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Invention as a Remedy for Unemployment.

MODERN industries have been made possible by a constant supply of new inventions, and the relation between invention and industrial prosperity is so intimate that by studying it carefully we may hope to find suggestions for a solution of the unemployment problem. An occasion for making such a study is afforded by the publication of the Report for the year 1925 of the Comptroller-General of the Patent Office, which is reviewed elsewhere in the present issue of NATURE: and we shall take as its basis the acute and convincing analysis of the problem which was given eighteen years ago by Mr. A. F. Ravenshear.[1]

Mr. Ravenshear showed that the two well-known types to which inventions tend to conform have entirely different economic effects. 'Originative' inventions, which create new demands, promote the absorption into new industries of unemployed labour. They only flourish under an efficient patent system, which promises to the pioneer an ultimate reward for the initial outlay and risk involved in their exploitation; and the patents granted for them can be roughly distinguished in statistics by their greater tendency to have a long life. On the other hand, 'intensive' inventions, which merely cheapen the supply for already existing demands, tend in so doing to create unemployment. Patent protection is by no means indispensable to their exploitation, for capital and organisation are already available for them in the industries in which they are to be incorporated; and the patents granted for them tend on the whole to have shorter lives than those for originative inventions, since they are of less value and are subject to more competition from inventions producing equivalent results. Mr. Ravenshear examined individually the patents surviving fourteen years from a sample year, and found that about 71 per cent. of the survivors could be assigned to the originative class.

The distinction may be emphasised by means of an example. The last twelve years have brought forth large numbers of originative inventions connected with wireless signalling: new branches of the electrical industry have arisen to meet the demand thereby created, and large bodies of skilled labour have found employment in consequence. It may be expected, however, that when the wireless art reaches stability, invention will concern itself mainly with the cheapening of the methods by which wireless equipment is produced. Unemployment will result, and if the labour thus set free is to be reabsorbed, some fresh development of the electrical industry will have to be created by means of fresh originative inventions. On

[1] "The Industrial and Commercial Influence of the English Patent System," by A. F. Ravenshear. (T. Fisher Unwin, 1908.)

the other hand, originative invention, although active in the wireless art, was during the War years largely diverted from the arts of peace. On the whole, therefore, there was a dearth of permanently useful originative inventions during that period, and it is to this circumstance that the present phase of unemployment may be largely attributed. If any doubt is felt on the subject, a comparison with the case of the wireless industry will afford conviction.

This is precisely the situation which can be ameliorated by wise improvements in the patent system, the purpose of which is to foster originative as distinct from intensive invention. Bearing that distinction in mind, we can obtain guidance as to the nature of the innovations needed by examining how far previous enactments have succeeded in promoting the grant of patents destined to live for a long term, as contrasted with those of inferior longevity: for the latter comprise the less successful originative patents together with the majority of the intensive patents. It must be remembered that in the British and German patent systems, as distinguished from the American, the inferior patents are progressively weeded out by renewal fees, which must be paid on an increasing scale from year to year if a patent is to be kept alive throughout the whole of the available term.

The various factors which might be thought to affect patent statistics can be eliminated only by means of an elaborate analysis, too intricate and tedious to be reproduced here. Such an analysis would leave no doubt, however, as to the effect produced by the Act of 1902, which introduced an official investigation as to the novelty of the inventions patented, the investigation being made for the first time in 1905. As regards the patents destined to live fourteen years, this Act had the effect of raising their number from a fairly steady average in the neighbourhood of 500 to a steady average of about 1200 per annum. On the other hand, it had only a small effect on the number of patents sealed annually, and no systematic effect on the number destined to survive for five years but no longer. The accompanying table gives illustrative figures only. It must be read in the light of the fact that the official examination was first made in 1905.

It will be seen, then, that the effect of introducing some sort of official investigation into the validity of patents before grant was precisely that which a patent system ought to have: the production was stimulated of originative patents having sufficient merit to earn a long life, as opposed to intensive patents and those of inferior quality. The Act of 1883, on the other hand, produced, by a general easing of patent fees, an indiscriminate multiplication of worthless as well as of useful patents.

The effect of the official investigation must be attributed to the enhanced value which was conferred upon patents by increased confidence in their validity, and if we wish to encourage originative inventions, and still more to encourage the exploitation in Great Britain of originative inventions, we must clearly seek some further methods of giving the patentee and his patrons an improved assurance that a patent, when granted by the Patent Office, shall not run a really serious risk of being found invalid if it should be tested by litigation.

Year in which patents originated	1902	1907	1913
Number of patents sealed (excluding patents of addition)	15,242	16,172	15,970
Number lapsing after four years	9918	10,625	9385
Number destined to survive for five years only	1497	1441	960
Number destined to survive for fourteen years	596	1175	[1250]*

* Extrapolated.

At the present day more than 100,000 British patents are actually in force, and of these, fewer than 250 have ever been tested in the Courts. The Patent Office has investigated their validity so far as certain issues are concerned, but it has made no examination whatever as regards other important issues, and it is probable that a very large number of existing patents are bad in law. The Patent Office does not test the novelty of an invention by searching anywhere but amongst British specifications less than fifty years old, nor does it concern itself with 'prior user' or 'quantum of subject-matter.' Since, then, only a negligible proportion of patents ever have their validity fully tested, the effect of the remainder rests upon bluff. Litigation is so expensive that only the richest patentees dare undertake it, and in this situation the advantage lies entirely with the man of wealth and the large industrial companies. Now it usually happens that in the early stages of a new industry capital is hard to come by: the pioneers have no money to spare for fighting actions in the High Court, so that the high cost of litigation tends to defeat the main aim of the patent system. It favours intensive inventions, which abound in well-established and heavily capitalised industries, but it cripples the comparatively poor nascent industries which are based upon new originative inventions.

The Patent Office, then, cannot assure the patentee of the validity of his patent, because its investigation is incomplete: and the High Court will not assure him of it except at a cost which is prohibitive for men of moderate means. Can nothing be done to remedy

this state of things? A detailed answer to that question would lead us into a highly technical discussion affecting powerful vested interests and admitting of legitimate differences of opinion, but certain broad lines of reform can be indicated as almost indisputably sound.

There is a gap between the legal area investigated by the Patent Office and that which is relevant to the validity of an invention. This gap can be narrowed by expanding the former or contracting the latter area, or both. To take the latter proposal first: it must be admitted that patents can at present be invalidated on grounds which are purely academic and out of relation with practical requirements. In particular, the mere publication of an idea in some long-forgotten specification or journal in a foreign language will invalidate the monopoly of a manufacturer who wishes seriously to establish plant for the practical exploitation of that idea. The law as to novelty, therefore, requires searching scrutiny and reform: it should be borne in mind that mere academic suggestions on paper are of far less service in the establishment of new industries than are the details of a practical method which has been reduced to a commercial basis by exhaustive experiment. Encouragement must indeed be given to the theoretical inventor: but at present he gets more than his share of encouragement as compared with the practical industrialist.

Confidence in the validity of patents can also be improved by extending the scope of the examination made by the Patent Office. In particular, it has already been shown in these columns (NATURE, July 25, 1925, p. 121; Aug. 1, 1925, p. 157) that the investigation for novelty which is made by the Patent Office examiners could, without any subsidy from the State, be made effective over an area equal to that in which the German and American Patent Offices undertake to search. For this purpose it might be necessary to encroach upon the heavy financial surplus which is realised by the British Patent Office every year, but there is no justification whatever for that surplus. So long ago as July 14, 1891, Sir Michael Hicks Beach admitted on behalf of the Govermnent of the day that "he did not think that the country ought to look to the Patent Office as a permanent source of income," but the country has inadvertently done so ever since. Although it has been obtained without raising the pre-War fees, and by means of the admirably economical manner in which the Patent Office has been administered (see page 429 of the present issue), this surplus ought clearly to be used for the benefit of the patentees themselves. It should be remembered that, far from taxing invention, the United States considers it worth while to subsidise its Patent Office.

In the next place, patent litigation can be cheapened by extending the powers of the Comptroller-General and authorising him to deal with issues at present reserved for the High Court. His decisions would, naturally, be subject to appeal: but the poorer class of litigants could be safeguarded by the grant of certificates of validity which would secure them against heavy costs in the event of an appeal, and consequently against the intimidation which is at present practicable. The information obtained by means of a really extensive search for novelty would be of value to the Comptroller-General in deciding questions of 'prior user,' as to which he should also hear evidence. The issue of 'quantum of subject-matter' is entirely comparable with that of 'manner of new manufacture,' of which he is already empowered to dispose: and he might also settle actions for infringement where the damages claimed lie within some moderate limit. That the Comptroller-General and his agents are qualified to carry out these duties is beyond reasonable dispute.

The reforms which have just been mentioned would tend towards enhanced confidence in the validity of the patents granted by the Patent Office, and would diminish the extent to which the poorer are intimidated by the wealthier patentees. They would, therefore, presumably have an effect similar to that of the Act of 1902 in selectively enhancing the production of long-life patents for originative inventions: in this way they would make for the establishment of new industries based on newly created demands, and so would help to solve the unemployment problem. But this effect is conditional on one consideration of great importance. It is a fact that not much less than half of the patents granted by Great Britain are granted to foreigners (*ibid.* p. 428), and the question arises whether such grants tend, on the whole, to promote the establishment of new industries in Great Britain, or to hamper British manufactures in the interest of imports from abroad. The question is of vital importance, since such a very large proportion of our inventions are under foreign control. Legislation in this connexion is subject to various international agreements, but these do not necessarily affect all the participating nations equally, for Great Britain grants a specially large percentage of her patents to foreigners. The existing law makes apparently ample provision against the abuse of patent monopolies by foreigners; but how far it is evaded in practice, and how far its provisions are understood and utilised by British manufacturers, are questions which demand the most scrupulous and painstaking attention on the part of those who are responsible for the solution of the unemployment problem.

Descartes' "Géométrie."

The Geometry of René Descartes. Translated from the French and Latin by David Eugene Smith and Marcia L. Latham. With a facsimile of the first edition, 1637. Pp. xiii + 246. (Chicago and London: The Open Court Publishing Co., 1925.) 17*s.* 6*d.* net.

RENÉ DESCARTES (1596–1650), philosopher and mathematician, is of course universally regarded as the inventor of the method of co-ordinates in geometry; hence the common name for them, Cartesian co-ordinates. Yet, if it were a question of priority, a good claim could be put forward for Fermat (1601–1665), a contemporary, and an even greater mathematician; for, though Fermat's work "Ad locos planos et solidos isagoge" was not published until much later (1679), it was certainly conceived and perhaps written before 1637, the date of publication of Descartes' "Géométrie"; moreover, the method of co-ordinates comes out much more clearly in Fermat, and his analytical geometry generally is much more like ours than Descartes' is. Fermat's share in the new discovery nevertheless remained unknown until quite recent times, and the whole credit was given to Descartes by no less learned a geometer than Chasles, who, in a eulogy which now seems exaggerated, speaks of Descartes' doctrine as "prolem sine matre creatam" and one "of which no germ can be found in the writings of the ancient geometers." Anticipations of the method of co-ordinates are, however, as is now well known, to be found in Archimedes and Apollonius of Perga; the latter stated, for example, in words (without symbols), the fact that the locus of a point satisfying the equivalent of an equation of the first degree in two unknowns is a straight line, and the form in which he states the fundamental property of each of the three conics is the exact equivalent of the Cartesian equation referred to any diameter and the tangent at its extremity as axes. Descartes' actual achievement —and it was momentous enough—was to remove the impasse to which Greek geometry had come through want of notation, by introducing into geometry the unrestricted use of all the resources of algebra (then recently introduced into France from Italy) as a recognised and even indispensable auxiliary.

A mathematician of to-day who should turn to the "Géométrie" in the expectation of finding some sort of introduction to co-ordinate geometry such as is contained in our text-books would be disappointed. As Prof. Loria has observed in a recent study, there is a greater gulf between Descartes' work and a modern treatise on analytical geometry than there is between an ancient (*i.e.* a Greek) and a modern treatise on any other mathematical subject. Descartes uses his new method mainly for the purpose of investigating *loci* of a higher order than conics; he does not, for example, apply it to the geometry of the straight line or the circle. It is strange that the usefulness of the method of co-ordinates for elementary geometry appears to have occurred to no one for a long time. Lagrange saw it and illustrated it in a work published in 1773, but the first systematic exposition of elementary analytical geometry in our sense seems to have been given by S. F. Lacroix as part of his great work "Traité du calcul différentiel et du calcul intégral" (Paris, 1797).

It is not possible within the space of a review to describe fully the contents of the "Géométrie"; we can only notice a few of the outstanding features. Much of the work centres round "Pappus's Problem." This may be shortly stated thus. Given any number of fixed straight lines ($2n$, say, if the number is even, $2n+1$ if it is odd), suppose that from a point (P) not lying on any of them we draw a straight line to meet each of the given straight lines, at given angles respectively; if the lengths of these straight lines l_1, l_2 . . . are taken, and if (when their number is $2n$) the product of n of them bears a given ratio to that of the remaining n, or if (when their number is $2n+1$) the product of $n+1$ of them bears a given ratio to the product of the remaining n and another given length, it is required to find the locus of the point P from which the straight lines are so drawn. The Greeks solved the case of three and four lines (the locus being in general a conic) and also apparently (according to Pappus) one other case, and that not the simplest possible. Descartes in his second book shows how to solve a particular case of five lines, where four of the given lines are parallel and at equal distances and the fifth is at right angles to them, while they are all met at right angles by the straight lines drawn from the point the locus of which is required. Descartes solves this case by means of a curve constructed in a 'mechanical' way. Imagine a parabola and a point (L) fixed on its axis at a certain distance from the vertex. Suppose the parabola to move bodily in such a way that its axis slides on a given straight line, and suppose a ruler to move at the same time in such a way that it always passes through the point L and also through a fixed point A not lying on the straight line on which the axis of the parabola moves. The intersection of the ruler GL with the parabola at any moment determines a point C which lies on a curve of the third degree.

Descartes shows that the point required in the particular case of Pappus's problem lies on a curve of this kind. Again, he constructs two mean proportionals between two given straight lines, trisects any angle, and solves a cubic and a biquadratic equation by using

one *parabola*, along with straight lines and circles, in each case. In his third book (as a final *tour de force*) he solves an equation of the sixth degree in which all the powers of the unknown are present with an absolute term; this he does by means of the intersections of a curve of the kind above mentioned with a certain circle. He does not generally write down or use the equations of the curves as such; like the Greeks, he simply supposes them drawn and then shows that the points of intersection supply a solution of the problem. His solutions, in fact, amount to the Greek procedure carried further by means of the additional resources which the unrestricted use of algebra puts at the disposal of the geometer for the purpose of determining the parts of the figures required. Incidentally, Descartes explains an algebraical method of finding normals to a curve which depends on the principle that, if a circle be drawn with its centre at the point on the axis where the normal meets it and passing through the point on the curve, the circle *touches* the curve at the point instead of cutting it; this means that a certain algebraical equation must have two equal roots, and the use of this fact enables the normal to be determined. Descartes also gives a construction for the normal at any point of the conchoid of Nicomedes without using algebra. He does not say how he discovered it, but it must evidently have been by considering the instantaneous direction of the motion of the point describing the curve, and resolving the motion into two components, in the same way as Archimedes must have determined the direction of the tangent to his spiral at any point, *i.e.* by a sort of anticipation of the differential calculus.

Descartes lays down a number of rules, in regard to the solution of equations, *e.g.* the 'rule of signs,' the method of increasing or diminishing the roots of an equation by any quantity (which enables us to get rid of the second term in an equation), and so on. He explains how, in order to solve a cubic equation, we should first, by considering the several factors of the absolute term, try to find a linear factor, as $x-a$, in the expression equated to zero; and similarly with a biquadratic. In the case of a biquadratic, if the expression equated to zero appears to have no linear factor, it may be possible to separate it into two quadratic factors; by the method of undetermined coefficients Descartes shows that the possibility of this expedient depends on the solution of a cubic in another unknown, y^2, where again we may be able to find a linear factor.

Descartes' notation is interesting. He started the fashion of using the last letters of the alphabet (especially x, y) for unknown quantities. He writes powers from the cube upwards as we do, but generally expresses a^2 or z^2 by aa, zz. He uses the signs + and −; equality he denotes by a sign like that for 'varies as' in algebraical text-books, but turned the opposite way. For the square root he writes $\sqrt{\ }$, for the cube root $\sqrt{C}$. A horizontal line above an expression serves as a bracket. Where the coefficient of a certain power of the unknown in an equation contains more than one term he writes the terms vertically, one below the other, with a bracket stretching from the top to the bottom.

We congratulate the Open Court Publishing Company on the idea of including this great classic in their series. We would only warn the reader that the translation must be used with caution, as it is in many places inaccurate and sometimes wholly misleading. Two examples may be given. Descartes says that the ancients (*i.e.* the Greeks) were much hampered in their explanations of things by the fact that they scrupled to use arithmetical terms in their geometry; the translators render "le scruple que faisoient les anciens d'user des termes de l'arithmétique en la géométrie" by "the considerations which forced ancient writers to use arithmetical terms in geometry," giving exactly the wrong sense. In another place Descartes says that, even if a certain change in the conditions were made, "ce point C ne laisseroit pas de se trouver tousiours en une ligne courbe, qui seroit de cete mesme nature," *i.e.* the point C would still always lie ("would not cease to lie") on a curve of the same kind; the translators say "the point C will not always lie on a curve of just the same nature."

The first edition of our treatise was originally published, not separately, but as the last part of the "Discours de la méthode," etc., in which it occupied pp. 297-413. The history of the copy from which the present facsimile was taken is interesting. It was first given by Descartes himself to his friend Letenneur, and it has Letenneur's signature as well as that of Chasles. Chasles gave the volume to Sylvester, who gave it to George Bruce Halsted, who again gave it to C. I. Palmer of Armour Institute, Chicago, by whom it was made over to the publishers. T. L. H.

The Origin of European Culture.

The Dawn of European Civilisation. By V. Gordon Childe. (The History of Civilisation Series.) Pp. xvi+328. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1925.) 16*s.* net.

ADVANCE in our knowledge of the various stages of prehistoric culture in Europe has never been uniform. This was necessarily the case in the earlier days of archæological investigation, when the material was drawn to a large extent from chance discovery.

Even now systematic exploration can be pursued only to a relatively limited degree, and fortune may at any moment bring to light evidence which will affect fundamentally our conceptions of the course of events in any given area at some particular point of time. It is, however, a remarkable, but not necessarily a surprising, fact that our knowledge of the neolithic and succeeding phases of the prehistoric period, but especially the neolithic, should so long have lagged behind that of the palæolithic stage. It is not surprising, if only because the high antiquity of palæolithic man and the mystery of his phylogeny have appealed strongly to the imagination, and this has tended to stimulate and systematise research. Greater attention, it is true, is now paid to the period immediately following the palæolithic and the break in continuity, which it was once imperative to recognise, has been filled by the culture of the epipalæolithic or mesolithic age. But in the neolithic age itself and in the later periods, although there is no lack of material, frequently the conditions of discovery in surface finds or in isolated hoards and caches have precluded the study of the material in its more precise chronological relations, which is necessary for the full understanding of the lines of development and the trend of events.

The greatest check on progress in the study of later prehistoric times has been the lack of anything like a comprehensive survey of the material as a whole which would have attempted to systematise our knowledge at any given moment, and to indicate the gaps which should be filled by future research. The time is now ripe for some such comprehensive study, if, indeed, it is not overdue. Much is still obscure; and the important investigations of archæologists on sites themselves well known but often isolated, have still to a large extent to be brought into relation. For the epipalæolithic period much has been done, and gradually from the material which is accumulating from North Africa, Spain, southern France, the Baltic, eastern Europe, and even to a limited extent from Great Britain, it is becoming possible to build up a picture of the movements of culture and more dimly of peoples directly ancestral to modern Europe. Further, in the Mediterranean area the researches of Sir Arthur Evans and others in Crete and in Greece, by demonstrating the relations of Minoan Crete to Egypt, to Asia Minor, and to Libya, and between Crete, the Ægean and the Greek mainland, are establishing something like a trustworthy absolute chronology for this area which ultimately will serve at once as a touchstone and a divining rod for the rest of Europe as it becomes possible to work out in detail the interrelation of the various centres of culture.

It has been necessary to dwell at some length upon these conditions in which intensive study of certain areas and sites has been accompanied by too general a lack of correlation of results as a whole in order to emphasise the special merit and the value of Mr. Childe's "Dawn of European Civilisation." It is the first attempt to summarise and evaluate the evidence relating to the various problems of the later stone and early metal ages as a whole. It follows the development of culture as we know it in each of a number of centres—Crete and the Eastern Mediterranean, Hissarlik and the coasts of Asia Minor, the Western Mediterranean, Spain, the Steppes, the Black Earth region comprising the Ukraine, Eastern Galicia and Rumania, the Danube, Scandinavia, "where east and west meet," the Baltic, eastern Germany and Poland, the lake dwellings of Central Europe and the culture of the Alps, the Atlantic seaboard, with its megalithic culture, and Great Britain. Mr. Childe, takes his readers from the epipalæolithic down to about the middle of the Bronze Age. In his preface he gives his reasons for thus setting the limits of his subject and defines his theme as "the foundation of European civilisation as a peculiar and individual manifestation of the human spirit." With the genesis of the common substratum of human culture, therefore, he is not concerned. At once, however, he finds himself confronted with the problem of the origin of this civilisation with which he deals. Does it come from the Ancient East, or are all the elements of this culture to be found in Europe itself? Mr. Childe modestly deprecates the attribution to him of an attempt to present a final synthesis. He lays claim to nothing more than "an earnest attempt to survey all the facts as a whole." In the end he seems on the whole to incline to the former view. The evidence he adduces certainly is in favour of those who look to the East, and it points to south-eastern Europe as the line by which the distinctive forms of early culture have come to the centre and west.

