. A. **Cockerell**, of the University of Colorado. It adds considerably to the previously known bee fauna of these islands, fifteen species being enumerated, eight of which are new to science. The author shows that the bees of the Seychelles consist of (i) an endemic element, composed partly of species without close allies elsewhere, and partly of species closely allied to forms found in other parts of the world, and (ii) certain widely spread species, perhaps introduced by man. The Aldabra bee fauna also contains an endemic element, as well as a single Madagascar species. This paper was followed by that of Mr. G. **Meade-Waldo** on the wasps (Diploptera) obtained by the expedition; it enumerates five kinds, but adds no species to the previous lists. Mr. J. C. F. **Fryer's** paper deals with all the Lepidoptera obtained by the expedition of 1908–9, excepting the plume-moths and the Tortrices and Tineina, which were worked out some time ago by Mr. Bainbrigge Fletcher and Mr. Meyrick respectively. Almost all the material from Aldabra, and some of that from the Seychelles, was collected by the author himself. The total number of Lepidoptera known from the Seychelles (including those dealt with previously by Mr. Fletcher and Mr. Meyrick) is now 240, of which more than 120 are peculiar to the islands. Mr. Fryer's own paper deals with 123 species, of which thirty are new. He states that these thirty are for the most part very distinct and well separated from their allies, while the non-peculiar species are mostly widely distributed, with a slight preponderance of African forms. With regard to Aldabra, sixty-six species are known from there, seven being, so far as is known, peculiar, while the rest all belong to African or Madagascar forms. The next two papers were by Mr. J. E. **Collin**, on two families of small and obscure flies, the Borboridæ and Phoridæ. All the material of these families is from the Seychelles Islands proper. There are nine species of Borboridæ, one of which is new, while the others are apparently of very wide distribution, some being identical with European and even with British species, while one is known from the East Indies, from Africa, and from South America. Of the Phoridæ there are twenty species, fourteen of which have not previously been described. The last paper was by Mr. F. V. **Theobald**, on the mosquitoes obtained by the expedition. There are nine kinds of Culicidæ known from the islands, five of them being new to science. One of these new forms was found by Mr. Fryer in Aldabra, and is named after him *Culicelsa fryeri*; the other four were found in the Seychelles, two of them being included in a new genus (Pseudoficalbia). Other species are of very wide distribution, one of them being the almost world-wide *Stegomyia fasciata*, notorious as the carrier of yellow fever. None of the malaria-conveying forms were found in the Seychelles.—F. **Summers**: Coast vegetation of south-west Lancashire.

PARIS.

Academy of Sciences, June 12.—M. Armand Gautier in the chair.—A. **Haller** and Edouard **Bauer**: 2 : 6-dibenzoyl-2 : 6-dimethylheptane and $\alpha\alpha'$-tetramethylpimelic acid. The sodium derivative of a dialkylacetophenone,