In attaching the importance he does to the culture of south-eastern Europe, Mr. Childe holds what is both strategically and tactically the inner position. His conclusions are to a great extent based upon, and coloured by, his intimate knowledge of the culture of Erösd and neighbouring sites in the valley of the Alt, which is described here for the first time in English. Erösd is a site in the Alt Valley in Transylvania just west of the Carpathians, which lies in the Black Earth country, so called from the fertile deposit which overlies the loess, a site eminently suitable for early agricultural settlers to whom the oldest traces here of post-glacial habitation are due. It was explored by the late Dr. Ferencz Laszlo, who brought to light remains of a high civilisation of the type which appears as an intrusion in Thessaly. The people of the Black Earth

region produced a painted pottery, the ware of the Tripolje culture, which has led some archæologists to hope that these earliest inhabitants of the area might possibly be linked up with the early peoples of Mesopotamia, Elam, Anau in Turkestan, and their pottery brought into relation with the remarkable and characteristic painted pottery of these sites, which seems to extend as far afield as Honan in China. Mr. Childe holds that the culture of the Alt is the earliest in the Danube basin, and would regard it as the source of the culture known to archæologists as Danubian I. He has, however, no certain suggestion to offer as to the origin of the Erösd culture. So early a civilisation of high standard, with its knowledge of grain, painted pottery, copper and gold, offers a problem to the archæologist which is as dangerously tempting as it is momentous. Mr. Childe is fully alive to the dangers of over hasty attribution of an eastern origin, and with a fine impartiality points out the obstacles in the way—difficulties arising from both style and technique.

It would be tempting to follow with Mr. Childe the spread of Danubian culture along the Rhine into Belgium and France, of the culture of the Mediterranean into Spain, and the spread of the megalith along the Atlantic coast, but enough has been said to indicate the scope and quality of his book. Its extraordinary and, indeed, almost marvellous grasp of an enormous mass of detail, and its breadth and sanity of view in dealing with the larger problems, as well as the acute and critical judgment of the author, combine to make the "Dawn of European Civilisation" a contribution to prehistoric archæology of first-rate importance which will have a profound effect on future lines of study and research.

Chemical Aspects of Life.

Lectures on Certain Aspects of Biochemistry. These Lectures were given in the University of London during the Summer Term, 1925. By Dr. H. H. Dale, Prof. J. C. Drummond, Prof. L. J. Henderson, Prof. A. V. Hill. Pp. viii+313. (London: University of London Press, Ltd., 1926.) 12*s.* 6*d.* net.

THE attempt to interpret the phenomena of life in terms of chemistry resolves itself in practice largely into the study of the mutual reactions between living and non-living matter. Living cells exhibit the remarkable property of exerting chemical action upon certain components of their environment, and of assimilating and ultimately of obtaining energy from them. The terms 'machinery' and 'fuel' are often used—loosely, it must be admitted—to distinguish the assimilator from the assimilated, though there is evidence that the two are to a certain extent mutually replaceable, structural parts disintegrating to supply energy, and energy-holding materials being built up into the structure. The analogy is, however, quite a useful one so long as it helps us not to forget that the chemical phenomena of life are quite as much attributes of a particular physical state of matter as of a particular chemical structure. Both considerations are important, for life, like a flame, is a temporary shape set to an unceasing flow of matter of peculiar properties.

Life as a state of matter involves the conception of conditions of equilibrium which can only be maintained with expenditure of energy . . . it costs us something merely to exist, in more senses than one. The more delicate the state of balance, the more numerous and potent are the conditions which modify it.

The investigation of the chemical relationships of the equilibrium which is life is the main concern of biochemistry; for the equilibrium itself involves chemical reactions, and is subject to modifications by various chemical influences both from without and from within the cell. Advance in biochemistry, as in other sciences, is largely conditioned by the methods which are at hand for its pursuit. It follows, therefore, that while its main objectives are unaltered, certain aspects of biochemistry show periodic developments as a consequence of advances in the cognate sciences, or of special developments of technique which open up new lines of attack upon its central, unalterable, and perhaps insoluble problems.

The central mystery of life, from the chemical point of view, concerns the means by which oxidation and so energy liberation is effected, and it is fitting that such exponents of animal physiology as Dr. H. H. Dale, Profs. J. C. Drummond, L. J. Henderson, and A. V. Hill should present to us various chemical aspects of this fundamental problem. The control of the circulation in the capillary blood-vessels is a subject which owes much to the researches of Dr. Dale and his colleagues. The flow of blood to the tissues is largely controlled by chemical means in accordance with the need of the tissues for oxygen, more or less blood being made available by dilatation or by constriction of the capillaries.

One of the perpetual problems of biochemistry is the manner in which the living cells are enabled to satisfy their energy requirements by carrying out at low temperatures oxidative reactions which in the laboratory often necessitate the employment of high temperatures and powerful reagents. A considerable step in the elucidation, or perhaps, rather, in the transference to a different plane, of this problem, has been made of late, and has been discussed by Prof. J. C. Drummond. Two ideas have been introduced from the realm of pure chemistry, the importance of

small amounts of inorganic catalysers, chief among which appears to be iron, and the part which is played by hydrolytic oxidation-reduction reactions and oxidation by dehydrogenation. Closely bound up with both of these questions is the rôle played by glutathione, and by inorganic and organic phosphates.

In the carriage of oxygen and carbon dioxide, the blood has long been known to have essential functions, but it is only recently that the researches of Prof. L. J. Henderson, of Harvard, have shown us by what a beautiful physico-chemical mechanism the functions of the blood in this respect are controlled. In reading his three lectures, one not only finds much new physiology, but one also appreciates that the subject is capable of exact mathematical treatment. The study of the means by which the blood adjusts itself to alterations in the external environment, and thus maintains constancy of the internal environment of the cells, has proved to be a very profitable one indeed, in the physiology of biological integration.

The environment of the living cell is naturally a matter of fundamental importance, and we are often apt to forget, as Prof. A. V. Hill says in his lecture, that in systems of such small dimensions, the alteration of the scale necessitates alteration in other scales, such as the time-scale, as well. Diffusion, for example, which we are inclined to regard as a very slow process, may occur with such relative rapidity as to modify the chemical reactions very considerably. Among the chemical reactions which take place in living cells, the formation of lactic acid, which Prof. Hill discusses in another lecture, is a very fundamental one. There seems to be little doubt that the formation of this substance, and its subsequent oxidative removal, stands in the most intimate connexion with the phenomena of muscular contraction.

Another focal subject in biochemistry is that of growth and nutrition, and the lecture by Prof. Drummond on the phosphates and on the vitamins shows how much has been accomplished in recent years in this direction. The establishment of vitamin D, which plays such an important part in the formation of bone, the relation of this to the action of ultra-violet light, and the part played by phosphates in the calcification of bone, all appear to be connecting up to form a new and most valuable chapter in physiology.

The proper integration of the various functions of the body is effected in various ways, Nature using any means at hand to achieve this result; the chemical co-ordination by means of the hormones is one means of great importance, and Dr. Dale treats of recent investigations of two hormones, the pituitary principles, and insulin.

One leaves this book with the feeling of having not only read matter of first-class importance, but also of having had it presented in an altogether fascinating manner. Biochemistry has certainly done much to deserve the high esteem in which it is held to-day.

Neoplasms.

(1) *The Nature of Tumour Formation: the Erasmus Wilson Lectures delivered before the Royal College of Surgeons of England, on Feb. 23rd, 25th and 27th, 1925.* By Dr. G. W. Nicholson. Pp. xviii+99. (Cambridge: W. Heffer and Sons, Ltd.; London: Simpkin, Marshall and Co., Ltd., 1926.) 6*s.* net.

(2) *Malignancy and Evolution: a Biological Inquiry into the Nature and Causes of Cancer.* By Morley Roberts. Pp. 319. (London: Eveleigh Nash and Grayson, Ltd., 1926.) 18*s.* net.

THE mystery of new growths, their nature, treatment, and the possibility of prevention, has aroused more interest recently than at any other time in the history of medicine. For some years it has occupied the attention of research workers in every field probably more than any other of the great problems of disease. Innumerable facts and data concerning the subject have been recorded, yet we seem to be little nearer its solution than we were at the close of the last century.

(1) Dr. G. W. Nicholson, in the Erasmus Wilson Lectures of 1925 on "The Nature of Tumour Formation," has no new facts to place before us and no fresh discoveries to disclose. He brings what in our present state of confusion is of far more importance, a fresh point of view. Commencing with his own histological observations, which may be confirmed by any one with microtome and microscope, he attempts to establish a sequence of events of which the tumour is the last. He regards neoplasms as malformations arising in previously healthy tissues. All living cells possess the property of growth, and there is evidence that the power of multiplying to an excessive degree is potential in every healthy cell. Dr. Nicholson considers every tumour to be a manifestation of this excessive growth, to which absolutely healthy cells have been stimulated by some change in their environment. He sees in every cell of the new growth an effort on the part of that cell to be normal, *i.e.* physiological, in structure and function, and where it fails to be so, there is some inhibiting accident of position or environment, such as the absence of appropriate physiological stimulus to differentiation. It is in this point that his explanation differs from the theory of growth habit, in which it is postulated that the cells abandon their function for the purpose of proliferating.

In attempting a scientific explanation of neoplasms, Dr. Nicholson has disregarded all theories, perceiving that they are based on pure speculation. It may be alleged from some quarters that he has merely enunciated a new theory, but such a comment would be quite unjust. He has simply shown that in the sequence of events leading up to tumour formation, certain things happen in accordance with the general principles of physiology, biology, and embryology. With the reason for these happenings he is not concerned; little reference, mainly in an appendix to these lectures, is made to the nature of the change of environment which stimulates cells to proliferate, and in this connexion it is of interest to note that parasites are considered to be among the possible factors which can produce such a change.

It is evident in this book that one of the most important reasons for our failure to understand new growths is the lack of co-operation between the pathologist and the biologist. The former is blamed for his ignorance of the biological views concerning the constitution of living matter; the latter is criticised for his lack of appreciation of tissue reaction and adaptability under conditions familiar to every pathologist.

(2) With these censures in mind we turn with interest to the effort of the philosopher, untrained in the medical and allied sciences, to co-ordinate the observations of scientists and by reasoned thought to bring order out of chaos. Mr. Morley Roberts has approached the problem as an expert in no science save sociology, having to work on material provided entirely by others, and being at the outset of his researches quite unfamiliar with the structures and processes he proposed to investigate. Yet these apparently insuperable obstacles have by their very nature given him an enormous advantage over the scientific investigators, who, following their own isolated lines of work and thought in biology, pathology, or physiology, have attempted to solve mysteries requiring for their elucidation a clear perception of all three. We have previously had evidence that Mr. Roberts has mastered the general principles of these subjects, has acquired a sound knowledge of anatomy and histology, and possesses that clarity of thought which enables him to correlate the various features of the problem he sets himself. "Malignancy and Evolution" is a worthy successor to "Warfare in the Human Body."

In this work the author extends the views advanced in his previous book to cover the development of new growths. The aspect of the human body as a community similar to societies and nations, with tendencies to be checked and laws to be obeyed, leads him to conclusions very similar to those advanced in "The Nature of Tumour Formation." Aided by social analogies, he sees variation and disease as a breakdown of settled order, and concludes that disease and repair are essential factors of evolution. Neoplasms are regarded as manifestations purely of growth, resulting from the same mechanism which produces the liver and kidneys In this book we find suggestions as to the nature of the environmental changes causing cell proliferation; it is supposed that the community controlling factors are in a state of unrest and instability by reason of the rapid evolution of the race, and that this naturally results in variation and breakdown as it would in the life of a nation.

The author expresses acknowledgment for assistance in practical details to various scientific workers, including Dr. Nicholson; but the reasoning is entirely independent, and their conclusions concerning the actual mechanism of tumour development are related only in being confirmatory of one another. Mr. Roberts's views are well worthy of the attention of biologists and pathologists, and he is to be congratulated on the result of his efforts to shed light on a question of greatest importance to the human race.

Our Bookshelf.

Emotion and Insanity. By S. Thalbitzer. Translated by M. G. Beard. (International Library of Psychology, Philosophy and Scientific Method.) Pp. x + 128. (London: Kegan Paul and Co., Ltd.; New York: Harcourt, Brace and Co., Inc., 1926.) 7*s.* 6*d* net.

DR. THALBITZER'S book is a psychological essay the material for which is provided by a study of the manic-depressive psychosis. It is a brief attempt to explain certain mental phenomena on a physiological basis. The author first considers the generally accepted division of mentation into the psychical elements of thinking, feeling, and willing, a classification which he rejects in favour of that of intellectual activity, feeling, and psycho-motor innervation. He thus defines the mind as that which thinks, feels, and acts. It is with the element of feeling that this book is mainly concerned. It is submitted that this function must, like the other two specific functions of the mind, have its own centre in the brain, a postulation which involves Dr. Thalbitzer in a very damaging and convincing criticism of Lehmann's dynamic theory of emotion. The suggestion that this localisation is in the occipital lobes, and the evidence offered in support of it, do not carry so much conviction, but they are comparatively minor points.

Dr. Thalbitzer's physiological explanation of emotion is based on three well-recognised physiological laws. The application of the law of specific energy of cells isolates the element of emotion to one definite part of the brain. The law of tonus, or continual functioning of cells, explains the presence in every psychic process of all three elements of the mind, a fact well emphasised in the mood-psychosis, where any of these elements may function to an abnormal degree. The law which

limits the variation of function of a cell to increase or decrease confirms the observation that the differences between various feelings are quantitative.

Whatever the view taken of this fascinating explanation, there is one plea in this book which must be whole-heartedly endorsed. It is that psychiatric research should receive much more consideration in the effort to determine the nature of normal mental processes. The services rendered to physiology by pathology are well known; in the sphere of the nervous system and neurology they have been of first moment. Yet, apart from the very dubious conclusions drawn from the study of the hysteric and neurasthenic, psychology has learnt little from observation of the mentally abnormal. Perhaps this reproach applies more to psychology in England than elsewhere; in no other country is better provision made for the care of the insane; the field for research is correspondingly greater. If the hint from the Danish psychiatrist is taken, psychology may make even more progress during the next decade than it has in the last.

The 'Eötvös' Torsion Balance. Pp. 90. (London: L. Oertling, Ltd., n.d.) 21*s*.

WHEN a scientific instrument assumes a commercial value beyond its intended scientific use, trustworthy and detailed descriptions of its construction and of the method of its operation become scant if not altogether inaccessible. This class of instrument includes the Eötvös torsion balance, designed in 1888 by the Hungarian physicist, Roland Eötvös, for analysing the local anomalies produced in the normal gravity conditions by tectonic and geological abnormalities. Of this period, extensive literature is available both as regards construction of the balance and the results of measurements. But since the torsion balance proved to be one of the most useful instruments available for the location of mineral ore deposits, and a considerable refinement has been achieved in its design, trustworthy sources of information and details, from which an independent judgment could be drawn, have been deplorably lacking. The commercial necessity of secrecy by users of the torsion balance renders valuable observational data inaccessible for an indefinite period. The present book is the first comprehensive treatise on the balance published in any language, and it presents a host of informative details.

The subject is treated in two parts. Part 1 presents the theory of the balance, the derivation of working formulæ, the method of making observations, the relationship of the quantities derived, the classification of gravitational effects and computation and elimination of normal, terrain, and topographical effects. The second part embodies notes on the practical employment of the balance and recommends itself particularly to the physicist operating the instrument. These two parts, which comprise three-fourths of the book, constitute a concise and broad treatment of the balance and apply to any model of the instrument. The third part gives a description of the Oertling model, in which instrumental details are described and illustrated with commendable candour.

This book is no touchstone whereby, with the aid of the instrument, valuable mineral deposits or oil domes can be located in a trice. The collection of observational data is routine after a preliminary training, but the rational elimination of effects extraneous to those of the deposit sought and the correct interpretation of the results thus obtained are problems of considerable difficulty calling for skill and extensive geological experience. Yet even in these difficult matters, this book offers a safe and instructive preliminary guide. Messrs. Oertling and the authors are to be congratulated on producing this well-bound, well-printed and arranged pioneer text-book on the Eötvös torsion balance, a subject the treatment of which on the lines here adopted has been long overdue.

E. R. F.

A Psychological Study of Immigrant Children at Ellis Island. By Dr. Bertha M. Boody. (Mental Measurement Monographs, Serial No. 3.) Pp. vi+163. (Baltimore, Md.: Williams and Wilkins Co.; London: Baillière, Tindall and Cox, 1926.) 18*s*. net.

EXAMINATION of immigrants at Ellis Island has been stimulated by fervid political propaganda maintaining that north-western Europe is better than south-eastern, and by sob-stuff propaganda dilating the hardships of those rejected by the apostles of eugenics. Mental measurements now permit exact inquiry.

Those more than sixteen years of age are expected to read. The Army 'Alpha' test seems to show the superiority of the north European, but in terms of Army 'Beta' the Latins are less inferior. The problem has been to invent new forms of performance tests which can be set in dumb show to a mixed group "of an Arab, a Greek, an Italian, a Welsh boy, an Armenian and a Russian. The members of such a group do not talk together; but they laugh together and spur each other on" (p. 103). The invention of such tests running smoothly and in silence without pencil or interpreter has been the great achievement (p. 132). Picture completion, form board, button holes, drawing stars, Binet weights, card sorting, bow knot are among the tests used.

The conditions of the examination are not ideal. Imagine a crowd of children of all ages, unequally seasick, exhausted, frightened, excited. What "recognition of the general emotional upset" would they demand? Attendance at the Island school is optional, and there is much interruption.

The tentative conclusion is that there are great differences, but that these differences are individual and not traceable to ancestral race or state nationality. But the numbers tested—27 Germans, 22 Armenians, 27 Hebrews, 15 Poles, 19 Italians, etc., of divers ages—seem too small to admit of any conclusion.

Chinese, Japanese, and Indians do not appear on the eastern seaboard. If the immigrant Irish are a mixed sample, it must not be assumed that they are a fair sample of those left behind in Ireland or that the sampling will not change as they segregate and settle industrially.

The direction of progress seems to be in examination at the home port of departure, maintaining exclusion of lunatics and deficients, and reliance on mental measurements rather than national quotas.

The book may be commended to schoolmasters, missionaries, and employers of native labour.

HUGH RICHARDSON.

Directions for the Dissection of the Cat. By Prof. R. P. Bigelow. Pp. xii+47. (New York: The Macmillan Co., 1925.) 4*s.* net.

THE directions for the dissection of the cat are here so arranged that the whole operation may be carried out on a single specimen, and the aim of the book is to give the student a clear survey of the organism as a whole and not as a system of organs. With this end in view, the dissection starts with the skin and muscles of the ventral body wall and works steadily through to the spinal cord and brain. Organs and structures are dealt with as they appear in the course of such a dissection and not in systems. The directions are clear and concise; necessary emphasis on particular points is given by heavy type, and the drawings which it is desirable for the student to make are indicated in their proper place and sequence. A useful introductory chapter gives valuable information on the preservation, embalming, and injection of material. The author believes that the dissection of the cat is a very desirable introduction to a course of human anatomy and physiology, and would be a valuable part of pre-medical studies; also that the size of the animal and the ease with which it can be obtained make it a favourable object for such studies. In such circumstances this book would be of considerable service, but the absence of any figures limits the value of the book and necessitates its use only in conjunction with standard works on the anatomy of the cat which are adequately illustrated.

The History of Arithmetic. By Prof. L. C. Karpinski. Pp. xii+200. (Chicago and New York: Rand McNally and Co., 1925.) n.p.

THE purpose of Prof. Karpinski's book is to present the development of arithmetical knowledge as a vital part of the history of civilisation. Particular attention is paid to the material of arithmetic taught in American elementary schools and to the historical phases of that work with which the teacher of arithmetic should be familiar. The book also contains a bibliography of the early American text-books of arithmetic printed before 1800, and refers to many of the early popular treatises on the subject used in England.

The volume is mainly intended to appeal to a popular audience desiring some acquaintance with the development of arithmetic from the earliest times. Prof. Karpinski gives a very entertaining account, based on the larger treatises of T. L. Heath, T. E. Peet, and D. E. Smith, of the progress of arithmetical knowledge from ancient Egyptian times until the present day. He also gives many carefully chosen diagrams which add interest to the theme. Most school libraries would be enriched by a copy of the book.

A Practical Handbook on Rat Destruction. By C. Leopold Claremont. Pp. vi+180+6 plates. (London: John Hart, n.d.) 3*s.* 6*d.* net.

THIS book deals in an exhaustive and essentially useful manner with the problem of the rat. A brief introductory chapter on the characters and habits of the brown and black rats is followed by an account of the destruction of rats by trapping, hunting, and the use of gas, and of the various poisons most effective for the purpose. These chapters are very exhaustive and of great practical value. The author then deals with the Rats and Mice (Destruction) Act of 1919, and discusses in detail its various clauses and the responsibilities of owners, local authorities, and the Ministry of Agriculture in carrying out its provisions. He pleads for more whole-hearted co-operation between these parties in combating the rat menace. Chapters on the relation of the rat to public health and disease, and on a general survey of what has been done and what may be done in the matter of rat control, conclude a very useful book, which should be of great service, particularly to those officers of local authorities whose duties include the enforcement of the laws relating to the destruction of these pests.

Travel and Travellers of the Middle Ages. Edited by Prof. A. P. Newton. (The History of Civilization Series.) Pp. viii+223+7 plates. (London: Kegan Paul and Co., Ltd.; New York: Alfred A. Knopf, 1926.) 12*s.* 6*d.* net.

THE contents of this volume, which is one of the series appearing as "The History of Civilization," is a course of lectures delivered in the University of London. The book does not profess to be a complete survey of the subject, but several of the lectures have been expanded and the editor has added an introduction on the conception of the world in the Middle Ages. The twelve chapters are by various writers, including Prof. M. L. W. Laistner, Prof. Claude Jenkins, Sir T. W. Arnold, Baron A. F. Meyendorff, Prof. E. Prestage, Sir E. D. Ross, Prof. A. Mawer, and Dr. E. Power. Those on Christian pilgrimages, Arab travellers, the routes to Cathay, and Prester John may specially be noted. Prof. Mawer, whose contribution on the Vikings has no references to authorities, apparently accepts the Norse voyages to Vinland, and does not mention the researches of Nansen and others with their conclusion that Vinland was a myth. The book has a few illustrations, but only two maps.

The Borderland of Music and Psychology. By Frank Howes. Pp. x+244. (London: Kegan Paul and Co., Ltd.; J. Curwen and Sons, Ltd., 1926.) 6*s.* net.

"ART and intellectual speculation are the two exceptional realms of the mind of which the psychologist finds it most difficult to give an account" (p. 147). Too much has been expected from psychology since it presumed to stand in its own right as an experimental science. Many who looked to it for immediate solution of age-long problems disappointedly turn away as from a charlatan. In doing so the valuable little that it already has to give is lost. The author, with sympathetic knowledge of current musical and psychological theories, has given a capable preliminary survey of an interesting no-man's-land lying between suspicious armed camps. If at times he laughs at both from the exalted heights of philosophy, we forgive him, for he never loses himself in the realm where the problem is of more importance than its solution, but ever returns to his theme with notes such as: "But this is not science, nor even musical criticism" (p. 142); "We step beyond psychology when, after saying what musicians and audiences do, we ask, 'What is music?'" (p. 40).