$$RR'CNa—CO.C_6H_5,$$

is treated with a dibromide, $Br.(CH_2)_n.Br.$, and the resulting diketones converted into benzene and the amide $NH_2.CO.C(RR').(CH_2)_n.C(RR').CO.NH_2$ by means of sodium amide. An example of this general method has been worked out, in which R and R′ are methyl groups, and the bromide $Br.(CH_2)_3Br$.—Pierre **Termier** and Jean **Boussac**: The exotic character of gneiss and granite complex known as the crystalline *massif ligure*, and the separation of the Apennines and the Alps.—M. Zaboudski was elected a correspondant for the section of mechanics in succession to the late M. Sire, and E. Perroncito a correspondant for the section of rural economy in succession to the late M. J. Kühn.—M. **Luizet**: The form of the curve of light of the variable star δ Cepheus obtained from the observations of Argelander. The discontinuity in the curve of luminosity of this star deduced by Argelander from his observations is shown not to exist. A curve is given embodying the results of various observers, and this is without a break. It is shown, moreover, that Argelander's own observations fall on this curve.—Marcel **Riesz**: A method of summation equivalent to the method of arithmetical means.—J. **Le Roux**: Incurvation and flexion in finite deformations.—Louis **Wertenstein**: An extremely absorbable ionising radiation emitted by radium C. Radium C gives off an ionising radiation which is relatively intense, with penetrating power analogous to that of radio-active projections, and slightly deviable by the magnetic field. It is probably the projection of radium D by radium C.—G. **Reboul**: Conductivity accompanying chemical reactions.—Luigi **Giuganino**: The action of terrestrial translation upon the phenomena of light.—G. **Moreau**: The corpuscular ionisation of saline vapours and the recombination of the ions of a flame.—Georges **Meslin**: Circular double refraction in sodium chlorate. The author has constructed a triprism of sodium chlorate similar to the quartz triprism of Fresnel. Sodium chlorate possesses rotatory power, but differs from quartz in having no ordinary double refraction. The expected separation of the green mercury line into two components was clearly proved.—Miroslaw **Kernbaum**: The decomposition of water by metals. A repetition of Traube's experiments on the simultaneous production of hydrogen and hydrogen peroxide by the action of zinc and other metals upon water. The non-production of hydrogen in the absence of dissolved oxygen is confirmed, but, contrary to Traube's results, some hydrogen always appears to be formed.—J. B. **Senderens** and J. **Aboulenc**: The catalytic preparations of fatty esters in the wet way. The addition of potassium bisulphate to an equimolecular mixture of acetic acid and ethyl alcohol causes a marked increase in the amount of ethyl acetate formed in a given time. The use of sulphuric acid in the preparation of esters is discussed from this point of view.—Jean **Nivière**: The action of isobutylamine and di-isobutylamine upon

α-bromobutyric acid. Isobutylamine gives α-isobutylaminobutyric acid; di-isobutylamine gives only α-oxybutyric acid. —G. **Vavon**: The addition of hydrogen to limonene. In presence of platinum black hydrogen is added to limonene in two phases, a dihydride being first formed and a tetrahydride the final product. Some reactions of the dihydride are given.—André **Meyer**: Azomethines derived from phenylisoxazolone.—Ch. **Mauguin**: The orientation of liquid crystals by the magnetic field.—Fernand **Guéguen**: A new organ differentiated from the thallus of Mucor.—A. **Prunet**: Various methods of plant pathology and therapeutics.—Marcel **Dubard**: The classification of Lucumæ with functiform radicle.—L. **Gain**: Two new species of Nostoc from the South American Antarctic region.—Marc **Bridel**: Meliatine, a new glucoside hydrolysable by emulsin extracted from *Menyanthes trifoliata*. —B. **Sauton**: Germination *in vivo* of the spores of *Aspergillus niger* and *A. fumigatus*.—L. **Launoy**: Can the guinea-pig be accustomed to strychnine? The tolerance of the guinea-pig to strychnine can be increased experimentally to a considerable extent.—K. **Landsteiner**, C. **Levaditi**, and C. **Pastia**: Research on the virus contained in the organs of an infant attacked by acute poliomyelitis.—M. **Maisonneuve**: The ovarian apparatus of Cochylis.—P. A. **Dangeard**: The fecundation of the ciliated infusoria.—A. **Magnan**: The relation between the ventricle and gizzard in birds.—A. **Desgrez**: The toxicity of two new nitriles and the antitoxic action of sodium hyposulphite towards one of them.—A. **Chauchard** and Mlle. B. **Mazoué**: The action of ultra-violet light upon amylase, invertine, and on a mixture of these two diastases. —A. **Joly**: The existence of limestones with flints (Eocene) in the Zarez Mountains, Algeria.—Raoul **Blanchard**: The glacial deposits at Rives.—Louis **Gentil**: A panorama of the Middle Mlouya (eastern Morocco).