R. J. B.

Letters to the Editor.

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, nor to correspond with the writers of, rejected manuscripts intended for this or any other part of* NATURE. *No notice is taken of anonymous communications.*]

On the Phosphorescence of Nitrogen.

By the use of a tube of a type recently designed by Dr. Coolidge of Schenectady, and kindly shown in action by him to one of us, we have recently been enabled to extend our knowledge of the spectrum of solid nitrogen made luminescent by bombardment with swiftly moving electrons. The tube we used was provided with a window of thin nickel foil through which electrons under a potential of 125,000 volts were projected into the vacuum space of a german silver thermos flask of special design. The nitrogen was deposited and solidified on the inner wall of the thermos flask within the vacuum space, and the refrigerant used was liquid hydrogen.

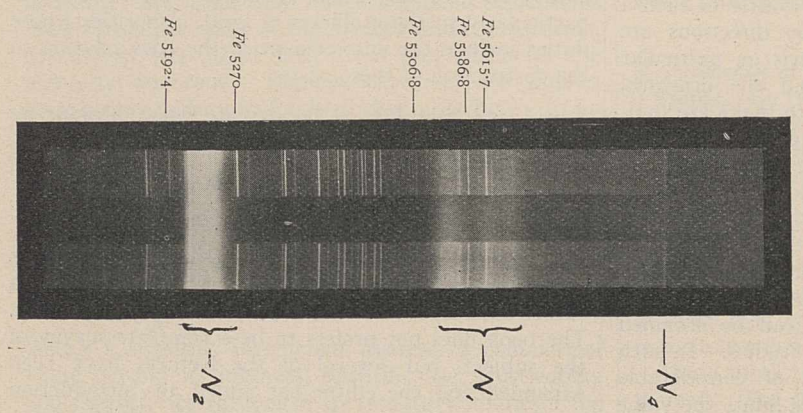

FIG. 1.

The luminescence of the solid nitrogen was observed in our experiments through a fluorite window in the outer wall of the thermos flask, and its spectrum was photographed with glass quartz and fluorite spectrographs. All wave-lengths measured and given below are in Ångström units.

Photographs of the spectrum of the light emitted while the solid nitrogen was being bombarded showed :

1. A single sharply defined narrow band (N_4) at λ 5945.

2. Three broad diffuse bands (N_1) shading each into the other with mean wave-lengths of approximately λ 5554, λ 5617, λ 5658.

3. A series of eight clearly defined bands (N_2) with the wave-lengths λ 5204·4, λ 5210·4, λ 5214·3, λ 5220·4, λ 5224·4, λ 5228·8, λ 5235, λ 5240 ; and

4. A number of faint diffuse bands each shaded off towards the red in the blue and violet spectral region between λ 4500 and λ 2460. Very approximate wave-lengths of the heads of these bands were found to be λ 4575, λ 4500, λ 4270, λ 3990, λ 3725, λ 3510, λ 3385, λ 3155, λ 2960, λ 2785, λ 2615, λ 2460. As regards these bands, some have been observed by Vegard already, and some, at least, appear to belong to the well-known second positive band spectrum of nitrogen.

Among a number of interesting results obtained by us, four are worthy of special note :

1. We failed to record on our plates, with twenty hours' exposure, any trace of a group of wave-lengths designated by Vegard as N_3 that were found by him to include one band at λ 6569, and one with its maximum intensity between λ 6320 and λ 6420. In this connexion it might be stated that our plates were highly sensitive up to λ 7000.

2. When the tube was in action and the solid nitrogen was strongly luminescent, we always found by visual observation that when the bombardment was interrupted, the wave-lengths of the group N_1 immediately disappeared from the radiation emitted by the luminous nitrogen, while the red band N_4 and the bands N_2 between λ 5204·4 and λ 5240 persisted some minutes, often very brilliant, but with slowly weakening intensity. Vegard has suggested that the groups N_2 and N_4 belong to the phosphorescence spectrum of solid nitrogen, and, as will be seen from the results given above, our experiments confirm this view.

3. As to the group of three bands N_1, we found that they were relatively strong when the solid nitrogen under bombardment had been freshly deposited. But with prolonged bombardment of a given layer of solid nitrogen, the intensity of the group of wave-lengths N_1 rapidly weakened and finally was scarcely sufficient to make the radiation observable. The intensities of the band groups N_2 and N_4, on the other hand, appeared to be unaffected by prolonged bombardment. Since exposures of long duration were required in photographing the complete luminescence spectrum, it was necessary therefore to deposit a fresh layer of solid nitrogen approximately every half-hour.

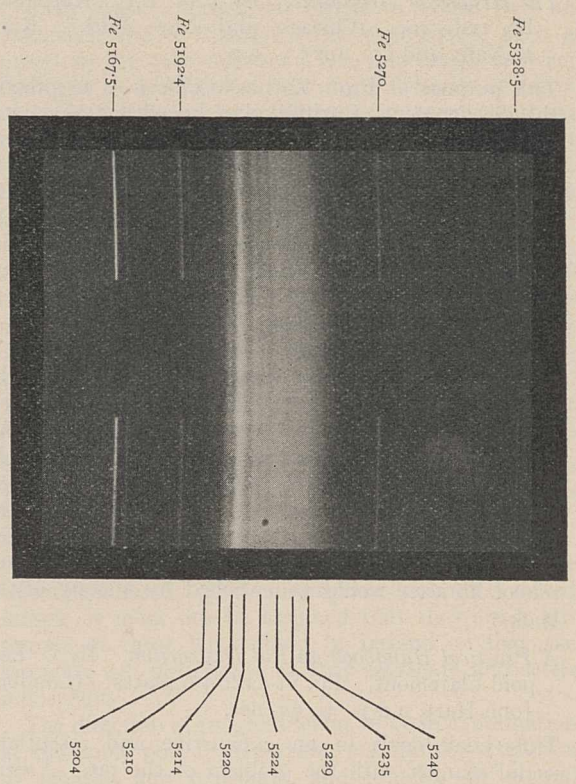

FIG. 2.—Band N_2.

From these results it is clear that two spectra are obtainable from solid nitrogen, one of which includes the band group N_1, and the other the bands N_2 and N_4. This would go to show that solid nitrogen can exist in two forms A and B, the one, A, emitting the radiation constituting the band N_1, and the other, B, the radiation constituting the band groups N_2 and N_4. Our experiments support the view that the solid nitrogen is initially deposited in the form A, and that under electronic bombardment, and possibly otherwise, it is soon transmuted into the form B, this form B being the one that exhibits the phenomenon of phosphorescence.

4. The band group N_2 as originally observed by Vegard and by McLennan and Shrum, consisted of a single sharply defined narrow band at approximately λ 5230. This band has been found, however, to be more extensive than was originally supposed, for, as shown above, it is now known to consist of at least eight strong and well-defined members. Since no band of anything like this character has ever been shown to be a feature of the spectrum of the aurora, in the neighbourhood of λ 5230, it would appear that Vegard's theory that finely divided solid nitrogen exists in that portion of the upper atmosphere where auroral displays originate is not tenable.

The bands N_1, N_2, and N_4 are shown in Fig. 1, and the bands N_2 in Fig. 2.

J. C. McLENNAN.
H. J. C. IRETON.
K. THOMPSON (Student of Canadian National Research Council).

The Physical Laboratories,
University of Toronto, August 20.

Polarisation of Wireless Waves.

IT is now generally accepted that many of the phenomena of wireless reception are caused by the interference between two waves, one of which has received reflection or refraction in the upper layers of the atmosphere. Considerable evidence is also now forthcoming of a fact which was suggested in earlier days; namely, that the reflection is not simple but that a vertically polarised incident wave may be returned with polarisation of a much more complex form. On this are based explanations of night variations in bearing, fading, and similar phenomena; and the subject has also been discussed theoretically by Appleton, Hulbert, and Nicholls and Schelling.

These investigators have confined their attention chiefly to wave-lengths of a few hundred metres at most, and there have been doubts as to whether the longer waves were affected in a similar manner. In a previous paper (*Journal I.E.E.*, No. 353, page 587) the present writer has referred to the elaborate but regular intensity variations occurring at medium distances on long waves during the sunset period, and recent experiments have shown that the cycle given by the transmissions from Sainte Assise (UFT) on 14,350 metres at Slough on page 587 is regularly accompanied by a definite cycle of bearing variation differing slightly in intensity from day to day, but always possessing the same general form. Variations of bearing of as much as 35° have been observed at times, showing that the departure from vertical polarisation must have been large.

Measurements were, therefore, made to see if any quantitative deductions could be made from these results.

Although it is theoretically possible to make use of bearing variations for such a purpose, the accuracy of observation is low owing to the non-silent minima which often occur, and it was found preferable to take three measurements of absolute electrical intensity: (*a*) in the plane of propagation; (*b*) in a vertical plane at right angles to this; (*c*) in any convenient intermediate plane from which the results can equally well be deduced.

In some cases it has been found that the intensity (*b*) actually exceeded the intensity (*a*) for short periods.

Now, in the general case of elliptic polarisation these results do not admit of any further solution, but by making the further assumptions: (i.) that second reflections are not present; (ii.) that the down-coming wave remains plane polarised but that the plane of polarisation is rotated, it is possible to deduce figures for this angle of rotation and for the co-efficient of reflection.

Observations taken at Slough and Exeter under these conditions show that during the sunset period a rapid rise in the coefficient of reflection occurs and also a rotation of the plane of polarisation of at least 90°, most of which persists throughout the night. It remains to be verified whether assumptions (i.) and (ii.) are justifiable, though there is evidence in their favour; but the two chief facts which emerge from the tests are independent of them. These are:

I. Long waves as well as short may be elaborately polarised by refraction in the upper atmosphere during the night.

This effect is also present, though in a less degree, during daylight in the winter, and occasionally even during daylight in the summer.

II. The effect persists during the hours of darkness, remaining fairly steady after the sunset period is over; and consequently it cannot be caused by the mere temporary displacement of the reflecting surface from its normal horizontal position owing to the ionic recombination which occurs at sunset; but must be an essential feature of the mode of refraction.

Further experiments on this point are in progress, but as the solution requires the construction of a vector triangle the conditions have to be very carefully chosen in order to avoid indeterminate figures due to the limitations of the geometrical process. The experiments referred to above were carried out for the Radio Research Board of the Dept. of Scientific and Industrial Research.

J. HOLLINGWORTH.

National Physical Laboratory,
Teddington,
August 31, 1926.

Plastic Deformation of Single Metallic Crystals.

NATURE has published two letters from Mr. S. J. Wright and Dr. Goucher respectively (June 26 and July 31) in reply to ours of May 22 on the wedge formed when a single crystal of a metal is broken in tension. We desire in reply to stress most strongly the fact that our analysis of such a wedge is concerned with the final position of an atom after movement and has no reference to the path or the mechanism by which it arrived there. This concerns directly both of the communications.

Mr. Wright's insistence on the fact that the wedges examined by him were bounded by curved surfaces, means no more than that the ultimate displacement of the atoms of his test-pieces was greater in some localities than in others and has no bearing whatever on the validity of our treatment. His remarks *re* hard spheres are similarly wide of the mark, since we have not made assumptions of any kind as to the mechanical properties of the atom in its response to the stress.

Dr. Goucher's letter, however, is worthy of more serious consideration. His statement that our formula presupposes a type of slip which is inconsistent with experimental fact is surprising, since throughout our letter it was Dr. Goucher's own experimental results which were considered. It may be well, however, to review what assumptions were made. They were two, namely, that for a perfect wedge the atoms slipped on equidistant parallel planes and that the movement on these planes was equal. The only possible alternative to these assumptions would be that the slipping occurred on planes at different distances apart, but that then the extent of the displacement was in all cases proportional to the thickness of the slab of metal between one plane of slipping and the next. Such a supposition is so absurd as to carry its own refutation with it. Unless then all present ideas of the plastic deformation of metals are entirely inaccurate. and the displacement does not occur by slip, there is no alternative to the only two assumptions we have made.

Our analysis was concerned with one part of the wedge only, and there is no question of a difference in wedge angle between one half of the fractured test-piece and the other. Dr. Goucher emphasises what he had already found, namely that the wedges had an included angle of 39° or more than 50°. We are quite unable to see why he should imagine there is any difficulty in this, since not only have we considered the fact but have even offered a reasonable explanation of why it should be so. He complains further that we have not taken into consideration the fact that the larger wedge angles were found only with test-pieces whose {112} planes were slightly asymmetric with regard to the direction of the stress. The reply is clear. We have not been concerned with the explanation of the deformation of the crystal. All we attempted to do was to discover, when a certain deformation had been produced, what was the nature of the atomic displacement in the final wedge. That asymmetry of crystal is necessary for the production of a blunt wedge is merely an experimental fact which has no bearing on our analysis of the deformation when it had actually been effected.

We would point out again that our letter offered a reasonable explanation and, incidentally, the only comprehensive one yet suggested, of all the experimental results which Dr. Goucher has obtained in his most excellent experimental work. Until, therefore, something more satisfactory is offered it must take precedence over an explanation which, as a result as it seems to us of a perfectly arbitrary assumption, is capable of explaining half the results only, leaving the remainder as inexplicable anomalies.

May we in conclusion point out that in the formula in our original letter a misprint occurs, and that $2/\phi$ should be $\phi/2$?

W. E. W. MILLINGTON,
F. C. THOMPSON.

Manchester, August 24.

The Ionisation Potential of O II.

PROF. A. FOWLER has worked out (*Proc. Roy. Soc.*, 110, 476, 1926) with much elaboration the main spectral characteristics of O II, but has not been able to obtain the fundamental levels because the jumps to them produced lines which were below 700 Å.U. With our high resolution hot-spark spectroscopy for the extreme ultra-violet and assisted by the new methods of identification of multiplet structure recently worked out by Russell, Hund, Heisenberg, and Pauli, and applied by R. H. Fowler and D. R. Hartree (*Proc. Roy. Soc.*) to the classification of Fowler's O II terms, we have succeeded in accurately fixing these fundamental levels as is shown in the accompanying table. Russell assisted us in this search by placing at our disposal his unpublished identification of the quartet p'' level, which should replace the x_3 level in Fowler and Hartree's classification.

The knowledge of this ionisation potential of O II should be useful in fixing the temperatures of certain stars.

I. S. BOWEN.
R. A. MILLIKAN.

Norman Bridge Laboratory of Physics,
California Institute of Technology, Pasadena.

TABLE I.

Series Lines of O II.

Int.	λ I.A.Vac.	ν	Δν	
		Quartet System.		
1	429·97	232574·4		$as - p''$
3	539·067	185505·7	157·1	$as - ap_3$
2	539·524	185348·6		$as - ap_2$
1	539·837	185241·1	107·5	$as - ap_1$
		Doublet System.		
0	440·51	227010·		$x - bp''$
1	441·97	226260·		$x - cd'$
2	481·56	207658·		$x - bd'$
2	484·00	206612·		$x - ap''$
2	485·56	205948·		$x - f$
4	616·325	162252·	185·	$x - 2p_2$
4*D*	617·030	162067·		$x - 2p_1$

Term Values.

$x(p' \text{ or } d) = 256202\cdot$
Assuming $ap_3 = 97100\cdot$[1]
$as = 282605\cdot9$

This corresponds to the ionisation potential 34·88 *volts.*

To the foregoing interesting communication, I think it may be usefully added that the designations and values of all but one of the doublet terms, apart from x, are those given in the paper by myself to which reference is made, namely:

$\left.\begin{matrix} ap_2'' = 49590\cdot80 \\ ap_1'' = 49476\cdot81 \end{matrix}\right\}$ $\left.\begin{matrix} bd_2' = 48618\cdot42 \\ bd_3' = 48565\cdot45 \end{matrix}\right\}$ $\left.\begin{matrix} 2p_1 = 94132\cdot52 \\ 2p_2 = 93952\cdot53 \end{matrix}\right\}$

$\left.\begin{matrix} bp_1'' = 29231\cdot39 \\ bp_2'' = 29229\cdot03 \end{matrix}\right\}$ $\left.\begin{matrix} cd_2' = 29974\cdot67 \\ cd_3' = 29972\cdot55 \end{matrix}\right\}$

The f term (= 50273·5) was afterwards provisionally identified as such by Fowler and Hartree from lines which I had somewhat doubtfully indicated as involving a term xd_2'. The writers of the letter appear to have overlooked the fact that Fowler and Hartree had already identified my x_3 term as the unresolved first p'' term of the quartet system.

While the value indicated for the *as* term is probably not much in error, it should be understood that the value of ap_3, on which it depends, remains somewhat uncertain. A Rydberg formula for ap_3 and bp_3 gives $ap_3 = 98850$, but this can only be regarded as an approximation, since only the first two terms of the sequence are known. A more trustworthy value would result if intercombinations between the doublet and quartet systems could be traced.

A. FOWLER.

[1] A. Fowler assumes $ap_3 = 100{,}000$. We have changed to the foregoing value in order to bring the Ritz formula for the sequence of *ap* and *bp* terms into better agreement with that for the corresponding terms of N I.

The Earliest Human Knowledge of Copper.

THE first discovery of metals by man is usually described as having resulted from the association of the necessary materials in the construction of a primitive hearth on some chance occasion. At best, this explanation does not contradict our accumulated knowledge about the habits and conditions of early human life.

There seems to me to be quite another possibility, not necessarily antagonistic to the earlier one, which is the outcome of a recent communication from Sir Flinders Petrie (*Ancient Egypt*, June 1926) on the Egyptian Paradise. He directs attention to the remarkable similarity of the place-names, the geography, and the "lakes of fire . . . in the midst of the paradise of cultivation" in the "Book of the Dead," with those of a definite region in the Caucasus —that along the rivers of the Iora and Kura. Then, following the normal lines of archæological argument, Sir Flinders suggests the possibility of the earliest Egyptian immigrants having come from that region.

It is known that some later arrivals, the earliest dynastic peoples, suddenly appeared in Egypt, equipped with a written language and with a knowledge of the working of metals, and of agriculture. If these constituted a later wave of wanderers from the same locality—just as there were several eruptions of tribes out of Arabia—they would bring with them knowledge naturally obtained from their home surroundings.

Copper occurs widespread throughout the Caucasian area. So also does petroleum; and the very locality in which Sir Flinders Petrie locates two lakes of fire and "a place of purification, probably by fire" from indications in the "Book of the Dead," is to-day occupied by an area of considerable richness in petroleum.

At one spot in a recent map ("Handbuch der regionalen Geologie," vol. v. pt. 5, heft 25, "Kaukasus," by v. Stahl, 1923) copper and petroleum are shown as being to-day in close proximity. But there must be and must have been innumerable seepages of oil over the whole area, so that many other points of intimate contact between copper and petroleum must have existed since remote times.

This being so, when a petroleum spring or lake became ignited, as is known occasionally to have happened, there is the greatest likelihood of the adjacent copper being reduced by the high temperature of the reducing flame to the metal itself, to be discovered by man at some later date.

This suggestion is supported by the fact that copper was in use very early in the history of the country that is now known as Iraq; this is also a petroliferous region, as is shown by the presence and use of bitumen from the earliest times.

It would be interesting to speculate on local results when other minerals were smelted in the same natural fashion, including the effect of the liberation of large quantities of arsenic or arsenic oxide over the surrounding country. PERCY E. SPIELMANN.

The Athenæum, August 19.

The Zoological Names *Simia*, *S. satyrus*, and *Pithecus* and their Possible Suppression.

UNDER the above heading in NATURE of July 10, p. 49, Dr. C. W. Stiles gives a summary of the argument in support of a proposition to re-open the case of *Simia* before the International Commission on Zoological Nomenclature. Although in agreement with most of the general principles enumerated in his summary, we dissent from the view that the names *Simia*, *S. satyrus*, and *Pithecus* are ambiguous and "so confused in zoological literature as to preclude hope of reasonable uniformity in their use in zoological, bacteriological, serological and public health work."

With regard to *Simia* for the orang, the name is supported by the many mammalogists who signed the list of "Nomina Conservanda" published in the *Proc. Zool. Soc.*, London, 1924, p. 345. It is consistently used by naturalists in general. To suppose that bacteriological and medical writers (at all events those on this side of the Atlantic) would accept and use such a completely unknown name as '*Pongo*' for the orang is to show ignorance of the mentality and prejudices of the very workers for whose benefit the argument is professedly framed. For such writers, past, present, or future, *Simia satyrus* is the name of the orang, free from all ambiguity whatsoever, and with that widely signed "Nomina Conservanda" list to support them they would certainly regard '*Pongo*' as 'Jazz'—and go their old way.

The fact that Dr. Elliot, in his bulky work on Primates, has used another name, would seem to have unduly influenced those who framed the argument outlined by Dr. Stiles; but unfortunately that work is so full of errors that as a standard of nomenclature it is repudiated by systematists in general.

The same has to be said about *Pithecus*, which is the technically correct name of the langurs, but has been wrongly used in another sense—for the macaques by Dr. Elliot alone among mammalogists. This wrong use has received no acceptance whatever, and cannot be said to render the name *Pithecus* ambiguous or unsuitable for acceptance by medical and other writers.

We would therefore reiterate our opinion that *Simia satyrus* for the orang, and *Pithecus* for the langurs fulfil the demand for names which are "thoroughly unambiguous and suitable."

Moreover *Macaca*, for which, according to the letter of Dr. Stiles, *Pithecus* would be abolished as the name of the macaques, should be, and is, used for these very animals, side by side with *Pithecus* for the langurs.

Arguments in favour of *Simia* for the orang are to be found in the Fiat lists above referred to, and for *Pithecus* in a paper by Thomas in the *Ann. Mag. N. H.* (8) xvii. p. 179, 1916. OLDFIELD THOMAS.
MARTIN A. C. HINTON.

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Lead Hydrogen Arsenate as a Mineral.

A SPECIMEN from the Tsumeb mines in the Otavi district, South-West Africa, recently acquired for the Mineral Collection of the British Museum, shows colourless transparent crystal plates with brilliant lustre, which had been labelled 'lanarkite.' The largest of these are 1 cm. across with a thickness of 1 mm. They rest on a crust of bayldonite pseudomorphous after mimetite (chloro-arsenate of lead), chessylite, and large crystals of anglesite ($PbSO_4$). The crystals are monoclinic ($a : b : c = 0{\cdot}8643 : 1 : 0{\cdot}7181$, $\beta = 84° 36'$) and show a development of sixteen crystal-forms. These forms have been listed to show the angles from each to the three axial planes; and it is believed that such a method of tabulation may effect a compromise between the method of giving interfacial angles in zones and that of longitude and latitude (ϕ and ρ) angles employed in two-circle goniometry. The crystals are optically positive, and the optic axial plane is perpendicular to the plane of symmetry and direction of good cleavage. The

refraction ($n_\gamma = 1{\cdot}9765$ for sodium-light), birefringence, and dispersion are all high.

A chemical analysis made by Mr. E. D. Mountain on a quarter of a gram of carefully selected crystal fragments agrees closely with the formula $PbHAsO_4$. It was then found that the crystallographic data agree with those previously determined for artificial crystals of this substance. A copy of E. S. Fedorov's "Tables for Crystallo-chemical Analysis" not being available, it was not possible to identify the substance from the crystallographic data alone. Artificial crystals of lead hydrogen arsenate had been prepared and completely determined crystallographically by the late Baron A. de Schulten (a political refugee from Finland, who worked in the chemical laboratories of the Sorbonne in Paris) in 1904. He also prepared a series of other compounds isomorphous with the mineral monetite ($CaHPO_4$), with strontium, barium, or lead in place of calcium, and arsenic in place of phosphorus. Of these only $CaHPO_4$ has been hitherto known to occur in nature. For the compound $PbHAsO_4$ occurring as natural monoclinic crystals the mineral name *schultenite* is suggested. The "lead arsenate" of commerce is the same substance. This is used as an insecticide, especially in America in sprays for fruit-trees; and being practically insoluble in water it is no doubt responsible for the retention of arsenic in apples.

A detailed account of the new mineral, so far as this can be completed from the single specimen, will be given in the December issue of the *Mineralogical Magazine*. There are no doubt other specimens of this mineral in collections amongst the rich series of crystallised material that has come from the Tsumeb mines.

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The Anomalous Flocculation of Clay.

IN a letter to NATURE of May 1, 1926, Dr. Joseph and Mr. Oakley allude to some experiments which have convinced them that the alleged anomalous flocculation of clay does not exist. The anomalous flocculation of clay is said by them to be the accelerating influence of hydroxyl ions on flocculation by calcium salts when compared with the retarding effect of hydroxyl ions on flocculation by sodium salts. I should like to submit, however, that the behaviour of calcium ions in alkaline medium is not regarded as anomalous by comparison with the behaviour of sodium ions in alkaline medium. Flocculation of clay by calcium salts is anomalous when considered in the light of prevalent theories, and not necessarily when compared with the behaviour of other ions. As I understand the anomalous flocculation of clay, the most that could be claimed by Dr. Joseph and Mr. Oakley is that the sodium flocculation of clay is also anomalous.

One realises, of course, that within the limits of a letter a description of experimental detail is not possible, but it is crucially important to know what precisely is meant by a "highly purified clay." The significance of the results in question is entirely dependent upon the complete removal of both adventitious and absorbed calcium in the clay. A highly purified clay suspension would ordinarily be taken to mean a suspension of clay in which there was no appreciable amount of the coarser particles, but such a clay suspension would still contain absorbed calcium, and on the addition of sodium salts that calcium would come into solution. Soils containing absorbed calcium can ordinarily be flocculated by the addition of a sufficient amount of alkali, but according to some incidental observations made on soil suspensions in these laboratories by S. J. Saint (*Proc. 2nd Comm. Intern. Soc. of Soil Science*), when the absorbed calcium has been completely replaced by sodium, no amount of sodium hydroxide will bring about a flocculating effect.

N. M. COMBER.

The University, Leeds.

Persistent Solar Prominences.

IN NATURE for July 24, page 131, reference is made to a large prominence formation on the sun's north-western limb on July 16. Apart from the interest in this display as to grandeur, consideration is enhanced by the fact of the many repeated appearances of this particular display. My records, which cover 71 observing dates since June 1, show that the first appearance of this exceptional formation was on June 18, in the north-west quadrant, in the north-east quadrant on July 2 and 3, again in the north-west on July 16, in the north-east again on July 29 and 30, once more in the north-west on August 12, and, although reduced somewhat, once again in the north-east on August 25 and 26.

We have thus 2½ complete synodic revolutions of the sun, during which this formation was preserved practically to the full extent for two complete synodic rotations, the display being easily recognisable, not only by its large extent, but also by the particular form which the various constituents retained, mostly magnificent tree forms, with bright trunks spreading into an elaborate tracery of interlacing branches. On the last appearance the trunks only seemed to be left, although faint overhead festoons and filaments were still visible.

ALBERT ALFRED BUSS.

Lee-Observatory, Chorlton-cum-Hardy,
Manchester, August 27, 1926.

Spraying Crops from Aeroplanes.

IN NATURE for August 14, p. 239, it is recorded that the first attempt in Great Britain to utilise the aeroplane for spraying operations took place in Lincolnshire in August 1926. It is to correct an error that the present communication is made. The first record of powder spraying by aeroplane in Britain is made in the *Fruitgrower*, June 29, 1922, and of which no reference can be found in NATURE of that year.

The experiment took place at Portobello Farm, Kingsdown, near Sevenoaks, owned by Major R. F. Bartlett, on an eighteen-acre cherry orchard badly infested by caterpillars. The material used was a proprietary dust ('Belumnite') manufactured and supplied by Messrs. W. J. Craven and Co., Evesham. The lessons learnt at this initial experiment are published in the *Fruitgrower*, July 13, 1922.

It should be placed on record that Major Bartlett was the first in Great Britain to use the aeroplane for the control of orchard pests, although the recorded facts of the efficiency of the method leave much to be desired.

G. FOX WILSON.

Dept. of Entomology, R.H.S. Laboratory,
Wisley, Surrey, August 27.

International Code of Zoological Nomenclature.

DURING this year I have so often been asked how this Code could be obtained that I hasten, with your permission, to announce that the Washington Biological Society has just published a reprint at the price of one dollar. Prof. C. W. Stiles, secretary to the Commission, says: "I would suggest that, if your colleagues wish copies, it would expedite matters to order a number at once." The address of the Society is at the Bureau of Entomology, Washington, D.C., U.S.A.

F. A. BATHER.

46 Marryat Road, Wimbledon,
London, S.W.19.

Seven Decades of Botany.[1]

By Prof. F. O. BOWER, F.R.S.

"The future of Biology lies not in generalisation but in closer and closer analysis."—BATESON (Birkbeck Lecture, 1924).

DEATH sudden and wholly unforeseen has stepped between Section K (Botany) and the president of its choice. Dr. Bateson had presided over the whole Association at its meeting in Australia, and partly on that account he had been specially selected for the chair of this Section in Oxford. From him we might have expected a broad outlook upon biological science. His address would have been instinct with wide experience in both of the branches of living things, the interests of which interweave in enthralling and often most perplexing ways. We should have heard a fearless statement of his mature views. Something constructive would certainly have justified the congratulations with which some of us had already welcomed his nomination. A great figure has been taken from the arena of biological science. A career still full of the promise of further achievement has closed prematurely.

This is not the time or the place for any comprehensive obituary of Bateson. I will only allude briefly to four leading events in his scientific career. He felt in early life the lack of facts bearing on variation, and sought to extend their area in his great work "Materials for the Study of Variation," published in 1894. This was the year when the British Association last met in Oxford. I do not remember that its contents came into the discussions in Section D, though the book centred upon the vital question of continuity and discontinuity. The second event was the publication in 1902 of "Mendel's Principles of Heredity," in which, though essentially a controversial statement, Bateson perceived latent in the rediscovered writings an expanding vista of advance. "Each conception of life," he says, "in which heredity bears a part must change before the coming rush of facts." In a third stage of his work Bateson expanded this theme into a fuller statement under the same title, and it was published in 1909. Passing from this period of high hopes to the fourth phase of 1924, we see in his address at the Birkbeck Centenary a chastened attitude. He there remarks: "We must frankly admit that modern discoveries have given little aid with the problem of adaptation," and that, much as Mendelian analysis has done, "it has not given us the origin of species." But that analysis having "led to the discovery of transferable characters, we now know upon what to concentrate. . . . Henceforth the study of evolution is in the hands of the cytologist acting in conjunction with the experimental breeder. Every appeal must ultimately be to the mechanics of cell-division. The cell is a vortex of chemical and molecular change. . . . The study of these vortices is biology, and the place at which we must look for our answer is cell-division." I would ask you to mark that last word. It is cell-division, not nuclear division; and earlier in his address we find the pregnant sentences: "As to what the rest of the cell is doing, apart from the chromosomes, we know little. Perhaps the true specific characters belong to the cytoplasm, but these are only idle speculations." Such extracts from Bateson's latest public pronouncement may suggest to you what the Section has lost by his death. They show the mind still elastic and perceptive: still both constructive and critical.

Any address that follows such a tragedy of disappointment as the Section has suffered can only fall short of what we had hoped to hear. Instead of attempting to fill the broad biological rôle that naturally fell to Bateson, I propose to centre my remarks upon three dates when the Association has met in Oxford, namely, 1860, 1894, and 1926. It happens that these dates mark approximately periods of transition in the progress of biological science, and particularly in botany.

1860.

I need scarcely recall that the meeting in Oxford of 1860, the year after the publication of the "Origin of Species," witnessed the clash between the new view and the opposition it was certain to arouse. The story has been often told of the aggressive attack and the crushing retort. But it is not sufficiently recognised that, though Huxley bore the first brunt of the fight, a large part in the contest was taken by Hooker. The meeting closed after he had spoken, and in his own words he was "congratulated and thanked by the blackest coats and the whitest stocks in Oxford."

Two generations have passed since the Oxford meeting of 1860: and still the "Origin of Species" holds its place as a great philosophical pronouncement. As the methods of research passed into greater detail, the area of fact has been extended through the labours of an ever-growing army of inquirers, and naturally divergences of view have arisen. Some authors appear to demand that for all time the "Origin" must cover every new aspect of biological inquiry, or else the whole theory crumbles. That is to demand a prophetic vision for its author. We need not for the moment follow these or other criticisms, but rather recognise that the theory rested essentially on facts of heritable variation, without defining their magnitude, limitations, or origin; and that it explained a means of their summation so as to produce progressive morphological results.

Before we leave the historical aspect of evolution a moral may be drawn from the lives of its four protagonists of 1860. Darwin, Wallace, Hooker, and Huxley were all equipped for the battle from the armoury of personal experience in the great world. The theory of evolution was born and bred of foreign travel, and upon foreign travel quite as much as upon quiet work at home its future still depends. We should not for a moment minimise the great developments of laboratory study and of breeding experiment in recent years that bear upon its progress. But it is not thence alone that the fullest achievement can be anticipated. The cytologist and the breeder, just as much as the abstract theorist, should know Nature

[1] From the presidential address to Section K (Botany) of the British Association, entitled "1860—1894—1926," delivered at Oxford on August 5.

face to face, not merely through a glass darkly. To those who believe in the close relation between environment and variation, which is to me the very core of evolution, this seems essential to any well-balanced view. The open forest, the sea-coast, steppe, and mountain-side should be regarded as the natural complement to the laboratory and the breeding-station. No one, morphologist or physiologist, should hold himself equipped for research or fully qualified to teach unless he have at least some experience of travel through wild Nature. This can best be acquired in the tropics.

What, however, do we find? In 1886 a committee of the British Association was appointed to assist the visits of botanists to Ceylon for study. Several well-known botanists availed themselves of its aid; but after a few years the scheme flickered out through inanition. In 1909 I visited the Cinchona Station in Jamaica, and again a scheme for continued use of the station by British botanists was initiated; but it has since died out for want of consistent support. Why did these efforts fail? We may set these failures down to under-valuation of the importance of foreign, and particularly of tropical, study; and the lack of full perception that open Nature is the greatest laboratory of all. Our future botany seems in danger of becoming myopic by reason of study being concentrated at too short focus. To correct this, young aspirants should travel early, as free lances, hazarding the fortune of the wild, as Darwin and his fellows did.

Homoplasy.

I have already alluded to the tempestuous meeting of 1860 in Oxford. Shortly after it an undergraduate came up to Christ Church who, before he was of standing to take his M.A. degree, had himself made a real contribution to the philosophy of evolution. It was Ray Lankester, who in 1870 published a short paper "On the Use of the term Homology in Modern Zoology, and the distinction between Homogenetic and Homoplastic Agreements." Its author was only twenty-three years of age, and its date barely a decade after the publication of the 'Origin.' This short paper went far to clear up the vague ideas surrounding the term 'homology' in the minds of early evolutionists. Lankester introduced the idea of 'homogeny,' substituting in a more strict sense the word 'homogen' for 'homologue.' He also suggested, to avoid confusion, the use of another new term, namely, 'homoplasy.' He defined homogeny as simply the inheritance of a common part, while homoplasy depends upon the common action of evoking causes or of a moulding environment upon homogonous parts, *or* upon parts which for other reasons offer a likeness of material to begin with.

This definition was at once adopted in the morphological study of animals, but Lankester did not himself apply it at the time to the morphology of plants. In point of fact the conception of homoplasy and the use of this clarifying term made its way but slowly into botanical literature. There is reason to believe that we are as yet only beginning to recognise in the evolution of the plastic plant-body how far-reaching has been the influence of homoplasy, not only upon external form, but also in the internal evolution of tissues. We are only now beginning to realise how far-reaching have been its results in plants as we see them. On the other hand, such realisation when well assured cannot fail to react upon our estimates of affinity of the organisms in which homoplasy appears. It may be going too far to trace all such results as consequences of the meeting of 1860; but the initiative was certainly given by Lankester in the years that followed.

1894.

Passing from the stormy period of 1860, when the whole outlook of biological science was being transformed by the advent of evolution, to 1894, we see that the atmosphere had cleared. One result was that the evidence of descent tended to become too definite in the minds of some enthusiasts, and there was even a disposition to argue deductively from the accepted position, a tendency that is much too prevalent to-day.

The outstanding feature of the Oxford meeting of 1894 was Strasburger's generalisation on the periodic reduction of chromosomes. This shed a new light on the vexed question of alternation, which, based on the brilliant results of Hofmeister, by this time held the field not only as an objective fact but also as an evolutionary problem. The effect of Strasburger's communication was to establish the chromosome-cycle as general for plants that show sexuality. It provoked comparison with a similar cycle in animals. The recognition of both cycles took its origin in the discovery by van Beneden in 1883 that in sexual fusion the number of chromosomes is the same in both of the conjugating nuclei. Later observers have confirmed this in a multitude of instances, and disclosed the correlative reduction, or meiosis. The existence of a nuclear cycle alike in animals and in plants cannot, however, be held as establishing any homogenetic unity of the two kingdoms. Comparison of the simpler forms of each indicates that the divergence of the kingdoms, if they ever had a common origin, was very early indeed, and probably antedated sexuality in either. Such similarities as they show in propagative detail, and particularly in the nuclear cycle, would be homoplastic, not homogenetic. If this be so for the two kingdoms of living things, may it not be equally true for the several phyla of plants that show sexuality; for we are not justified in assuming that sexuality arose but once in plants?

Historically this generalisation of Strasburger fell like a bomb-shell into the midst of the old controversy between the rival theories of alternation, styled in the words of Celakovsky 'homologous' and 'antithetic.' But it must be remembered that at the moment there was no complete demonstration of a cytological alternation in any one Alga, though the facts soon followed for Fucus and for Dictyota. We need not recite again the arguments for and against that old discussion. It soon lost its intensity in face of the obvious deficiency of crucial facts, which alone could lead to some final conclusion. Loose comparisons between organisms not closely allied are but the long-range artillery of morphology. Comparisons between organisms closely related are its small arms. The discussions of the 'nineties of last century on alternation were all engagements at long range, which could not be decisive

without the use of close comparison. As the necessary facts were not then in our hands, those premature engagements might be held as drawn; and it was open to both parties still to entertain their own opinions.

Before discussing the relation of somatic development to that cycle, it will be well to revise the terminology then in use. It would be well to drop those old terms, which are neither exact nor explicit, and to support a more general use of the words 'interpolation theory' in place of 'antithetic' and 'transformation theory' in place of 'homologous.' These words accord better with current views, and are explicit.

1926.

From the time that the periodic reduction of chromosomes was recognised as general in organisms showing sexuality, the nuclear cycle has formed a natural foundation for the comparison of the life-histories of plants. The normal cycle may be figured to the mind as a closed circular thread with two knots upon it, syngamy and reduction. Between those knots beads may be strung, one or more than one, or none. These represent somatic developments, which are normally diploid between syngamy and reduction, haploid between reduction and a fresh act of syngamy. They follow in alternate succession in any normal cycle, but either may be repeated indefinitely by vegetative propagation.

Certain questions arise with regard to the evolution of these somata as we see them. The first is, how far are the diploid and haploid somata of the same cycle comparable one with another? The reply will turn upon the constancy of the events of syngamy and reduction throughout descent. If they were constant, then it appears a necessary consequence that the alternating diploid and haploid somata must have been distinct throughout their history; and any similarity which they may show, as in Dictyota or Polysiphonia, would be homoplastic. It would indeed appear natural that they should be alike in Algæ, since they are parts of the same organic life and live in identical circumstances. It has, however, been suggested that reduction may not be a fixed but a movable event in the individual life: liable to be deferred or carried over to a later phase, in which case a diploid generation might arise by transformation from an already existent haploid phase. The monospores of the Nemalionales have been cited as possibly convertible in other red seaweeds into tetraspores, by some sudden deferring of the act of reduction.

I am not aware that this has been advanced by close comparison beyond the position of tentative suggestion, though the existence of a diploid gametophyte and of a haploid sporophyte in certain abnormal ferns would indicate the possibility of the suggestion being true. Pending the advance of a closely reasoned argument it is best to keep an open mind. Meanwhile the weight of facts hitherto known from plants at large may be held to support the stability of the events of syngamy and reduction during normal descent. The two generations of the same life-cycle would, in the absence of a carry-over of reduction, be homoplastic, not homogenetic.

No one has yet made out a closely reasoned case for the descent of the Archegoniatæ from the green, the brown, or the red algæ. The old view that they originated from the green algæ has never recovered from the blow delivered by Dr. Allen, when he showed that the reduction in Coleochæte takes place in the first divisions of the zygote, and that the presumed primitive sporophyte is really haploid, and not cytologically a sporophyte at all. It is a perfectly tenable position to hold that the Archegoniatæ sprang directly from none of these groups, as we know them. In the absence of definite comparative evidence, the field appears to be open to an origin of alternation in the Archegoniatæ by interpolation of a sporophyte *de novo*, developed not in water but in relation to a land-habit.

Devonian Fossils and a Land Flora.

Palæobotanical discovery has been greatly advanced within the period under review. The features of the vegetation of Mesozoic time are becoming clearer than ever before under the hands of Prof. Seward. The Carboniferous flora has been richly presented to us by Williamson, Scott, Oliver, and Kidston in Britain, and by continental workers such as Renault, Zeiller, Bertrand, Nathorst, and Solms-Laubach. We are now able to substitute something positive in place of vague surmisings. Not only do the new facts illuminate our knowledge of plants now living, but they also apply a check upon theories as to their origin.

Latterly a vision is becoming ever more and more real of a Devonian flora, revealed by Kidston and Lang in Britain, and by other workers in Scandinavia, in Germany, and in America. Given more extended collecting, an improving technique, and the fortune of finding more material as well preserved as that at Rhynie, who knows but what the coming decades may see the land of the Devonian period clothed before our eyes by a flora no less stimulating and even more suggestive than that of the coal? But though Devonian lands are the earliest yet known to have supported a sub-aerial flora, the highly advanced structure of such a fossil as *Palæopitys Milleri* suggests that we are still far from visualising the actual beginnings of land vegetation. Moreover, the mixture in the Rhynie Chert of algal types with vascular land-plants presents at the moment a problem as perplexing as it is ecologically strange.

It is always difficult to estimate justly the times in which we live; but we may well believe that the future historian of botany will note the present period as one specially marked by successful study of the floras of past ages, and by the increasing cogency of their comparison with the vegetation of the present day.

The *Annals of Botany* as an Historical Document.

Perhaps too much time has been claimed for morphological questions, which are closely related to the dates of the three meetings of the British Association in Oxford. The brief space that remains may be devoted to a more general survey of the period which these dates cover. In this we could not do better than to take as an index the pages of the *Annals of Botany*, for the existence of which we owe a deep debt to the Oxford Press. In 1860 there was no organised laboratory

teaching of botany in any university in Britain; and as yet there was no journal of the nature of the *Annals*. But the revival of close observational study in botany under Huxley and Thiselton-Dyer at South Kensington in the early 'seventies, recorded last year by various writers in the *New Phytologist*, was beginning to take effect in 1881, when the British Association met in York. There the outstanding feature was the address of Hooker on geographical distribution. This and the papers by Bayley Balfour on Socotra and by Baker on Madagascar were all that really mattered botanically, and almost all the contributions were systematic or regional in subject. The revival of the laboratories had not yet fructified.

At this time all the work that was done in laboratories was called 'physiology,' as distinct from systematic botany, which was conducted on dry specimens in the herbarium. In 1887, six years after the York meeting, the *Annals of Botany* was founded through the activity of the late Sir Isaac Bayley Balfour, and a small committee of guarantors whose personal security induced the Clarendon Press to make the venture. From the start that journal has paid its way. The forty stately volumes form a record, between the pages of which may be read the history of botanical progress in Britain, and in some degree also in the United States, for American botanists have always been with us in its pages.

In the first issues of the *Annals*, morphology and systematic botany preponderated, and from the proceedings of the meeting of the British Association in Oxford in 1894 we see that this was still so. That meeting witnessed a crisis in the affairs of botany in Britain. A newly established Section I of Physiology assumed that the functional activities of plants would be swept, together with those of animals, into its hands. Up to this time Section D had been the undivided section of Biology. An irregular cleavage of interests was set up by this claim, for the zoologists were mostly willing to give up their physiology, but the botanists were not. Their refusal to accept divorce of form from function contributed to, or at least coincided with, the foundation of a separate Section K of Botany, and has dictated the policy of British botany ever since.