June 19.—M. Armand Gautier in the chair.—J. **Boussinesq**: Simple construction (having recourse only to the two ellipsoids, inverse and direct) for light rays for each of the two systems of plane waves of given direction propagated in a transparent crystal.—C. **Guichard**: Certain triple orthogonal systems deduced from curves several times isotropic.—E. **Vessiot**: The kinematics of continuous media of n dimensions.—J. **Hadamard**: Slow permanent movement of a viscous sphere in a viscous liquid medium.—E. **Delassus**: The material realisation of linkages.—Louis **Roy**: Discontinuities of the first order in the movement of flexible threads.—Jules **Courmont** and Ch. **Nogier**: Progressive diminution of output in the ultra-violet with quartz mercury lamps working at high temperatures. The chemical, physical, and physiological actions of the light from mercury vapour lamps in quartz tubes falls off steadily when they are used at high temperatures. This seems to be due partially to the formation, on the interior surface, of a greyish coating (possibly a silicate of mercury). The lamps should be cooled during use.—Henri **Malosse**: Photometer for the control of the illuminating power of public or private lamps.—A. **Guillet**: A regulator depending on synchronisation.—A. **Leduc**: New method for determining γ, the ratio of the specific heats of vapours.—L. **Decombe**: The heat of Siemens.—C. **Caudrelier**: Frequency of electric oscillations in sparks.—F. **Grenet** and P. **Boulenger**: Porcelain filtering funnels.—J. **Meunier**: Spectra produced by the combustion of hydrocarbons and of various metals. The spectra produced by the combustion of magnesium, zinc, cadmium, nickel, copper, lead, bismuth, and antimony are described.—Georges **Baume** and F. Louis **Perrot**: Melting-point curves for mixtures of gases: systems formed from carbon dioxide and sulphuretted hydrogen with methyl alcohol and methyl ether. Melting-point curves for the systems $(CH_3)_2O—CO_2$,

$$CH_3OH—CO_2,\ (CH_3)_2O—H_2S,\ \text{and}\ CH_3OH—H_2S$$

were obtained, but only in the case of $(CH_3)_2O—H_2S$ was the existence of an oxonium compound, $(CH_3)_2O+H_2S$, indicated.—Paul **Bary**: Osmotic phenomena in non-conducting media. Experiments on solutions of indiarubber and acetyl-cellulose proved that such colloids are to be considered as solid solvents, and that the permeability, for a given substance of a colloidal membrane, will be proportional to the solubility of that substance in the colloid. —Pierre **Jolibois**: The allotropic modifications and the melting point of arsenic. Grey arsenic is stable at all temperatures up to 850°; arsenic deposited as a mirror is unstable, and changes to grey arsenic at about 280° with production of heat. The melting point of grey arsenic determined by two methods is $850° \pm 10$.—Max. **Wunder** and B. **Jeanneret**: The action of syrupy phosphoric acid on various alloys obtained in the electric furnace. Many metals and alloys thus obtained, although very resistent to the action of most reagents, are attacked by hot phosphoric acid of specific gravity 1·75. Silicon, zirconium, ferro-silicon, ferro-titanium, ferro-vanadium, manganese silicide, titanium nitride, nickel boride, and even carborundum are all attacked. If carbon be present it remains wholly or partially undissolved.—Mlle. Pauline **Lucas**: Dehydration of alkyl and benzyl-isobutylphenyl-carbinols. Tertiary alcohols are produced by the action of organo-magnesium compounds on trialkyl acetophenones. These on dehydration give hydrocarbons containing a double bond.—L. H. **Phillipe**: Glucodecose and glucodecite.—Jakob **Erikson**: The mildew of mallow (*Puccinia malvacearum*); its nature and phases of development.—Jacques **de Lapparent**: The Permian eruptive rocks of the Pic du Midi d'Ossau.—Paul **Godin**: Variations in the size of the bodies of males during post-fœtal growth.—J. **Le Goff**: Glycosuria and saccharosuria in healthy subjects, following the absorption of saccharose.—V. **Balthazard** and Maurice **Nicloux**: Coefficient of toxicity in poisoning by carbon monoxide.—Mme. Marie **Phisalix**: Effects of the bite of a venomous lizard from Arizona (*Heloderma suspectum*).—F. **Picard**: Some points in the biology of *Conchylis ambiguella* and of *Polychronis botrana*.—P. **Sisley**, Ch. **Porcher**, and L. **Panisset**: The action of micro-organisms on some types of colouring matters.—L. **Cayeux**: The transformations of the *massif* of the Cyclades at the end of the Tertiary and the beginning of the Quaternary epochs.—Maurice **Lugeon**: A local inversion of the slope of the rocky bed of the Rhone, below Bellegarde.—E. A. **Martel**: The exaggerations of glacial theories.