As we pass from 1894 to the current period we perceive a marked shifting of the interest of botanists from the study of form to that of the intimate constitution and functional activity of plants. Whole fields of colloidal chemistry and physics, of quantitative physiology, of cytology and genetics, of ecology, of fungology and bacteriology, have been opened up. The present century has been specially marked by the extension of opportunities for physiological research, by better equipment of departments in the universities, and by the foundation of independent establishments carrying on experimental inquiry in its broadest application. This is rapidly bringing the science into closer relation with Imperial and social aims.

It is needless to specify, but the effect of it all is plainly written in the pages of the *Annals*. Experimental results have gradually taken the preponderant place over description and comparison, as is amply shown in the last January number. 'For better, for worse,' the pendulum has definitely swung over from the extreme systematic position of half a century ago, through a phase of prevalent morphology (or perhaps we should better say of organography), to an extreme physiological position at the present time. Some may even have felt that this address is in itself an anachronism, in that it has not touched upon the moving physiological questions of the day. While I may claim none the less to sympathise with physiological aspirations, I do not assent to any ultra-physiological aspect of botany that would degrade or minimise the comparative study of form. *Medio tutissimus ibis* is still a true maxim. The laboratory physiologist, dealing with the things of the moment, cannot safely detach himself from the things of the past as recorded in heritable form. He should not allow himself to be immersed in statistics and neglect history. The pendulum has gone full swing, within a period of about half a century; but we may confidently anticipate a return towards some middle position.

Power Alcohol and other Petrol Substitutes.

ALTHOUGH opinions differ concerning the extent of the world's petroleum reserves, it is generally agreed that if the consumption of petrol continues to increase at its present rate, available supplies will soon become inadequate. Thirty years ago, it is said, there were but four motor cars in the United States; to-day there are nearly twenty million, and the consumption of petrol in that country has risen to about 900 million gallons a month. The demand for aviation shows every sign of expanding, and when we consider that petroleum is very unequally distributed in the earth's crust, and that economic independence is still a watchword in international politics, we can readily understand the vigorous efforts that are being made to produce liquid fuels by artificial means.

So far as we can see to-day, there are not many possible alternatives to petrol. There are, indeed, immense supplies of liquid fuel lying dormant in the oil-shales that are so abundantly distributed over the earth, but until methods of extraction and purification are devised that are both technically and economically successful, we shall continue to look to other fossil fuel, coal or peat, to vegetable matter, and to the mixture of carbon monoxide and hydrogen known as 'water-gas,' to supplement our present supplies of petrol, and to replace them when the day of extinction draws nigh.

Benzol is an excellent motor-fuel, but its production is comparatively small; and it is required for other purposes: for example, for dyes and explosives. Acetone is the ideal liquid for mixing with other motor-fuels, but at present it is too costly to compete with them, although its commercial production through the acetic acid made by fermenting cellulose may be achieved at an early date, and so bring it into the foreground. Alcohol is of especial significance, because the raw materials of its manufacture, cellulose and sugar, are renewed incessantly by a bountiful Nature, and also because its value as a motor-fuel, particularly in admixture, has been proved beyond a doubt. Hydrocarbon

oils of low boiling-point, such as are produced by 'hydrogenating' coal and peat, or by passing water-gas over heated catalysts, are among the most likely substitutes for petrol; from the technical standpoint the elaboration of such processes will be comparatively easy; the whole issue lies in their economy. Though the raw materials—coal, peat, air, water—are cheap, heavy capital expenditure upon plant appears to be unavoidable, and in some instances a considerable amount of energy has to be expended in promoting the chemical reactions concerned.

Of a different order are the processes for producing alcohols (and acetic acid) from cellulose or sugar by fermentation, for they require neither a high temperature nor a high pressure. Here again the problem is essentially an economic one. The raw material may be very cheap, especially if it grows wild, but it may cost a great deal to collect and transport. A few years ago there was much talk of utilising the Indian mahua flower as a source of power alcohol, but the proposition was soon found to be uneconomic, mainly on account of the cost of collecting the flowers. Cultivated sugar-cane and sugar-beet are necessarily more costly than wild vegetation, and they cannot be grown everywhere. Moreover, they contain an essential foodstuff, and the world-price of sugar rules them out as sources of power alcohol unless their production is subsidised by the State. Molasses, being a by-product, is in a different category. Although it is produced in considerable quantity (constituting about 30 per cent. of the weight of raw sugar manufactured), supplies of it would not cover more than a fraction of the world's requirement of light motor-fuel in the event of a petrol famine; its production is confined to sugar-growing countries, and it is in great demand by manufacturers of rum and cattle-cake. The production of fuel-alcohol from molasses is now being undertaken on a large scale in Queensland, Australia, states Dr. W. R. Ormandy (*Journ. Soc. Chem. Ind.*, Aug. 13, 1926), where, with the aid of the Queensland Government, a plant is being erected to produce two million gallons of alcohol per annum, and three additional plants are projected. This enterprise will be assisted by the existence of a thriving sugar industry, and by the total absence of petroleum deposits in Australia.

Among post-War developments the initiation of a State-subsidised beet-sugar industry in Great Britain is one of the most interesting. A flourishing industry of this kind would have far-reaching effects, especially upon agriculture; and the view being held in certain quarters that agriculture would benefit more if beets were grown for the distillery than for the beet-sugar factory, the Government appointed a small committee, consisting of two chemists and one physicist, to inquire into certain economic aspects of the question. The report,[1] which was issued in July, is a short document of a few thousand words. In reply to the questions put to it, the Committee estimates the cost of raw material per gallon of alcohol (taken throughout as 95 per cent. by volume) to be 5 per cent. of the price per ton of beet, due allowance being made for the value of residual products. Cost of conversion or manufacturing cost is given as 9*d*. per gallon of alcohol, so that, excluding other charges (*v.i.*), the cost per gallon net naked at works would be 1*s*. 9*d*. or 2*s*. 9*d*., according as the price of sugar-beet is taken at 1*l*. or 2*l*. per ton. The yield of alcohol from one cwt. of sucrose is 8 gallons theoretically, 6·8 gallons in practice. With the aid of these figures, and taking 28*s*. per cwt. as the commercial price of sugar and 1*s*. 6*d*. or 2*s*. per gallon as the probable price of power alcohol, the Committee calculates that with the same rate of subsidy in both cases (19*s*. 6*d*. per cwt. for sugar and 2*s*. 10½*d*. per gallon for alcohol), the subsidy would amount to 70 per cent. of the commercial price of sugar, and 191 or 144 per cent. of the commercial price of alcohol.

The economic case against subsidising the sugar-beet industry for producing power alcohol is really stronger than these figures suggest. The Committee ignores (wittingly) charges for denaturing, packing, transporting, and selling. Assuming a wide distribution, these charges would amount to about 1*s*. per gallon; hence the subsidy would really represent 258 or 221 per cent. of the commercial price of the alcohol. Furthermore, it must not be overlooked that the present rate of subsidy is very high and will diminish as time goes on. Last season the price paid to English growers was about 56*s*. per ton of beet, and the subsidy per ton was about equal to the price received by Dutch growers for their produce; in other words, the English beet-sugar manufacturers practically obtained their raw material for nothing.

The Committee was also asked to report upon the prospects of producing power-alcohol by synthetic processes. Its reply is to the effect that the present position of such processes is obscure, and that reliable statements of costs will not be available for some time. Nevertheless, a useful appendix is inserted containing remarks on the chief processes that are potentially important for making alcohol and other liquid fuels from sugar, cellulose, coal, and water-gas.

Preparation through ethylene appears unlikely to provide alcohol in quantity, and synthesis from calcium carbide is regarded as improbable in view of the abandonment of carbide manufacture in this country owing to economic considerations. The use of water-gas for making liquid fuels, whether alcohols or hydrocarbons, is held to be promising, although but little has been done in this direction in Great Britain. Processes involving the use of high pressures, like those of Patart and Fischer, are referred to, but no specific mention is made of Fischer's work on producing hydrocarbon liquid fuel from water-gas without employing high pressures. In some quarters this development is regarded as a great advance, but it should not be overlooked that the saving effected by dispensing with the costly high-pressure plant is quite counterbalanced by the cost of the very much larger plant required for working with gases at ordinary pressure. A few reasons are given for and against the use of methyl-alcohol as a motor-fuel, but the Committee issues no verdict on this head. Actually methyl-alcohol is a very inferior fuel, not only because it has a low calorific power, but because it causes serious 'pinking' in the engine. The Committee thinks well of the possibilities of the improved Classen and Prodor processes for converting the cellulose of wood, or waste-wood, into

[1] Power Alcohol Production, being a report to the Minister of Agriculture and Fisheries of the Departmental Committee appointed by him in connexion with the Manufacture of Alcohol for Power Purposes from Sugar Beet. (London: H.M. Stationery Office, 1926.) 6*d*. net.

sugar and alcohol, especially in countries where wood is abundant. There is, however, little prospect for making alcohol from waste sulphite-liquors in Great Britain, whilst production by fermenting cellulose is more likely to be developed in the overseas dominions than in our own country.

The outlook for producing motor-fuel from coal is considered to be favourable, but not by the low-temperature carbonisation process, which, the Committee states, cannot yet be worked on a large scale at a profit, and when it can be so worked it would not provide more than a fraction of our requirements in heavy and light fuel-oil. The Bergius process (for the investigation of which the Government has recently granted the sum of 25,000*l.*) is stated to be the only one which could satisfy our requirements, but in view of the difficulty in constructing plant, some years must elapse before really commercial data concerning it can become available. In its remarks upon this process the Committee gives some quantitative data which are not up-to-date. The statement that at least one ton of coal must be burnt for every ton put through the process should read "one ton of coal is burnt as fuel for every *two* tons put through the process"; and the yield of light fuel is not 15 gallons but from 20 to 25 gallons per ton, according to the quality of the coal treated. Further, the remark that "65 per cent. of the weight of the coal may be converted into a kind of oil," would be more accurate in the form: "85-93 per cent. of the coal substance is converted into oil."

In its summary of this interesting section of the report, the Committee states that of all the processes not involving the distillation of fermented foodstuffs, the most likely to be adopted in Great Britain are those based upon the use of water-gas as raw material, and those by which fermentable sugars are obtained in high yield from wood. It is, however, strongly open to doubt whether the latter processes could be worked economically in Britain, where wood is scarce and expensive, and where wood-waste can only be collected and transported at prohibitive cost.

Discoveries in the Gobi Desert by the American Museum Expeditions.[1]

By Prof. HENRY FAIRFIELD OSBORN, For. Mem. R.S.

IN 1799, William Smith, then a young man of thirty, who was born at Churchill in Oxfordshire, dictated his now classic document, "The Order of the Strata," including a map showing the successive and characteristic fossils of southern Britain and the Oxford clay underlying this great University, with its Jurassic deinosaur Cetiosaurus. In the century and a quarter which has intervened before the present meeting of the British Association in Oxford, the twin sciences of geology and palæontology have reached a degree of precision which enables us, after our relatively brief and intensive surveys of the past four years, to declare 'the order of the strata' of Mongolia. Included in the Gobi Desert is a stratum equivalent in age to the Oxford clay of William Smith, containing the giant sauropod Asiatosaurus, a first cousin of the Oxford Cetiosaurus.

Meanwhile, physicists have extended the life-history period of the earth from the momentary 5000 years of Usher to the 1,000,000,000 years of Rutherford. This allows a comfortable margin of 400,000,000 years' time for the wonderful procession of evolutionary advance recorded in the twenty-four chapters of Mongolian prehistory, beginning with the equivalent of the Purbeck and Oxford formations of Upper Jurassic time, continuing with the appearance of man in the Old Stone Age, ending practically with the dominance of Ghenghis Khan, and followed by the decline of Mongolia to its present desert and relatively uninhabited state.

In the meantime, this now arid 'roof of the world' has been the scene of a whole succession of animal dynasties, fertile, productive, with a relatively temperate and invigorating climate, sometimes arid, sometimes pluvial, from first to last the homeland of waves of migrating land reptiles and mammals, which successively spread into every other continent (Fig. 1). It is a singular fact that this first and greatest of all life-centres (7) of prehistory was the last to be discovered, following by a half to three-quarters of a century the discoveries of great life-centres in Australia, in North and South America, in northern Africa, and in southern Asia. Although each of these great centres contributed its quota to the prehistory of the earth, none played a part at all comparable to that of central Asia.

With this introduction we may proceed to show by means of photography the contrast between the present geography of Mongolia and its palæogeography as recently revealed, and exhibit a new palæogeographic map of the world (Fig. 1) prepared especially for this discourse, showing that by placing North America on the east, Asia in the centre, and Europe on the west of an equal-area projection, we have a complete solution of all the animal migratory routes from Upper Jurassic time to the six great waves of human migration which swept over northern Asia into North America in late Pleistocene time.

PRESENT GEOGRAPHY OF MONGOLIA.

The position of Mongolia in Asia as shown in the map of Perthes may be projected areally on a map of the United States along lines of the 40th parallel; and there at once appears the remarkable similarity between the Mongolian fauna and that of the Rocky Mountain region throughout the entire period from Jurassic to recent times, the parallelism varying in closeness from epoch to epoch, at times Europe being closer than the United States. To the north of the hypothetical 'Gobia' lies 'Angara,' to the south the 'Gondwana' of Suess.

[1] From an evening discourse delivered to the British Association at Oxford on August 9. For further information regarding these expeditions reference should be made to "Methods and Results of the American Museum Expeditions in the Gobi Desert, 1922–25" (NATURE, August 7, 1926, pp. 198, 199), a lecture delivered to the Geological Society of London, June 23, 1926.

PERSONNEL AND TRANSPORTATION.

It has been estimated in the United States Geological Survey that as much was accomplished in three years by the American Museum survey as had been accomplished in the first fifty years of discovery in the corresponding Rocky Mountain region, namely, from 1850 until 1900. This was due to prolonged palæontological experience in America and to the combination of slow camel transport and rapid automobile transport, under the guidance of ten Mongols, ten Chinese, and an equal number of Americans trained in the western desert region. These rapid modern methods were rendered possible by the approval of the Mongol Government, but neither aeroplanes nor radio were allowed admission. Over the great level stretches now traversed by wild asses and gazelles, the camels advanced fifteen miles a day, the automobiles a hundred and fifty miles a day, or ten times as rapidly.

The routes and discoveries of three seasons (1922–1925) may be summarised as follows :

(*a*) Peking, Kalgan, Pang Kiang, Irden Manha, Houldjin, Iren Dabasu, Tuerin, Urga (the main and only telegraph line in Mongolia).

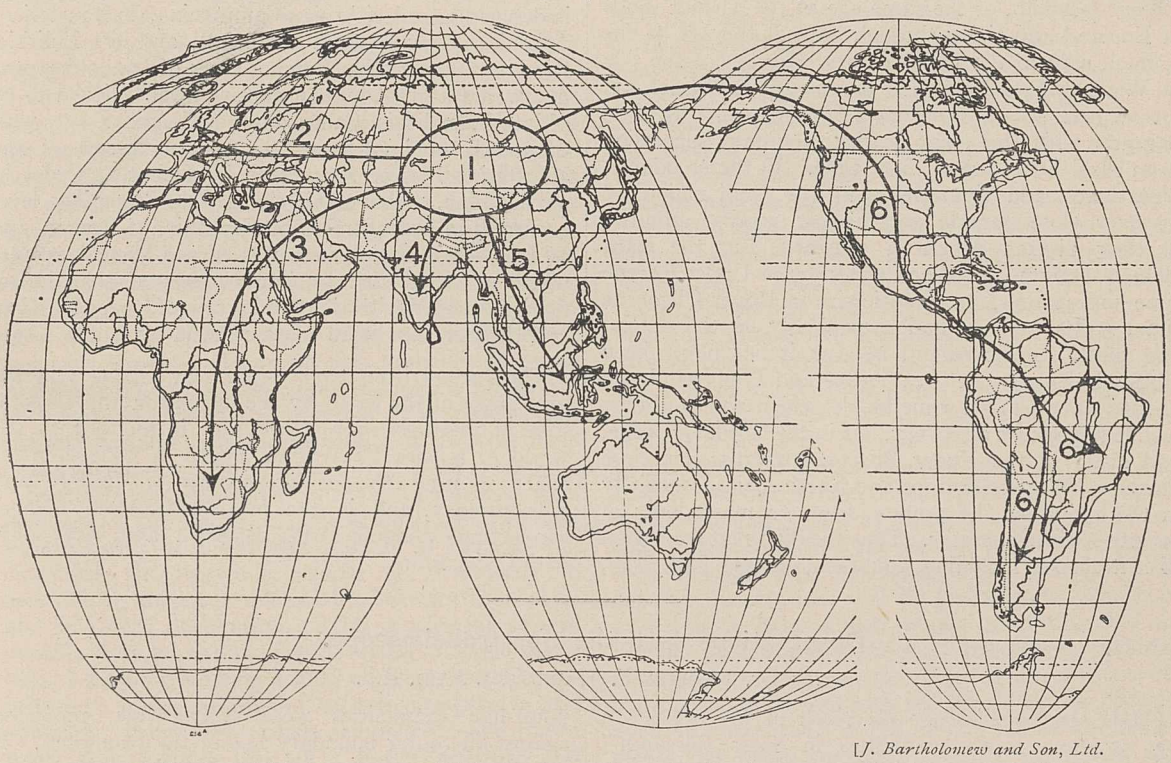
(*b*) North-west Uliassutai route : Shara Murun, Ardyn Obo, Sair Usu.

(*c*) Altai route, travelling southward to Kolobolchi, Ondai Sair, Oshih (Ashile), Djadokhta, Gashato, Golobol'n Ola.

(*d*) Northward on the main route to Urga through Irden Manha, Houldjin, to Iren Dabasu.

Excepting Peking and Kalgan, all these localities yielded fossils, often in enormous quantities. At Houldjin we found the very spot where Obruchev discovered the single rhinoceros tooth, hitherto the only fossil vertebrate found in all Mongolia. At Iren Dabasu Andrews pointed out to me distant fossil beds of the Wealden age on the horizon, a rich Lower Cretaceous level. Each of the watering stations mentioned in the above routes, where wells are sunk for the camels, now gives its name to a more or less great geological horizon or formation contemporaneous with the great horizons of western Europe or of the United States.

Nothing could exceed the fidelity and ability of the Mongols and of the Chinese ; the former were found to be true to their word on every occasion, and the latter were not only faithful but also became extremely expert in the discovery of fossils ; and many of them are now engaged in working the fossils out of the rock in our Peking laboratory.



[*J. Bartholomew and Son, Ltd.*

FIG. 1.—**1** : New Central Asiatic continent. **2**-**6** : Migration lines of the great reptilian Sauropoda—to Europe (2), to South Africa (3), to India (4), to Malaysia (5), to North and South America (6).

THE UPPER JURASSIC CONTINENT AND FIVE LIFE-ZONES OF UPPER MESOZOIC TIME.

It is an interesting coincidence at the present meeting of the British Association that the oldest horizons, known as Ondai Sair and Oshih (Ashile), are of sub-Wealden age and at present appear to be close to the Purbeckian and Oxfordian horizons of England. They contain primitive short-headed iguanodonts. Above them lies the Iren Dabasu, probably of Wealden age, containing large iguanodonts, ostrich deinosaurs, and megalosaurs. Still more recent are the famous Flaming Cliffs of the Djadokhta, which have no terrestrial equivalent in England ; here were found the skulls of five small Cretaceous mammals and a host of deinosaurs, herbivorous and carnivorous, including the

now famous Protoceratops with its supposed enemy, the Oviraptor or egg-snatching deinosaur. From the lower Ashile level the giant sauropods, Asiatosaurus, may have wandered to all the great continents except Australia. The fascination and the perils of fossil hunting among the Flaming Cliffs of Djadokhta for the eggs and skeletons of deinosaurs were recorded by instantaneous photography.

Successive Life Phases of the Age of Mammals.

Even closer and more continuous is the remarkable succession of Gobi formations starting with the basal Eocene Gashato, of the same age as the Thanet sands of England and rising through beds of the age of the London clay to the Hordwell and Headon of the Isle of Wight, where England's terrestrial formations are interrupted, presenting a series of extraordinarily close parallels with the great Rocky Mountain succession from basal Eocene to Miocene time. In the creodonts, uintatheres, and titanotheres of the Gobi region we discover close generic and almost specific affinities to their distant American cousins. But the giant Baluchitherium, which had ancestors in Upper Eocene time and attained its gigantic size in Upper Oligocene time, seems to have had a monopoly of the central and south Asiatic region, because it has never been found elsewhere. In the Miocene and Pliocene phases of the Gobi there are some breaks which will doubtless be filled by future discovery, but in the Middle Miocene, and again in the Upper Pliocene, we discover close kinship to Western Europe and North Africa, especially in the arrival of the proboscideans or mastodonts of remote African ancestry. Thus the high plateau region of central Asia, including, doubtless, Chinese Turkestan, Tibet, and Mongolia, is firmly established as the previously missing area of origin not only of the terrestrial life of the entire northern hemisphere, but also of life which wandered into the extremities of Africa and of South America as well.

Scientific truth is far stranger than scientific fiction: Gobia takes the place of the mythical Atlantis and other imagined continents as the source of most of the animal civilisations and probably also of most of the vegetal civilisations of the northern hemisphere.

Discovery of the Old Stone Age in 1925.

At least four periods in the Old Stone Age of man were recognised in the campaign of 1925, namely, in descending order, Azilian-Campignian, (?) Mousterian, Acheulean (much more doubtful), and (?) Eolithic. Directly opposite the Flaming Cliffs of Djadokhta was discovered a great human culture level believed to be of late Palæolithic, Campignian, and Azilian age, with thousands of implements, to the north-east of the Mousterian horizon discovered by Licent at Ordos in north China. Above this closing Old Stone Age level occurred, in order, traces of Neolithic, of Bronze, and of Iron ages, ending in traces of pre-Mongol peoples which are succeeded by burial-places of the Mongol race that ended with the warrior race of Ghenghis Khan and the conquest of all southern Asia by Kubla Khan.

Thus are written twenty-four new chapters in the prehistory of the earth by the expansion and elaboration of methods of research first introduced to the world of science by William Smith of Oxford in his chart showing the companionship of geology and palæontology, and in the most unexpected manner connecting Mongolia with England and, especially, with Oxfordshire.

Observations with the Spectrohelioscope.

By Dr. George E. Hale, For. Mem. R.S.

THE spectrohelioscope described in my article on "Some New Possibilities in Solar Research" (NATURE, July 3, 1926) has been provided with new oscillating slits and driving mechanism and an improved parallel-plate line shifter and micrometer for setting various parts of the Hα line on the second slit during observations, with divided arc indicating the exact wave-length employed. In this form the spectrohelioscope not only discloses the most delicate details of structure shown on the best Mount Wilson spectroheliograms, but has also served for the detection and measurement of some new and interesting phenomena.

Three cases observed on August 15 may be mentioned, all in the hydrogen vortices associated with the large spot group which on that day was near the central meridian of the sun. The first two were noticed south of the following spot of the pair. By rocking the parallel glass plate back and forth, thus showing the change in form with wave-length of two slender curved flocculi, their dark heads were seen to advance toward the spot as the Hα line was moved across the second slit from its centre toward the red. At a slit position about 1·3 angstroms from the centre of the line, the curved flocculi had disappeared, but their point-like extremities were still visible, projected against the outer boundary line of the penumbra. If we assume this effect to be caused by the rapid descent of the hydrogen in the vortex above the spot, the radial velocity was about 65 km. per second. Another slender flocculus south of the preceding spot behaved in the same way. A similar observation on August 16 gave a maximum radial velocity of 56 km. per second for the descending point. These velocities are of the same order as those of knots in prominences moving toward spots, measured by Slocum and Pettit on photographs of the sun's limb made with the Rumford spectroheliograph, and observed visually by myself with the spectrohelioscope.

Although I confirmed the new results on August 17, the day I left Pasadena for a month's absence, I wish to check them more completely before expressing a final opinion as to their interpretation. It now seems probable, however, that the spectrohelioscope can be used for a more complete analysis than has previously been possible of the hydrogen vortices surrounding sunspots. These vortices involve the prominences as well as the chromosphere, and a means of measuring the velocities of the hydrogen, seen in projection against

the disc as well as in cross-section at the limb, should prove of great service.

If we may interpret another group of observations in the same way, the parallel plate micrometer will also make it easy to distinguish eruptive jets, rising near spots and descending at some distance after following a long-arched trajectory, from the true vortex structure with which they are likely to be confused on spectroheliograms. At their source these apparent jets often appear as bright flocculi, seen on the violet side of Hα, which seem to become dark absorbing streams at a higher level and finally descend at a velocity sufficient to produce a marked displacement to the red, beyond the normal boundary of the Hα line.

Bright hydrogen flocculi include those of the quiescent or slowly changing type and those of short life, which change rapidly in form and intensity. These short-lived bright flocculi are themselves of two kinds: eruptions, shown by the spectrohelioscope, when near the centre of the sun, to give a displacement of the bright Hα line to the violet; and bright flocculi which are receding or stationary in the line of sight. From my recent visual observations, it appears probable that the short-lived stationary or receding bright flocculi are often due to the descent of comparatively cool hydrogen, which appears dark at high levels but turns bright as it falls. The distinction is important, as terrestrial magnetic storms and auroras will probably be found to result from the presence near the middle of the sun of bright flocculi of the eruptive type, which emit charged particles at velocities sufficient to carry them to the earth.

Spectrohelioscopes capable of distinguishing such eruptions, if they could be built at small cost and used systematically at a sufficient number of stations well distributed in longitude, should aid materially in determining the exact relationship between these solar and terrestrial phenomena. After considering several possible designs, and making a variety of preliminary tests, I am now building a solar telescope and spectrohelioscope which promise to be both inexpensive and powerful. From tests already completed, I find that a single plano-convex lens of 3 inches aperture and 18 feet focal length, used with a simple heliostat or cœlostat just large enough to fill it with light, will serve very well for the necessary solar telescope. In the spectrohelioscope a single prism, twice traversed by the sunlight, will take the place of a grating. Its dispersion will be adequate with a focal length of 13 feet, or by the use of additional prisms the focal length can be reduced. For general use, fixed monochromatic telescopes of the above type will be less expensive and probably more satisfactory than those carried by an equatorial mounting. Moreover, I have designed a spectrohelioscope for attachment to equatorial telescopes, but have not yet found opportunity to build and test it.

Continued use of the spectrohelioscope has strengthened my hope that in the hands of amateur astronomers it may contribute materially to our knowledge of the solar atmosphere. As another indication of its service, I may add that on June 26 last I observed a phenomenon recorded but once, and then incompletely, in the entire collection of Hα spectroheliograms obtained on Mount Wilson since the beginning of such records in 1908. This unique case was the sudden engulfment, on June 3, 1908, of a large dark flocculus (prominence) by the vortex associated with a sunspot, illustrated and described in "Solar Vortices," *Astrophysical Journal*, vol. 27, September 1908. The phenomenon of June 26 was very similar in appearance, and although the parallel plate micrometer was not then completed, I was able to see its final stage, which was necessarily missed in the earlier record. This was the appearance of a black dot, after the large dark flocculus had been sucked into the vortex, exactly upon the outer (preceding) boundary line of the penumbra, as in the observations of August 15 and 16. This could be seen only when the second slit was on the red side of Hα, indicating the rapid recession of the hydrogen. The detailed observations will be given later. The point to be made here is that many interesting and unfamiliar phenomena of the solar atmosphere, including cases of this kind, can be observed by any one who cares to equip himself with the simple and inexpensive apparatus required. A full description of the instruments now under construction will be published soon after the final tests have been completed.

News and Views.

THERE have just been placed on exhibition in the Geological Department of the British Museum (Natural History) the remains of a Stegosaur or armoured deinosaur, obtained by the late W. E. Cutler from the Belly River sandstone of the Red Deer River, Alberta. Baron Nopcsa, who will soon publish a description of the specimen, believes that it represents a new genus; but in any case it is closely allied to Panoplosaurus (Lambe) and Ankylosaurus (Barnum Brown) from the same beds, and is not very unlike Polacanthus (Owen) from the Wealden of the Isle of Wight. The chief interest of the specimen lies in the preservation of the plated skin still in position over the greater part of the skeleton. The bony plates range from large broad-based spikes, presumably covered with horn in life, to minute specks in the wrinkled skin of the neck. The skin of the under surface has left no trace and was no doubt relatively thin. The vertebræ of the back lie in a straight line, and the ribs were probably fused to them, as in Ankylosaurus. The sacral vertebræ are fused to one another. The vertebræ of the neck and tail were movable. The limb-girdles are clearly shown, and the large bones of the left fore-limb clearly retain their natural position, indicating a squat posture with a bend at the elbow, so that the height at the shoulder was only about three feet. The left hind-limb has been bent over the belly, and is almost complete. The skull is missing. The length of the fossil is 15 feet, and its breadth 6 feet. In the absence of jaws and teeth, the feeding habits must be inferred from those parts in allied forms. Baron Nopcsa holds the view that the creature roamed a sandy desert and lived on occasional swarms of

locusts; the museum labels adopt the more usual interpretation of the Stegosaur teeth as adapted for vegetable food.

THE Trustees of the British Museum have recently placed in the Central Hall of the Natural History Museum a case illustrating the tragic effect on sea-birds of the waste oil which is allowed to escape from ships or is pumped out with bilge-water. The scene shows a portion of a beach on the south coast shortly after the turn of the tide, the sand in the foreground being still wet from the sea. At the high tide level lie six dead birds just as they have been washed up by the waves, together with the usual flotsam, while a little higher a guillemot, with glazing eye and panting breath, is evidently on the point of death. The feathers of the living and dead are heavily befouled with the thick dark liquid. A realistic touch is added by the two large flies which have already scented the dead bodies. Guillemot, razorbill, and red-throated diver are the three diving birds represented. The scene reproduces with exact fidelity an actual group of dead birds which were washed up on the Isle of Wight. Such sights are, however, by no means confined to the shores of the English Channel, and may be seen in crowded waters all over the world where oil-burning vessels congregate. The prevention of the oil nuisance was considered at an international conference held at Washington this summer, and it is hoped that as the result stricter regulations will be enforced by the several maritime nations which will lead to an abatement of the nuisance. What precisely is the action of the oil on the birds which leads to their destruction is uncertain.

THE town council of Swindon has decided to purchase for the sum of 2150*l.* the small farmhouse and land adjoining the Marlborough road at Coate, about one and a half miles from the town, which was the birthplace of Richard Jefferies. Jefferies died in 1887, and, since his death, his name, which meant so little to his neighbours during his lifetime, has attained to a certain immortality in the big railway town. The small house in Victoria Street, in which the early days of his married life were spent, is marked with a tablet recording that fact. There is a 'Jefferies Club' amongst the young people of the secondary schools, and the Field and Camera Club, as well as the flourishing branch of the Workers' Educational Association, regard him more or less as their patron saint. But as with so many others, so too with Richard Jefferies: he was no prophet to his neighbours whilst he lived, and only became one when he died. In truth, to country people the "common objects of the country" are so common that they do not appeal to them, as they do to the dwellers in towns. The study of natural history has its strongholds in the large towns and not in the country districts; and this is probably even more the case now than it was fifty years ago. But the influence of Richard Jefferies, for all that, lives to-day. It was he who for tens of thousands of town dwellers discovered the beauty of the Downs and the hanging wood of the chalk escarpment, which are the characteristic features of the country that he loved so well. He was not a scientific naturalist. He troubled himself not at all as to the minute points of distinction between sub-species and varieties, so beloved by many specialists of the present day; but he was a great observer, and what he saw he set down on paper and taught others to see too, and so may rightly claim to have been one of the chief founders of that 'Nature Study' which is now regarded as a necessary means of education.

A NOTEWORTHY event of the seventy-second meeting of the American Chemical Society, held on September 6-10 in Philadelphia, was the great pilgrimage of chemists to the grave and former home of Joseph Priestley at Northumberland, Pa. It was there, on the pleasant banks of the Susquehanna River, that Priestley, in 1794, then aged 61 years, joined his sons after religious persecution had made his life intolerable in England; and it was there that he spent the remaining ten years of his life engaged mainly in the study of theology and philosophy. He never became naturalised, saying that "as he had been born and lived an Englishman, he would die one, let what might be the consequence." The house which was built by Priestley at Northumberland in 1796 has acquired additional fame from the fact that it was the meeting-place of a band of American chemists who assembled there in 1874 to celebrate the centenary of the discovery of oxygen, and to found an association which two years later developed into the American Chemical Society, now the largest chemical society in the world. In 1920 the house was in a sad state of decay, having been used during the War as a boarding-house for immigrant labour, but owing to the enterprise of the G. G. Pond Memorial Association it was purchased at public auction, thoroughly renovated, and a museum was erected on the lawn, which still bears two pine trees planted by Priestley himself.

THE ceremonies held at Northumberland on September 5 comprised a visit to the grave where Priestley, his wife, and seventeen descendants lie buried; an inspection of the house and of the museum containing original apparatus and other personal effects of Priestley; and a short meeting on the lawn at which addresses were delivered, by Dr. W. H. Walker on the history of the house, and by Dr. C. A. Browne, of the U.S. Bureau of Chemistry, on the life of the famous 'pneumatic' chemist, whose great-granddaughter, Mrs. Frances Priestley Forsythe, took part in the proceedings. Although England lost what America gained when Priestley emigrated to Pennsylvania, English chemists will always be grateful to their American colleagues for the way in which they have honoured and preserved his memory. Not all of them, however, will endorse the official reference to Priestley as "the founder of modern chemistry," great as his experimental achievements undoubtedly were. The number of famous chemists in different lands who have been awarded the title of 'founder' or 'father' of the science tends to become embarrassing, and it almost seems time to invoke the

Code Napoléon and put a ban on any further "recherche de la paternité."

IN a recent paper before the American Chemical Society, Dr. W. Blum, electro-chemist to the U.S. Bureau of Standards, stated that the manufacture of metal tubes and sheets by electrolytic means is fast becoming a reality. Although no details are given in the announcement before us, Dr. Blum is reported to have said that the possibility of continued manufacture on a commercial scale was not yet proven. In the past large sums of money have been spent on working out such a process, but the results have hitherto been disappointing, largely owing to the difficulties experienced in obtaining impervious deposits and uniform distribution of metal of the required structure and quality. These obstacles are now stated to have been overcome. Advantages claimed for the new process are ease in making complicated forms, and, unlike the rolling and drawing processes, thin-walled tubes are cheaper to manufacture than heavy ones.

THE future of petroleum supply is a problem that is interesting many countries to-day, and none more than the United States, which has been the chief producer and consumer since the industry began, and, it is said, is likely to be the first to have the wolf at the garage door. Nineteen years has of late been the accepted probable life of the known petroleum deposits in that country, but a more pessimistic view was expressed by Dr. A. C. Fieldner, chief chemist to the Pittsburgh Department of the U.S. Bureau of Mines, in a recent address to the American Chemical Society at Philadelphia. According to this authority, the United States owns five-sixths of all the motor cars and trucks in the world, and consumes 80 per cent. of all the motor-fuel, mainly petrol. The oil-wells of proved extent are estimated to contain 5 billion barrels of readily available petroleum, a quantity which, at the present rate of consumption, would last only until 1936; the amount left in the oil-sands, which may be recovered when ordinary pumping is finished, is about 26 billion barrels. Supplies of proved extent could be made to last until 1943 if the yield of petrol from 'cracked' oils were increased from the 35 per cent. obtained in 1925 to 55 per cent., which is regarded as a likely figure; and they could also be conserved by using engines with a higher compression-ratio than that now in vogue in the United States (about 4 : 1). Looking to the future, Dr. Fieldner foresees the use of alcohol, derived from vegetation or obtained by synthesis, for mixing with petrol, but ultimately, he thinks that oil-shale, soft coal, and lignite will be the main sources of motor-fuel. Failing these, we may have to use a light electric storage-battery, or revert to Diesel's original idea and use coal-dust in our motor-engines.

PROF. SCHWARZ, in an undated volume, "The Kalahari or Thirstland Redemption," proposed an ingenious scheme for the development of the Kalahari Desert by flooding depressions to the west and east of Lake Ngami by dams across the Cunene River and the Chobi River above its confluence with the Zambezi. The southern Kalahari was expected to benefit by two overflow channels from the projected lake near Ngami to the Orange River, and the whole climate of South Africa to be improved by the moistening of the atmosphere by evaporation from the large water surfaces. To test this project the South African Government last year sent out an expedition under Dr. Du Toit, whose opinion will carry much weight. His report, of which an abstract was published by the *Times* of September 10, declares Prof. Schwarz's scheme impracticable, and emphatically rejects its axioms that there has been a progressive desiccation of South Africa within the last century, and that the reduction in the size of Lake Ngami was the result of that change. The new report concludes that the climate has not altered appreciably within historic times. Owing to heavy rains Lake Ngami, according to recent reports, is as large as it has been ever known.

THE Commission concludes that owing to the high rate of evaporation the water supplies on which Prof. Schwarz relies would be inadequate, and that for the establishment of any extensive permanent lakes the main flow of the Zambezi would have to be diverted by the erection of a dam 60 ft. high across the Zambezi at Katombora, which would submerge 4,600 sq. miles. A rejoinder by Prof. Schwarz severely criticises the report on the unconvincing grounds that the expedition did not go near the Kalahari and was not led by an engineer. He declares that damming the Zambezi is "not practical politics," as the submergence of half Barotsiland and some native towns would be opposed to the Colonial Office insistence that there must be no interference with native rights. Considering, however, what has been submerged by the Nile dams, the transference of native settlements would not be a serious objection to any scheme for the better utilisation of the waters of South Africa, especially as due compensation to the natives, apart from the improved value of the rest of their land, would no doubt satisfy the Colonial Office stipulations as to native rights. The report of Dr. Du Toit, as one of the leading geologists and geographers in South Africa, will doubtless receive careful consideration.

IN the *Wireless World* for September 1, Col. Crawley gives a survey of the overseas radio services in Great Britain. He proves that, so far as radio communication is concerned, the position is satisfactory. We are now on the eve of a complete system of Imperial radio communication. The control of all the overseas commercial messages is in the hands of the Government and the Marconi Company, but the military messages are controlled by the three fighting services. The Post Office services are operated from the London General Post Office, on the roof of which eight receiving aerials are installed. To obviate the effects of local electrical interference, however, this receiving station will shortly be transferred to St. Albans. The messages

received are relayed to the recording machines in the same building. These machines are placed alongside the transmitting machines which actuate the sets at Rugby, Oxford, Northolt, Stonehaven, Dollis Hill, and Caister. When the St. Albans station is ready the received signals will be relayed to the General Post Office.

THE Rugby station, with a frequency of 16 kilocycles, transmits messages to stations and ships all over the world. It is hoped also to inaugurate shortly long-range radio telephone services. The station at Leafield, near Oxford, communicates with Halifax and Cairo, both by an electric arc (24·21 kilocycles) and by a valve set (6000 kilocycles). The station at Cairo is operated by the British Post Office and communicates with Oxford, Germany, France, Italy, and Basra. At Northolt there are two aerial systems, one a valve set and the other an arc set. This station communicates with Czecho-Slovakia, Italy, and Hungary. Stonehaven communicates with Germany, Norway, Iceland, Poland, and Esthonia. Caister communicates with Holland when the cable service is interrupted, but it is normally closed. Dollis Hill is the Government experimental station. Last year the Post Office point-to-point services dealt with over ten million words of paid traffic. The Marconi Company operate an alternator station at Carnarvon and a group of valve stations at Ongar. They have a large receiving station at Brentwood. Considerable extensions are in progress. They erect the beam sending and receiving stations for the Post Office; the transmitting station at Bodmin and the receiving station at Bridgwater are practically completed.

THE Royal English Arboricultural Society held its summer meeting recently at Newcastle, with Mr. Leslie S. Wood as president and Mr. Gerald W. E. Loder, vice-president. The secretary, Mr. Edward Davidson of Haydon Bridge, had arranged a programme of excursions to Middleton Hall, Chopwell, and Healey. The woodlands were evidence of the energy of those responsible—Messrs. Gerard F. T. Leather, A. D. Hopkinson, and W. St. A. Warde-Aldam. Outdoor discussions were shared by foresters, estate agents, timber merchants, nurserymen, and university lecturers. South country visitors were surprised to see little planting of ash, elm, sycamore, though these with birch and mountain ash come by natural regeneration. The timber merchants' control demands conifers for pit props, especially larch. Sitka, Douglas, Corsican, Japanese larch are being tested by the acre. Pre-War plantations are thriving. Even in war-time some planting was achieved. Post-War planting has struggled against increase of rabbits and a legacy of forst weeds, gorse, bracken, and bramble. Gorse has been twice cut, and the trees may now outgrow it. Bracken has grown apace this year, cutting seems necessary. The blackberry-picking problem is accentuated when the forest is on the edge of an unemployed mining village. One estate was remarkable for continuity of management —only three foresters in a century; another for the high qualifications of its officers although their reigns have been short; a third for the skilfully arranged economies of an estate railway, sawmill and wood-work shops, the engine fed by gas generated from scrap and sawdust.

A REMARKABLE find of Mycenæan treasure is described by Mr. A. J. B. Wace in the *Times* of September 10. The Swedish Archæological Expedition to Greece, in excavating a beehive tomb near the village of Dendra, which lies at the foot of the acropolis of the Homeric Midea in the neighbourhood of Nauplia, has discovered four grave-pits, two of which are undisturbed. This is the only untouched burial hitherto found in a beehive tomb, excepting that at Vaphio from which the famous Vaphio cups were obtained. In one of the undisturbed pits lay two extended skeletons, one male, the other female. In the second was a female skeleton. The 'king' was covered almost from head to foot with gold, silver, and other riches. On his breast was a magnificent golden cup, 18 cm. in diameter, cunningly chased with what is described as "almost . . . a submarine seascape," the figures including argonauts, dolphins, and four octopuses. Artistically and technically the cup is a masterpiece. In the cup were the king's seals, and on or by his body were bronze swords with hilts of gold, or ornamented in gold, silver vases, a gold cup sheeted with silver, a bronze vessel, knives and spearheads. With the 'queen' lay a splendid gold cup sheeted outside with silver inlaid in gold, bronze, and black silver. Other treasures were a necklace of 61 gold beads, a lamp of steatite and a vase of ostrich-egg with applied ornament in gold, silver, and bronze. The 'princess' was less richly supplied, but had a gold ring, a necklace of 38 gold beads of rosette form, and the remains of a girdle. All the finds, excepting the 'king's cup,' are of a comparatively late date, on the ceramic evidence scarcely earlier then 1350 B.C. The older cup, it is suggested, may be an instance of the burial of an heirloom or antique, in which case, Mr. Wace points out, it indicates caution in accepting theories recently put forward that the beehive tombs should be dated much earlier than they usually are.

PROF. V. H. BLACKMAN, Prof. F. G. Donnan, and Prof. F. A. Lindemann, have been appointed by Order of Council dated August 20, 1926, to be members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research, in succession to members who have retired on the completion of their terms of office

THE ninth International Congress of Zoology, held at Monaco in March 1913, decided that the tenth Congress should take place in 1916 at Budapest, with Dr. G. Horváth, Hungarian National Museum, Budapest, as president. The War rendered the meeting impossible. The international situation, however, has now so much improved that the Congress need no longer be postponed. After due consultation with members of the permanent committee of the international congresses of zoology,

Dr. Horváth is able to announce that the tenth Congress will meet at Budapest on September 4-9, 1927, and he cordially invites all zoologists and friends of zoology to attend. The detailed programme of the Congress will shortly be issued and sent to all who are interested.

A SERIES of Sunday afternoon addresses under the general title of "The Contribution of Science to Human Life" is to be given during the autumn at the Guildhouse, Eccleston Square, London, W. The lectures are free, and no tickets are required. The lecturers and their subjects are as follows: Oct. 3, Sir Richard Gregory, the worth of science; Oct. 10, Dr. Bernard Hollander, sound and unsound mind; Oct. 17, Sir Sefton Brancker, the scientific problems of commercial aviation; Oct. 24, Dr. W. A. Bone, the economic aspects of coal; Oct. 31, Prof. H. H. Turner, the fight against fear; Nov. 7, Dr. W. H. Eccles, the influence of wireless on modern life; Nov. 14, Dr. E. E. Fournier d'Albe, eyes and ears of the future; Nov. 21, Dr. G. C. Simpson, meteorology in the service of man; Nov. 28, The Right Hon. Viscount Haldane, the wider meaning of relativity; and Dec. 5, Sir George Newman, the contribution of medical science to human life.