CALCUTTA.

Asiatic Society of Bengal, June 7.—Rai B. A. **Gupte**: Folklore of the origin of the constellation Mrigashirsha. The folklore seems to have been based on the shape of the constellation known as Mriga Nakshatra in India and Orion in the west. It says that on the borders of the southern land there was a hunter who was locked up by his creditors in a Shiva's temple, and had to fast. His creditor was paid out of a subscription raised in the temple, and he was released. He went to *Shikár*. During the night one antelope came to the *Bael* tree on which he was sitting. She spoke to him in the human voice, and was allowed to go on promising that she would return. Another came; she promised return, and was allowed to go. Then came a black buck. He was also allowed to go. Lastly came a doe with young ones. They were members of one united family. They held consultation, and decided that they should all present themselves before the hunter for being killed. But the sun rose, and with it there came a change in the disposition of the hunter, due to the fact that he had to fast and to keep up all the night on the sacred Shivarātra-day, dropping *Bael* leaves on a *lingam*. Shiva's agents came to the spot, took the hunter to Kailás, and sent the antelope family to the Starry Heaven, that is, Nakshatralök, and blessed them, saying that they would form in heaven a constellation which should be known as Mriga Nakshatra. In examining the constellations and the signs of the Zodiac in connection with this story, the author found that the position of Sagittarius the hunter suggests the origin of the Shivapanchāyatan, or five in one, in the four signs of the Zodiac, viz. Taurus the Bull, Gemini the Ugma of Shiva, Cancer his *Ganás*, with their chief or *ish* Ganesh, and Leo the Lion. Comparing these signs with the group of Shiva and Pārvati, the resemblance becomes so striking that it would be difficult to call it a coincidence. Shiva and Pārvati therefore have their origin in a myth based on the Zodiac.—W. **Kirkpatrick**: A vocabulary of the Pàsi Boli or Argot of the Kunchandiya Kanjars. Kanjar

is the generic name for a number of Indian tribes of a gypsy character, from Sanskrit kánana chará, in the sense of a wanderer in the jungle. Like the gypsies of Europe, the Kanjar and other wandering tribes of known predatory habits have a secret language or cant of their own. The collection given appears to be chiefly based on Hindi, with certain inflections which are attached to the verbal root implying that there is consistence and character in the cant, and perhaps that some of the inflections are from an old form of language now obsolete in modern colloquial Hindustani. Many of the words, however, seem to have no connection with known languages spoken or written in India, nor with any of the various slang or secret codes of other recognised wandering tribes of Dravidian origin. The Argot of European gypsies known as Romanes or Romni similarly has numerous words identical with modern Hindustani, while its Oriental, if not Indian, origin is generally accepted. The Romanes word for dog is *Jookel* or *Jukal*, while the Kanjar word is *Jhukal*. There are other resemblances and exactly identical words apparently common only to Romanes and Kanjar cant. A bibliography of references to the Kanjar and allied tribes is appended, with a list of various secret codes and slang languages, and also gypsy vocabularies.—Lieut.-Colonel D. C. **Phillott**: Some notes on Urdu grammar.

FORTHCOMING CONGRESSES.

JUNE 28, 29.—Conference on Education and Training of Engineers. London. President: Mr. Alexander Siemens, President of the Institution of Civil Engineers. General Secretary: Dr. J. H. T. Tudsbery.

JULY 18–22.—International Association of Seismology. Manchester. President: Prof. Arthur Schuster, F.R.S.

JULY 25–28.—British Medical Association. Birmingham. President: Sir H. T. Butlin, Bart.

JULY 26–29.—First Universal Races Congress. University of London. President: Lord Weardale. General Secretary: G. Spiller, 63 South Hill Park, Hampstead, London.

JULY 29–AUGUST 5.—Congress of French Geographical Societies. Roubaix. President: Prince Roland Bonaparte.

JULY 30–AUGUST 2.—Annual Meeting of the Swiss Society of Natural Sciences. Soleure. President: Dr. A. Pfaehler. Inquiries to Secretaries: Dr. Küng (German) and Prof. Brönnimann (French).