APPLICATIONS are invited for the following appointments, on or before the dates mentioned:—An assistant in the anatomy department of the University of Aberdeen—The Secretary (September 27). A head master for the Eye Grammar School, graduate, science preferred (with agricultural bias)—W. E. Watkins, Hon. Clerk to the Governors, County Hall, Ipswich (September 29). A joint keeper of archæology in the National Museum of Wales and lecturer in archæology in the University College of South Wales and Monmouthshire—The Director, National Museum of Wales, Cardiff (October 16). A senior lecturer in zoology and physiology at Huguenot University College, Wellington, Cape Province, South Africa—The High Commissioner for South Africa, Trafalgar Square, W.C.2. A laboratory attendant for histology in the anatomy department, University College, London—Prof. J. P. Hill, Anatomy Department, University College, Gower Street, W.C.1.

Our Astronomical Column.

THE METEORIC PHENOMENA OF SEPTEMBER 6.—Mr. W. F. Denning writes that a large number of observations have been received of apparently two large fireballs which illuminated the sky in many parts of England on the evening of September 6 at about $20^h\ 30^m$ and exactly at $20^h\ 45^m$ G.M.T. respectively. The data collected have not yet been thoroughly discussed and will necessarily take some time. The first meteor appears to have travelled from a southern radiant northwards and was observed at places so distant as Wanstead, near London, Durham, the south-west of England, and Sunderland. It gave a considerable light and some persons mistook it for lightning, but its motion to north dispelled the idea.

The second meteor made its apparition about 10 or 15 minutes later, and was no doubt the most brilliant object of the pair. Its path was also to the northwards, and it terminated its career by a series of loud detonations when it was some miles south of York. This meteor appears to have given several flashes of dazzling brilliancy; for some observers compared its light with that of the sun. For a moment or two it illuminated the landscape as it is at noonday. Some fragments of this object may possibly have fallen to the ground unobserved in the north-east region of Yorkshire, but no evidence of actual stonefalls has been received. In the district of Selby, and Goole, Yorkshire, the height of the fireball was about 26 miles, and it was decreasing.

The first object seen on September 6 appears to have been of very unusual size and aspect. Did it represent anything of similar nature to the auroral beam which passed over England on November 17, 1882?

THE UNIFORMITY OF THE EARTH'S ROTATION.—M. Bigourdan, of the Paris Observatory, contributes an article to *Comptes rendus de l'Académie des Sciences* for August 30, in which he points out that the comparison of the clocks of a large number of observatories by the aid of wireless time-signals distributed from Bordeaux-Lafayette, Saïgon, Honolulu, and Washington, should afford a very delicate test of the uniformity of the rotational movement. It is not even necessary for this purpose to await the determination of the errors of the different clocks, provided that their daily rates are uniform to 0·01 sec. or thereabouts. Comparison of 100 such clocks will permit the testing of the uniformity of rotation to the order of 0·001 sec. The present time is particularly appropriate, as the International Astronomical Union has arranged for a general series of wireless longitude determinations to be made between October 1 and November 30 next.

A very large number of signals will be recorded at each observatory, but a small number will suffice for M. Bigourdan's purpose, and he asks that observers will communicate to him the Bordeaux-Lafayette signals Nos. 113-122 and 235-244, that is, those just preceding $20^h\ 3^m\ 0^s$ and $20^h\ 5^m\ 0^s$ of Universal Time The uncorrected clock times of reception of the signals will suffice, and they need only be sent for the period of 30 days, commencing on October 15. It will be remembered that many astronomers, including Prof. E. Brown, now attribute the unexplained irregularities in the moon's motion to changes in the earth's rate of rotation. The inequalities that M. Bigourdan wishes to examine are of much shorter period than these, but analogy leads one to expect that if inequalities are present at all they may have many different periods.

MR. WILK'S COMET ANNOUNCEMENT.—It has now been confirmed that a motion among the stars of a degree in 4 minutes of time was the correct interpretation of the telegram from Cracow Observatory referred to last week, p. 388. Since no further observations have been received, it is evident that the material is insufficient to pronounce definitely in favour of the cometary nature of the object. It may have been a patch of aurora or the trail of a meteor in the upper atmosphere.

Prof. Perrine and his assistants observed a somewhat similar object at Cordoba in May 1916. In that case also its nature remained doubtful, but Miss Glancy showed that, if a comet, it must have approached very near to the earth (even closer than the moon).

Research Items.

THE MAGLEMOSE CULTURE. — Some interesting observations on the genesis of the Maglemose culture were made by the Abbé Breuil in a communication to the Institut Français d'Anthropologie, and are now published in *L'Anthropologie*, T. 36, Nos. 3-4, *à propos* of a characteristic harpoon from Béthune, dated 1849, now in the British Museum. Similar harpoons from the Béthune marshes and from Isbergues near by are recorded. Deer's antlers, pierced and ornamented, from the Somme and Paris described by Acy afford further incontestable evidence of Maglemose influence. Several examples of Maglemosian harpoons have come from Belgium; but in the Musée d'Histoire Naturelle of Brussels are a number of unpublished harpoons found by M. Lequeux in mixed Tardenoisian-Maglemosian sites, and quite recently investigations still going on have brought to light harpoons in which the barbs are made of Tardenoisian triangular implements. A harpoon ornamented in Maglemosian style has also been found at the proto-Tardenoisian level of the Remonchamps site. The opinion already expressed, though not accepted by Scandinavian archæologists, that while Maglemose is related to the Magdalenian, but not directly descended from it, being rather a result of a combination of Magdalenian and eastern elements coming from the direction of the Urals, has received support from the discovery at Wercholensk, near Irkutsk, of an Upper Palæolithic site with harpoons. While the harpoon is a link between Magdalenian and Maglemose, the difference in the decorative art precludes close connexion. Even the style of the harpoons found on the peripheral Magdalenian sites of Central and Eastern Europe, like the decorative art, have distinctive characters indicating important ethnic differences. A composite origin for Maglemose is therefore suggested, including provincial Magdalenian of Central Europe, oriental (decorative motives and Campignian forms), a Southern or Mediterranean influence (Tardenoisian), and possibly a late Palæolithic from Scandinavia when Norway was free from ice during the latest oscillations.

PHYSICAL ANTHROPOLOGY OF THE JAPANESE.—A study of the cephalic index and the stature of the Japanese, by Akira Matsumura, is published by the Imperial University of Tokyo as Vol. 1, Pt. 1 of Section 5, Anthropology, of the *Journal of the Faculty of Science*. The chief point that this study serves to emphasise is the marked differences in head form and stature which are to be found among the population. The Japanese, both men and women, are brachycephalic, the men slightly less so than the women, but the mean values of the cephalic index according to locality differ from province to province. The variability in head measurements also differs from province to province. On the whole, the south-western district, which has received the benefits of culture from ancient times, is more variable than other parts where civilisation arrived later. In head-length, head-breadth, and cephalic index, the Japanese differ from the Ainu and Koreans. They appear to resemble closely the people of eastern Siberia and south China. As regards variation, however, the Japanese are less variable than the Koreans in head measurement; but sensibly more so than the Ainu. The stature of men and women has shown a tendency to increase slowly during the last ten years. The variation in stature as between provinces is marked, but not so much as is the cephalic index. The relation of stature to cephalic index is also different for each province. As in the case of head-form, the Japanese in stature resemble the peoples of eastern Siberia, south China, and Indo-China, and not the Koreans or the Ainu. By combining the stature and cephalic index, grouped according to the significance of the differences between means, it is found that the Japanese fall into nine different local groups.

THE EFFECT OF THE GROUP ON MENTAL WORK.—In the *Indian Journal of Psychology* (vol. i. No. 2) N. N. Sen Gupta and C. P. N. Sinha report an interesting piece of research on mental work done in isolation and in the group. Five subjects took part in the experiments and the test employed was the well-known cancellation. The same column taken from a number of copies of a daily paper was given to each subject and he was asked to cancel all the 'a's' and 'e's' for a period of three minutes. Each subject did the test several times alone and also as a member of the group. The writers exercised the frequently neglected precaution of securing that adequate practice had taken place beforehand. The results show a significant difference in favour of working in the group. The reasons for this result cannot yet be given. It would be necessary to know whether other subjects gave the same result, how long such group stimulation could operate, whether different types of people reacted differently. It is a commonplace in industrial occupations that some people prefer to work alone while others dislike it. From the statistical point of view, we would suggest to the writers that the standard deviation or probable errors should be inserted. In this case all the details are given and the reader can work them out, but with larger numbers that would not be possible.

TERTIARY MOLLUSCAN FOSSILS FROM KOREA.—Comparatively little is known concerning the Tertiary invertebrate fauna of Korea, but Jirô Makiyama is now able (*Mem. Coll. Sci. Kyoto Imp. Univ.*, Ser. B, vol. 2) to add somewhat to our knowledge regarding the mollusca. His specimens came from beds in the neighbourhood of Meisen, North Kankyô-dô, which have been divided by the Japanese geologists into two groups: a lower, or Ryûdô group, which contains a rich flora of the so-called 'Arctic Miocene,' and an upper or Meisen group. This last is further subdivided into three members: in ascending order, the Heirokudô, the Kanchindô, and the Mankodô. These J. Makiyama, from their fossil molluscan contents, is lead to infer belong respectively to the Upper Eocene, the Oligocene, and the Lower Miocene. The author comments on the fact that some of the Korean forms recall corresponding ones from Europe, from Nigeria, and California, but none resembles those from the Eocene of either India or Java. The main part of the paper contains the descriptions of the sixteen new species, which form the bulk of the material, and are figured on two well-executed photo-litho. plates.

LAND MOLLUSCA OF PANAMA AND COSTA RICA.—Considerable interest attaches to the land molluscan fauna of southern Central America on account of the light its study should yield as to the region where the typical North American assemblage gives way to that of South America. Dr. H. A. Pilsbry (*Proc. Acad. Nat. Sci.*, Philad., vol. 78) describes and gives a catalogue of all the Panamic land mollusca, including that of the Canal Zone. Seventy-seven species and three subspecies, including nine new species and five new subspecies, referable to thirty-one genera are now

known from this area. Their geographical relations are set forth in a table with indications of the northern and southern limits of the genera and species. It results that thirty-four species have been found only in Panama and the Canal Zone; twenty-four also occur northward; thirteen both north and south; and six species only southward. From these and other statistics it appears that while the transition between the South American and tropical North American faunas is gradual, some genera of each region penetrating far within the other, the change is most rapid in a comparatively short section of the isthmus at and immediately east of the Canal Zone. Some modification, however, may be expected with further research, which may even double the present number of species. Appended are notes on the classification of snails from Mexico to Columbia, referred by authors to Microphysa and Thysanophora. Four new genera, six new subgenera, and three new species result from this investigation. The foregoing is followed by descriptions by the same author of Costa Rica land shells collected by A. A. Olsson. It is a short communication, but yields one new genus, four new species, and one new subspecies. Excellent figures throughout the text and on three plates illustrate the two papers.

A Small Ultra-violet Spectroscope.—For the convenience of those using ultra-violet light, Messrs. R. and J. Beck have introduced a small quartz prism spectroscope which can be held in the hand and requires no source of light other than that to be observed. The spectrum is formed on a fluorescent screen so that the lines are visible. The scale is in Ångström units and extends from 2000 to 4500, each 100 units being marked.

Intermittency in Photographic Exposures.—Mr. Raymond Davis, photographic technologist in the Bureau of Standards, Washington, finds that if the exposure is intermittent, such as is produced by the rotation of a sector wheel in the incident light, an equivalent exposure, as compared with the effect on development of a continuous exposure, may give either a gain or a loss (or an intervening zero effect) in the resulting density, according to the intensity of the illumination. That a more intense light gives a gain "has not been heretofore brought out." As an explanation of this result he suggests that the action of light on the silver haloid is not a single step or simple conversion into the developable image, but that there are two actions going on simultaneously which produce respectively a lessening and an increasing of the recipient exposure effect, the more intense light favouring the increase and the feebler light the decrease, during the intervals of nonexposure of an intermittent exposure. These results vary with the nature of the emulsion and the illumination, as well as with the number and duration of the intervening nonexposure periods. The experiments suggest that with illumination intensities higher than 4-candle metres, the growth of the exposure effect during the intervals would probably exceed the fading in all cases.

Gaseous Combustion at Medium Pressures.—Experiments by R. W. Fenning on air-fuel explosions in closed vessels have been in progress at the National Physical Laboratory during the last five years, and the results relating to carbon monoxide and methane have been published in No. 998 of the Aeronautical Research Committee's reports and memoranda. Two investigations are described, the first deals with the effect of hydrogen-air mixtures and water vapour on carbon monoxide-air explosions in a closed vessel, and the second relates to explosions of methane and air over a range of temperatures and pressures. The report includes tables of explosion temperatures and pressures, and the results are illustrated by reproductions of indicator diagrams under various conditions.

Copper Hydride and its Crystal Structure.—The *Journal of the Chemical Society* for July 1926 contains an interesting paper by H. Müller and A. J. Bradley on copper hydride and its crystal structure. *Cuprous* hydride was prepared by a method similar to that of Wurtz, namely the interaction of hypophosphorous acid and copper sulphate. The ratio of copper to hydrogen was determined by combustion, or by a method analogous to the Schiff nitrogen estimation, and was found to agree with the formula CuH. X-ray diagrams were obtained by the Debye powder method and the crystal structure was shown to be hexagonal close-packed with an axial ratio of 1·59-1·60. The X-ray spectrum of the substance obtained by the reduction of copper oxide with hydrogen, or the action of hypophosphorous acid on copper sulphate and copper oxide, which was considered to be *cupric* hydride, corresponded exactly with the spectrum of a mixture of copper and copper oxide. In conjunction with other evidence, the results of these experiments cast considerable doubt on the existence of *cupric* hydride.

The Catalytic Decomposition of Nitric Oxide.—When exposed to heated platinum wire at temperatures from 1000°-1500°, nitric oxide decomposes into nitrogen and oxygen; and if the products are allowed to cool before the reaction is complete, nitrogen peroxide is formed from the unchanged nitric oxide. This involves a diminution in volume, and the maximum contraction occurs when the oxygen produced is sufficient to combine with all the residual nitric oxide. A paper in the July issue of the *Journal of the Chemical Society* describes the temperature and pressure measurements made by T. E. Green and C. N. Hinshelwood, which prove that the order of the reaction $2NO = N_2 + O_2$ is unimolecular with respect to nitric oxide. It is uninfluenced by nitrogen but retarded by oxygen. Jellinek has shown that the ordinary thermal decomposition is bimolecular; this is, therefore, an example of a reaction which is bimolecular in the gas phase becoming unimolecular at the surface of the catalyst.

Active Nitrogen.—There are two views as to the nature of the active modification of nitrogen which is produced when an electrical discharge is passed through the gas at low pressures: that it consists either of atoms or of metastable molecules in an excited form. E. J. B. Willey and E. K. Rideal conclude from their experiments on the heat of formation of active nitrogen, which are fully described in the *Journal of the Chemical Society* for July 1926, that metastable molecules are the cause of the activity. The heat of formation was calculated by measuring the rise in temperature in a calorimeter, first when active nitrogen reacted with nitric oxide and secondly when the gas underwent catalytic decay in the presence of the air. By means of a calibrated heating coil in the calorimeter, the temperature changes observed in these experiments were reproduced and the heat equivalent of the reactions obtained. The mean value for the energy content of the active nitrogen was found to be 42,500 cals. per g.-mol.

Patent Office Statistics.

THOSE who are interested in the industrial applications of science will find much that is worthy of their attention in the recently published report of the Comptroller-General of the Patent Office for the year 1925. The report consists entirely of statistics, so that, in the absence of any official commentary, an attempt to analyse some of the figures and to compare them with those given elsewhere may perhaps be of value, for the relation between invention and industrial prosperity is an intimate one. Further, it is of interest to assess the quality of the services rendered to the State by the Patent Office, not only because this is essentially a scientific department, but also because it has been felt for some time past that the Patents Acts cannot be left where they are: and the question whether the desired improvements are practicable is one which depends in great measure on the degree of efficiency with which the existing system is being administered.

The number of applications for British patents filed during 1925, namely, 33,003, exceeded the numbers filed during 1923 and 1924 by 1·1 per cent. and 5·2 per cent. respectively, the corresponding excesses in the case of the United States being 4·3 per cent. and 4·2 per cent. respectively. Too much importance should not be attached to these figures, however, for fairly wide fluctuations are common even in normal times. In fact, when averaged over several years, the annual input of patent applications appears to depend, for countries having comparable patent and industrial systems, mainly on the population of the countries considered: thus, the number of applications per 10,000 of the population is, under normal conditions, roughly 7·5 in Great Britain, 7·3 in the United States, 7·2 in Germany, and 8·7 in Switzerland. In France, however, which is more extensively agricultural and has a backward patent system, the corresponding figure is only 4·8. It is contended by the United States Commissioner of Patents that fluctuations in the input of patent applications are in some sort an index of fluctuations in national prosperity: and though his contention would require considerable qualification before it could be generally accepted, the upward trend of inventive enterprise in Great Britain is satisfactory so far as it goes. The number of patents actually sealed in 1925 was about 52 per cent. of the number of applications filed, and 88 per cent. of the number of complete specifications filed. These figures indicate the extent to which worthless patents are weeded out by the official examination and various other causes, but no figures are given which would enable us to judge the effect of the official examination on the drafting of the specifications finally issued; nor is any information given as to what the United States Commissioner calls the 'gain in dates.' In the United States, the average time which an applicant had to wait for the first official action was reduced in the course of the year from 4·5 to 2·6 months, and the delay in dealing with amendments from 3 or 4 to 2·3 months. Promptness in the issue of patents is of such importance that it would be of interest to the public to know how far the British office has been able to make good the ground lost during the War. It is to be noted that the examining staff has been reduced in strength from 260 in 1913 to 241 in 1925: such economies are desirable in themselves, but the 'gain in dates' is of greater importance, and the public might with advantage be allowed to know how this matter stands.

As regards the nationality of applicants for British patents, it is to be noted that the percentage of these residing in Great Britain fell from 75 per cent. in 1923 to 69·8 per cent. in 1924 and 68·1 per cent. in 1925: at the same time the percentage residing in the United States rose from 8·2 per cent. to 8·9 per cent. and then to 9·6 per cent. Further, it must be remembered that only the best of the foreign inventions will be considered worth patenting outside their country of origin, and consequently the great majority of applications coming from abroad lead to the actual grant of patents. Thus in 1923 (the latest year for which complete data are available) 16 per cent. of the patents actually granted (as distinct from mere applications) were granted to persons residing in the United States, and only 57 per cent. to persons residing in Great Britain: for the previous year the corresponding figures were 15·5 per cent. and 59 per cent. respectively. Of the patents issued by Germany in 1923, 80 per cent. were granted to Germans, 2·1 per cent. to Britons, and 2·8 per cent. to Americans, while Germans took 6·5 per cent. of the British patents and 2 per cent. of the United States patents. These figures are not likely to change greatly, in the absence of unforeseen causes, for they must be ascribed mainly to differences in population between the countries concerned: thus, in the year 1923, while 3 out of every 100,000 Britons took United States patents and 2·3 took German patents, 2·5 out of every 100,000 Americans took British patents and 1·2 took German patents, and 1·6 out of every 100,000 Germans took British patents and 2·4 took United States patents. Out of every 100,000 Frenchmen, 2·5 took British patents.

For the year in question, 6615 or 43 per cent. of the British patents were taken by foreigners, while the corresponding figures for the United States were 4465 or 12 per cent., and for Germany 9127 or 20 per cent. The German patent is thus the most popular among foreigners, as judged by the absolute figures, and its popularity is not due to abnormal economic causes. In 1912, for example, when Germany issued fewer patents than now, 4251 or 32 per cent. of these were granted to foreigners. (The German '*gebrauchsmuster*' are excluded from the preceding figures.) But when we consider *percentages* we find that not much less than half of the monopolies which Great Britain grants for the manufacture and sale of goods within her borders are granted to persons residing outside the country: and we find that this state of things, depending as it does on differences of population, is likely to continue. It is to the advantage or the disadvantage of British industry according as the monopolies granted will be used for the purpose of developing new industries in Britain, or for the purpose of obstructing British manufacture in favour of imports. Examples can be cited in which each of these effects has been produced, but no general statistics are available for ascertaining the balance of good or ill which at present results from the grant of patents to foreigners. The Acts provide that where a patent is being obstructively used, an interested party may apply to the Comptroller-General for the compulsory grant of a licence to work the patent, or for its revocation: but in 1925 *only two such applications were made, and one of these was withdrawn.* It may be mentioned in passing that of the patents granted by Canada, about 70 per cent. are held by persons residing in the United States.

While the Patent Office is not empowered to make an exhaustive investigation into the validity of the patents which it grants, it does make an investigation of limited scope which is relevant to validity: and the Comptroller-General has powers which constitute

him a court of first instance for the trial of certain legal issues. It is of interest, therefore, to see with what degree of efficiency the Patent Office discharges its legal functions. The report before us shows that in 1925 the Comptroller-General, or rather three senior members of the corps of examiners who appear to have acted for him, gave decisions in over 2000 'hearings' under various sections of the Patents Acts, and in 84 'oppositions' brought by interested parties against patents provisionally granted. The quality of the work done in these cases can best be gauged by reference to the decisions of the Law Officers of the Crown, to whom a cheap appeal lies from the findings of the Patent Office. It appears that 27 appeals against the 'opposition' decisions of 1924 and 1925 were disposed of during the year, the official decision being vindicated in 20 cases (including 4 cases of withdrawal), varied in 2 cases, and reversed in 5. The appeals against 'hearing' decisions which were disposed of during the year numbered 42: the official decision was vindicated in 34 cases (including 3 cases of withdrawal) and reversed in 8. Actual figures for the number of hearings held during the year are given for only three sections of the Acts: the number of hearings under these sections was 2088, of which 0·33 per cent. gave rise to successful and 0·86 per cent. to unsuccessful appeals. As regards the work of the corps of examiners as a whole, it is to be remarked that while 19,434 complete specifications were examined and 17,199 patents sealed during 1925, the official actions taken have now been accepted by all concerned except in the case of 11 successful and 5 outstanding appeals, unless any further question should arise upon them in the High Court.

In the financial section of the Comptroller-General's report the tables of receipts and expenditure are fairly complete, and take account of such items as depreciation of buildings, the estimated value of pension rights, and the upkeep of the public library; but a more precise statement of the distribution of the staff would be of interest when it is desired to estimate the cost of changes in the patent system. Of the revenue 82 per cent. is derived from Patents fees, 2·4 per cent. from Designs fees, and 9·9 per cent. from Trade Marks fees. The total of Patents fees, namely, 391,677*l*., is made up of items which may be divided into three groups. The first group comprises items which are likely to give a fairly constant yield in future years, namely, the initial filing and sealing fees (28 per cent. of the whole), renewal fees for the 5th, 6th, and 7th years (24 per cent.), and miscellaneous fines and fees (9 per cent.). The total of these, accounting for 61 per cent. of the yield of patents fees, may be regarded as normal. Renewals for the 8th to the 11th year (of war-time patents) are affected by the War, and their total (18 per cent.), being abnormally low, will improve during the next few years. Renewals for longer periods (21 per cent.) do not yet show the effect of the War, and their yield will therefore fall off for a few years to come. On the whole, therefore, revenue is likely to be stationary, and in the absence of new expenditure the inventor will continue to pay large sums in relief of general taxation. The surplus was 75,203*l*. in 1924 and 88,540*l*. in 1925, after accounting for all imaginable charges and meeting the deficit on publications and the upkeep of the library, which represents a service to the general public. The United States Treasury, on the other hand, subsidised the American Patent Office to the extent of 81,720*l*. in 1924 and 68,150*l*. in 1925, so that the United States subsidises invention to nearly the same extent that Great Britain taxes it.

The financial section of the report is also relevant to the degree of efficiency with which the Patent Office is administered, for under the prevailing conditions the most rigid economy is incumbent, as a patriotic duty, upon public departments. It is extremely difficult to find a standard by means of which administrative economy may be measured, but we can obtain some idea as to how far an economic spirit prevails at the Patent Office by comparing its present scale of staffing with that which obtained before the War, with that which obtains in the United States, and with that which obtains in other comparable Government Departments in Great Britain. We find that whereas the number of patent applications per annum has increased by 10 per cent. as compared with 1913, the strength of the corps of examiners has decreased by about 8 per cent., so that each member is on the average dealing with 20 per cent. more applications now than before the War. The salary bill for this section of the staff is not distinctly shown, but if we estimate the cost-of-living bonus from the average salary and then assume that (in accordance with the Ministry of Labour index) 1*l*. in 1925 was equivalent to 0·57*l*. in 1913, the 'real' or purchasing value of the salary bill appears to have decreased by 6 per cent. As regards the auxiliary staff, there is no sign of any increase in strength or cost disproportionate to the increase in work done, the 'real' salary bill for the whole office being 2 per cent. more than that for 1913. The staffing is roughly on the same scale as that of the United States Patent Office. In each case there are 130 to 140 patent applications per annum per member of the corps of examiners, and the duties in the two cases, though not identical, are probably comparable. Our third comparison may conveniently take the form of a table, the contents of which have been compiled from the Estimates (Class II.) for 1926–7:

Department.	Total staff.	Number of posts with salaries rising to a maximum of		Total of higher posts.	Percentage of higher posts.
		1000*l*. to 1800*l*.	2000*l*. and more.		
Treasury . .	331	21	11	32	9·7
Foreign Office .	839	25	3	28	3·3
Ministry of Transport . . .	524	11	2	13	2·5
Board of Trade (Head Office) .	667	8	5	13	1·9
Ministry of Agriculture .	1197	14	3	17	1·4
Patent Office, with Trade Marks and Designs Branches	685	4	0	4	0·38

From the point of view of economy, attention may also be directed to the large amount of judicial work performed by the Hearing Officers, as set out above. For men who doubtless have other important duties to perform, the record of 2172 hearings and oppositions is a remarkable one.

The outstanding inferences to be drawn from the Comptroller-General's figures appear, then, to be that an enormous proportion of British patents is held by foreigners, while manufacturers take no advantage of the existing facilities for the grant of compulsory licences; that the legal work of the Patent Office is admirably performed; that the Office is administered in a spirit of economy which deserves particular attention; and that a large annual surplus is available for the improvement of the patent system when this step is considered desirable.

The Royal Photographic Society's Exhibition.

THE Royal Photographic Society's Annual Exhibition is now open at the Society's House, 35 Russell Square, London, admission being free; and it closes on October 9. In the Scientific and Technical Section the items that seem to be the most novel or the least often seen are some results obtained by a combination of the cinematograph and microscope, and a photograph of the ultra-violet spectrum of silicon by Prof. A. Fowler, of the Imperial College. This is done in sections, from wave-length 2820-2420 Å.U. on ordinary plates, from 2250-1840 Å.U. on plates smeared with a fluorescent oil, and from 2150-1250 Å.U. on Schumann plates using a vacuum grating spectograph.

Cinematography is more fully represented than it has been before. Dr. S. Bayne-Jones shows the life-history of the Penicillium, taking the pictures at the rate of two per minute by means of an automatic mechanism which also turns on the light. Dr. S. E. Sheppard and Dr. R. H. Lambert, of the Kodak Research Laboratory, have photographed the electrophoresis of rubber latex particles, the film showing the Brownian movement of the particles and their movements in an electric field. Mr. Loyd A. Jones, also of the Kodak Research Laboratory, has studied the growth of crystals using elliptically polarised light and the 'Kodachrome' process, and he contributes films of six different substances in very realistic colours. There are several other films of the more usual type and also a collection of historic films, including the famous train film of Lumière Bros., which was the first ever exhibited to a paying audience (in 1895). Photo-micrography is associated with colour processes in the four autochromes of Dr. C. F. Elam, of the Royal School of Mines, which show at a magnification of × 100 various crystalline forms of silver nitrate taken between crossed Nicols. Dr. L. F. E. Johnson, besides two slides taken in a similar way, has two illustrations of fabrics as they appear under the microscope when illuminated by Rheinberg's differential colour stop, which shows the warp red and the weft blue.

Of the numerous photo-micrographs taken in the usual manner we would direct attention to Dr. G. H. Rodman's series of 24 which illustrate the various forms of hairs occurring on plants which are recognised as liable to produce mischief (sting, etc.) in those who come in contact with them; Mr. J. H. Pledge's 9 photographs (× 10) of an Indian mistletoe that has no leaves; cultural types of meningococci and gonococci from the Lister Institute of Preventive Medicine; and a series of the rabbit embryo in utero and rabbit placenta, each showing various stages in its development, by Mr. G. S. Sansom. There are many others of considerable merit and interest, and a large collection that shows the present results of metallography obtained in numerous laboratories where it is practised, including the National Physical Laboratory. Viewing the photo-micrographs as a whole, the difficulty of getting good results at certain rather low magnifications seems to have been entirely overcome, and they indicate that no more detail is obtained by increasing the magnification above about × 2000.

Radiography and photographic printing in colours are as well represented as ever. The structure of emulsions, and the changes produced in the silver bromide grains, are shown by Mr. L. F. Davidson and the British Photographic Research Association, and Mr. L. E. Jewell shows the advantage of what he calls 'relief illumination' in photo-micrography, that is, the mirror in the vertical illuminator is considerably decentred so that there is a mixture, in regulatable proportions, of oblique specular and diffused light. The General Motors Corporation of Michigan, U.S.A., contributes prints of its Midgley Optical Gas Engine Indicator, which records as curves the character of the combustion in automotive engines. Of the various trade exhibits, those that impressed us most were Messrs. Ross's rapid speed photographs of the last test match taken with a 40-inch *f*/8 Teleros lens from outside the ground, and Messrs. Ilford's illustrations of the method of making and testing their light filters.

Smoke Abatement Conference.

A CONFERENCE on smoke abatement was held in Birmingham last week, organised by the Smoke Abatement League of Great Britain, in connexion with an exhibition of apparatus and methods bearing upon fuel economy and the abolition of smoke. The conference was divided into two main sections, one of which dealt with the industrial, and the other with the domestic, smoke problem. On the morning of September 7, Mr. J. Robson read a paper dealing with smoke in Bengal, describing the action taken to prevent undue emission. A special smoke commission was appointed, and it was stated that, since 1906, 90·8 per cent. of the smoke from factory chimneys had been abolished—a remarkable achievement. In an evening address on the same day Sir John Robertson, Medical Officer of Health of Birmingham, emphasised the injury done by smoke in obstructing the sun's rays, more particularly the ultra-violet. This affects children especially, and results in a failure to deposit lime salts in the bones and teeth, thus causing rickets and dental decay. It was stated that the exposure of rickety children to sunlight is an almost certain cure if the disease has not progressed too far.

In the conference Dr. Fishenden gave a general summary of the position relative to the low temperature carbonisation problem, and the general trend of the discussion showed that the real difficulties in producing a low temperature coke, suitable for domestic use, are financial and economic rather than technical. Nothing new or of outstanding interest was brought forward in connexion with the industrial side of the smoke problem, but there was a general agreement that the real reason why industrial smoke still remains a serious evil in Great Britain is not any technical impossibility in preventing it, but rather the absence of any special effort to do so on the part of many manufacturers.

On the domestic and housing side of the conference there were several interesting papers—one by Mr. E. D. Simon and Miss Marion Fitzgerald. This gave valuable statistics of the steps taken in different places in connexion with new housing schemes. The Ministry of Health was criticised somewhat severely for "totally ignoring" the recommendation in the Interim Report of the Departmental Committee on Smoke Abatement that "the central housing authority should decline to sanction any housing scheme submitted by a local authority or public utility society unless specific provision is made in the plans for the adoption of smokeless methods for supplying the required heat." This criticism was afterwards replied to by Mr. Poynton-Taylor, chief assistant architect of the Ministry of

Health, who endeavoured to show that they had done as much as they could.

A paper by Messrs. R. Unwin and Poynton-Taylor, chief and chief assistant architects respectively of the Ministry of Health, dealt with the problem of the domestic fire and set out the methods at present available. In the discussion on this there was an expression of opinion against the 'all-electric' house as a possible solution of the smoke problem, owing to the high cost of electricity and the absence of the ventilating effect with electric heaters. Messrs. Unwin and Taylor described the theory of 'zoning,' whereby the factories in a new town should be located outside the town, and on that side where the prevailing wind would blow the smoke away from the living quarters. Dr. Owens criticised the soundness of this principle, suggesting that it is the light anti-cyclonic, rather than the strong turbulent south-west, prevailing wind which should govern the position of factories; concentration and low drift of smoke are characteristic of the former, while dilution — owing to high velocity and turbulence — with the latter makes smoke of less consequence. He therefore suggested that factories should be so situated that the light easterly anti-cyclonic wind does not blow smoke over the living quarters.

Dr. Leonard Hill gave to the conference a paper on ventilation and heating, in which he stated that the most healthful form of heating is by a bright, visible source. He said, "We want, then, an elastic system of heating, not plenum or stove heating with windows all sealed up, but a fire which can be made up or let down, and an open window." Radiant heat and cold air are his ideals of healthful heating.

The chief interest in the conference centred round the domestic heating problem and the need for a cheap, smokeless, solid fuel which, apart from ordinary gas coke, is not available in sufficient quantity at present to help materially. Probably the most valuable effect of the conference was to keep before the public the importance of smoke abatement rather than any specific contribution towards the solution of the problem.

University and Educational Intelligence.

CAMBRIDGE.—The commemoration of the tercentenary of the death of Francis Bacon will take place on October 5. The University is conferring honorary degrees upon Sir Ernest Rutherford and Prof. William Holdsworth. A reception at Trinity College will be followed by a lecture upon Bacon, by Dr. C. D. Broad. In the evening, Trinity College will entertain a number of guests to dinner.

AN interesting programme of lectures has been arranged by the British Institute of Philosophical Studies for the forthcoming session, beginning October 4. In the Michaelmas term the Hon. Bertrand Russell will give two courses of lectures: (1) on the problems of philosophy, (2) on mind and matter. Dr. T. W. Mitchell will deliver ten lectures on medical psychology. Prof. G. Dawes Hicks will deliver ten lectures on the development of philosophy since Kant. A course on general psychology, by Prof. C. W. Valentine, should appeal to a wide audience. In the Lent term Dr. C. Delisle Burns will lecture on the philosophy of social life, and Prof. J. S. Mackenzie on social values. The Very Rev. Dean Inge, Dean of St. Paul's, has promised to give a course of six lectures on the philosophy of religion, in the Summer term. A full syllabus of lectures can be obtained on application to the director of the Institute, 88 Kingsway, W.C.2.

Contemporary Birthdays.

September 21, 1867. Rt. Hon. Lord Bledisloe, K.B.E.
September 23, 1850. Prof. W. Mitchinson Hicks, F.R.S.
September 23, 1863. Mr. William Lutley Sclater.
September 23, 1850. Prof. Richard von Hertwig.
September 25, 1843. Dr. Thomas C. Chamberlin.
September 25, 1866. Prof. Thomas H. Morgan, For. Mem. R.S.

Lord BLEDISLOE was educated at Sherborne and Eton, graduating at University College, Oxford. Until lately he was chairman of the Lawes Agricultural Trust Managing Committee. In 1922, at the Hull meeting of the British Association, he was president of Section M (Agriculture), delivering an informing, if pessimistic, address on efficient organisation in agriculture and the means of its development. Lord Bledisloe is now Parliamentary Secretary to the Ministry of Agriculture and Deputy Minister of Fisheries.

Prof. HICKS, born at Launceston, was educated at Devonport, graduating 7th wrangler at St. John's College, Cambridge. He was principal of and professor of physics in the University of Sheffield from 1883 until 1905. At the Ipswich meeting of the British Association in 1895 he was president of Section A (Mathematics and Physics). The Royal Society awarded a Royal medal to Prof. Hicks in 1912 for his contributions to hydrodynamics and those on vortex motion. He is Hon. D.Sc., Victoria.

Mr. SCLATER, bearer of a name much honoured in the scientific annals of a past generation, was educated at Winchester and Keble College, Oxford. He was a science master at Eton College, 1891–95; afterwards director of the South African Museum, Cape Town, from 1896 until 1906.

Prof. RICHARD VON HERTWIG, distinguished as a zoologist, emeritus professor of zoology and comparative anatomy in the University of Munich, and director of the Zoological Institute, was born at Friedberg, Hesse. He has specially studied the Radiolaria and the Rhizopoda, whilst he contributed two monographs on the Actiniaria to the reports of the *Challenger* Expedition. Prof. Hertwig is Hon. Sc.D., Cambridge, and a foreign member of the Linnean Society.

Dr. CHAMBERLIN, the veteran geologist, was born at Mattoon, Illinois, U.S.A. He graduated at the University of Michigan. Professor of natural science in the State Normal School, Whitewater, Wisconsin, 1867–1872, he held afterwards the chair of geology in Beloit College from 1873 until 1882, transferring then to a similar chair in the University of Chicago, retiring in 1919. Dr. Chamberlin has rendered valuable geological service to the State of Wisconsin. He acted as geologist in the Peary Relief Expedition of 1894. He is a foreign member of the Geological Society.

Prof. T. H. MORGAN, occupant, since 1904, of the chair of experimental zoology in Columbia University, N.Y., was born at Lexington, Kentucky. He was educated at the State College of Kentucky and Johns Hopkins University. Prof. Morgan is a foreign member of the Royal Society. In 1924 the Society awarded him its Darwin medal for his researches in biological evolution, variation, and inheritance. He is the author of "The Mechanism of Mendelian Heredity" (1915) and "The Physical Basis of Heredity" (1919).

Societies and Academies.

PARIS.

Academy of Sciences, August 17.—A. **Lacroix**: The crystalline schists containing dumortierite and lazulite of Madagascar.—Charles **Moureu**, Charles **Dufraisse**, and Marius **Badoche**: Autoxidation and antioxygen action. The catalytic actions of various nitrogen compounds. Eighty-three nitrogen compounds of various types have been studied and from the results obtained certain general conclusions can be drawn. The amino group possesses marked antioxygen properties, but the amido group is only slightly active. The aminophenols are especially active, one part in 10,000 completely protecting acrolein from oxidation.—G. **Pólya**: Linear functional operations exchangeable with the derivation and on the zeros of the polynomials.—Silvio **Minetti**: The radius of convergence and the singularities of certain Taylor developments and the analytical functions which they define.—Carl A. **Garabedian**: A disc of constant or variable thickness in uniform or accelerated rotation.—N. **Boneff**: The arrival in the solar system of a foreign star. A theoretical study extending the conclusions given in a recent paper by Chazy.—A. **Piccard** and E. **Stahel**: Michelson's experiment, realised in a free balloon. Details of four experiments carried out at an altitude of 2500 metres and another series at an altitude of 4500 metres. The accuracy of the measurements was not sufficient to confirm or refute the experiments of Miller at Mount Wilson, but it can be said that if Miller's ether wind exists it does not increase with altitude.—A. **Korczynski** and B. **Fandrich**: The preparation of nitriles by the diazo reaction. Experiments to determine to what extent nickel chloride with potassium cyanide can replace cuprous cyanide in the preparation of nitriles. It was proved that the nickel reaction could be generalised and that the yields were better than when cuprous salts were used in the Sandmeyer reaction.—Jacques **Bourcart**: Preliminary observations on the tectonic of the Bouches de Cattaro.—V. **Agafonoff**: The podzolic process in the sandy soils of the Landes.—Gabriel **Guilbert**: The visibility of the atmosphere. There is no connexion between the presence of haze in the air and hygrometric state and various explanations put forward to explain the nature of haze are considered by the author as unsatisfactory.—E. **Lacroix**: The use of coccoliths by the arenaceous Foraminifera for building their shells.—G. and R. **Moussu**: Normal glycemia in cattle. Glycemia and vitular disease in cows in milk.

ROME.

Royal National Academy of the Lincei, June 20.—O. M. **Corbino** and T. **Levita-Civita**: Doppler's principle and the ballistic hypothesis of light. According to the ballistic theory of light, the velocity of the light emitted from a source moving relatively to the observer is represented by the vectorial sum of the normal velocity of the light and that of the source. This would indicate the existence of a Doppler effect of velocity and also a Doppler effect of acceleration, which would be capable of reaching values considerably greater than the former. The consequences of this conclusion are, however, untenable, and the ballistic hypothesis is hence incompatible with the ordinary postulates of classical physics.—Leonida **Tonelli**: Certain properties of a polynomial of approximation.—A. **Russo**: The two sexual cycles of *Cryptochilum echini* Maupas take place with two classes of individuals, which divide and regenerate in different fashions.—Silvio **Minetti**: Radius of convergence of the Taylorian development $\Sigma a_n z^n$ where $a_n = g(n)$ for n wholly positive with $g(n)$ wholly transcendental.—Vladimiro **Bernstein**: Interpolation by means of holomorphic functions in a semi-plane.—Filippo **Burzio**: Mayevski's law for ballistic precession.—Giulio **Krall**: Conditions for the stability of elastic equilibrium.—Glauco de **Mottoni**: A new method for measuring microscopic and ultramicroscopic distances by means of diffraction gratings. Ronchi has recently devised a stellar interferometer based on a new application of rectilinear and circular dioptric gratings. It is now shown that the application of such gratings to the microscope admits of approximately sixfold increase in the resolving power of the instrument.—Francesco **Vercelli**: Results of the cruise of the (Italian) naval ship *Marsigli* in the Straits of Messina. The influences of physico-chemical factors on the currents in the Strait are considered.—Alberto **Pirovano**: The possibility, by means of ionolysis, of hybridising species having little affinity.—Giulio **Cotronei**: Morphology and ecology in the study of Petromyzon.—Ettore **Remotti**: Reactions to luminous stimuli and their probable relation to morphological arrangements in the salmon during development.

Diary of Societies.

SATURDAY, SEPTEMBER 18.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (North-Eastern and Yorkshire Districts) (at Whitby), at 12.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS (South-Eastern District) (at Rural Council Offices, Epsom), at 2.30.—T. E. Ware and others: Discussion on Epsom Rural District.

TUESDAY, SEPTEMBER 21.

INSTITUTION OF GAS ENGINEERS (Annual General Meeting) (at Institution of Civil Engineers), at 10 A.M.—Report of Advisory Committee on Education, presented by F. W. Goodenough.—Fifteenth Report of the Gas Investigation Committee: Methods of Testing Products of Combustion from Gas Appliances.—C. H. Rutter: The Development and Reconstruction of the Portslade (Brighton) Gasworks.—Sixteenth Report of the Gas Investigation Committee: Studies in Carbonisation. Part I. Influence of Size of Coal.

WEDNESDAY, SEPTEMBER 22.

INSTITUTION OF GAS ENGINEERS (Annual General Meeting) (at Institution of Civil Engineers), at 10 A.M.—T. F. E. Rhead: Investigation of some of the Factors affecting Carbonisation in Continuous Vertical Retorts.—Report of the Refractory Materials Joint Committee, presented by J. P. Leather.

THURSDAY, SEPTEMBER 23.

INSTITUTION OF GAS ENGINEERS (Annual General Meeting) (at Institution of Civil Engineers), at 10 A.M.—A. W. Sumner: The Distribution of Gas at High Pressures.

FRIDAY, SEPTEMBER 24.

INSTITUTION OF FUEL ECONOMY ENGINEERS (at Royal Society of Arts).—Dr. A. E. Dunstan: Liquid Fuels.

CONGRESSES.

SEPTEMBER 19 TO 26.

GERMAN SCIENTIFIC AND MEDICAL ASSOCIATION (at Düsseldorf).

SEPTEMBER 22 TO 24.

GERMAN RÖNTGEN SOCIETY (at Düsseldorf).—Discussions on X-ray Treatment of Inflammation, the Compton Effect, and Irradiation of the Ovary and Offspring.

SEPTEMBER 24 AND 25.

READING AND DISTRICT TEACHERS' ASSOCIATION (at Reading University).—Discussion on Education and Life.

September 24.—Prof. Winifred Cullis: The Teaching of Biology in Schools.

September 25.—Mrs. A. H. Radice: The Changing Child.—N. Richmond: The Physiological Basis of Change.

SEPTEMBER 26 TO 29.

INTERNATIONAL CONGRESS OF INDIVIDUAL PSYCHOLOGY (at Düsseldorf).

SEPTEMBER 26 TO OCTOBER 2.

CONGRÈS DE CHIMIE INDUSTRIELLE (at Brussels).

SEPTEMBER 27 TO 30.

ALL RUSSIAN OPHTHALMOLOGICAL CONGRESS (at Moscow).

SEPTEMBER 30 TO OCTOBER 2.

GERMAN SOCIETY OF UROLOGY (at Vienna).

OCTOBER 13 TO 26.

GERMAN SOCIETY FOR THE STUDY OF DISEASES OF DIGESTION AND METABOLISM (at Berlin).

OCTOBER 25 TO 28.

ITALIAN CONGRESS OF SURGERY (at Padua).