JULY 31–AUGUST 5.—French Association for the Advancement of Science. Dijon. President: M. Charles Lallemand. Secretary: Dr. Desgrez, 28 Rue Serpente, Paris.

AUGUST.—Centenary of the Foundation of the University of Breslau.

AUGUST 12–18.—First International Congress o Pedology. Brussels. President: M. Alexis Sluys. Secretary: M. Vital Plas, 35 Avenue Paul de Jaer, Brussels.

AUGUST 13–20.—Prehistoric Society of France. Nîmes.

AUGUST 31–SEPTEMBER 6.—British Association. Portsmouth. President: Sir William Ramsay, K.C.B., F.R.S. Address for inquiries: General Secretaries, Burlington House, W.

SEPTEMBER 4–6.—Centenary of the University of Christiania. President of Festival Committee: Prof. Brögger.

SEPTEMBER 9–20.—International Congress of the Applications of Electricity. Turin. President of the Committee of Honour: H.R.H. the Duke of the Abruzzi. Honorary Secretary of the Committee: Signor Guido Semenza, Via S. Paolo 10, Milano International Secretary: Col. R. E. Crompton, C.B., R.E., Crompton Laboratory, Kensington Court, W.

SEPTEMBER 24–30.—International Congress on Tuberculosis. Rome. Address for inquiries: Honorary Secretary of the National Association for the Prevention of Consumption, 20 Hanover Square, W.

OCTOBER 2–7.—Third International Congress of Hygiene. Dresden. General Secretary: Dr. Hopf, Reichsstrasse 4, Dresden.

OCTOBER 15–22.—Tenth International Geographical Congress. Rome. President: Marquis Raffaele Cappelli. General Secretary: Commander Giovanni Roncagli, Italian Geographical Society, Rome.

DECEMBER 27.—American Association for the Advancement of Science. President: Dr. C. E. Bessey, University of Nebraska. Permanent Secretary: Dr. L. O. Howard, Smithsonian Institution, Washington, D.C.

DIARY OF SOCIETIES.

THURSDAY, JUNE 29.

ROYAL SOCIETY, at 4.30.—On a New Method of Estimating the Aperture of Stomata: Francis Darwin, F.R.S., and Miss D. F. M. Pertz.—Memoir on the Theory of the Partitions of Numbers. Part VI. Partitions in Two-dimensional Space, to which is added an Adumbration of the Theory of the Partitions in Three-dimensional Space: Major P. A. MacMahon, F.R.S.—The Kinetic Theory of a Gas constituted of Spherically Symmetrical Molecules: S. Chapman.—Radiation in Explosions of Coal Gas and Air: W. T. David.—The Mechanical Viscosity of Fluids: Dr. T. E. Stanton.—A Silica Standard of Length: Dr. G. W. C. Kaye.—The Properties of Oil Emulsions: R. Ellis.—(1) On a Class of Parametric Integrals and their Application in the Theory of Fourier Series; (2) On a Mode of Generating Fourier Series: Dr. W. H. Young, F.R.S.—Pendulum Clocks and their Errors: A. Mallock, F.R.S.—On Ceratopora, the Type of a New Family of Alcyonaria: Prof. S. J. Hickson, F.R.S.—Note on the Sensibility of the Eye to Variations of Wave Length: Prof. W. Watson, F.R.S.—And other Papers.

FRIDAY, JUNE 30.

PHYSICAL SOCIETY, at 5.—On the Effect of a Narrow Saw-cut in the Edge of a Conducting Strip on the Stream Lines in the Strip and on the Resistance of the Strip: Prof. C. H. Lees, F.R.S.—The Capacity Coefficients of Spherical Electrodes: Dr. A. Russell.—Exhibition of the Benkö Primary Battery: W. R. Cooper.

MONDAY, JULY 3.

ARISTOTELIAN SOCIETY, at 8.—Emotional Experiences of some Higher Mystics: Rev. A. Caldecott.

ROYAL GEOGRAPHICAL SOCIETY, at 8.30.—Explorations in Dutch New Guinea: Capt. C. G. Rawling, C.I.E.

CONTENTS.