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Empire Agricultural Research.

THOSE engaged in agricultural research cannot complain that the authorities take no interest in their subject ; in fact, attention has grown to an extent that is almost embarrassing, as the official reports on various aspects of agricultural research that have been issued in the past few months bear witness. We may mention the report of the first Imperial Agricultural Research Conference, the report on the Colonial Agricultural Service (itself a corollary to two previous reports on the same subject), the Empire Marketing Board's account of its second year of work, and finally the Royal Commission on Agriculture in India, the report of which has been reviewed recently in our columns.

The Imperial Agricultural Conference stressed, both explicitly and by inference, the essential unity of agricultural research throughout the Empire ; the differences, no matter how large they appeared on the surface, were of degree and not of kind. It is therefore particularly opportune that the Colonial Office and Indian reports should have appeared almost simultaneously, since each gives in some detail the organisation proposed for the efficient conduct and extension of research work within the regions in question.

The recommendations are almost identical, and the significance of this is enhanced when the difference in the constitution of the recommending bodies is considered : the Colonial Office Committee included members with expert experience in agricultural research, while the Indian Commission, owing no doubt to its extensive terms of reference, was composed mainly of members having general rather than special experience. The expert and the man with general training are so often in conflict on matters of policy that the agreement in this case, reached independently and by consideration of quite independent conditions, is strong evidence that the recommendations are sound.

To summarise them very briefly, an Advisory Council is proposed on which various interests are represented, with a layman of wide administrative experience as chairman, and two or more permanent officers who will be agricultural scientists of standing, and deal with soils and crops, and animals respectively. The success of the Council's work is recognised to depend very largely on the ability of these scientific advisers to stimulate research work, to suggest new activities, to co-ordinate and to prevent overlapping in the services and institutions over which the Council has advisory functions. Improvements are outlined in organisation, status, and prospects for members of the agricultural

services, and although the details vary widely in the two reports because of the difference in conditions, the intentions are the same: to encourage first-class research workers to enter the agricultural services, to pay them adequately, and to avoid so far as possible any water-tight compartments between different institutions and areas.

The proposals give rise to a number of important points. The Colonies and India will have adequate organisation for research, but what of the rest of the Empire? Australia is making generous provision both from the Commonwealth and State funds; the Council of Scientific and Industrial Research—a body that has similar functions to the Department of Scientific and Industrial Research in Great Britain—is putting into effect a bold and extensive policy. Canada has had for some time an agricultural service that incorporates the most successful features of the United States' organisation. South Africa has moved forward rapidly in recent years, thanks to a far-sighted policy of scholarships that attracted the most promising of its young graduates in pure science. It may fairly be said that, except for the absence of an Advisory Council constituted exactly as outlined above, the agricultural services in these three countries follow in essentials the scheme contemplated by the Colonial Office Committee and the Indian Commission.

This leads to the second point: is it feasible to extend to the whole Empire the elastic organisation for research contemplated for the non-self-governing Dependencies? In other words, is it possible to have administrative machinery that would effect a worker's transfer from, say, Australia to South Africa, or Great Britain to India, with no more difficulty than from Kenya to Nigeria? It is self-evident that anything approaching a unified Empire Agricultural Service is outside the realms of possibility. The whole tradition and policy of the Empire is towards independent development and administration of its constituent parts. Nevertheless, fundamental agricultural research cannot pay any tribute to political divisions. Deficiency diseases of animals occur in many parts of the Empire, while irrigation problems do not exist only in India. If we regard the matter from the point of view of the problems in fundamental research, it may truthfully be said that a unified agricultural service is already in being, and the question becomes resolved into the simpler and practicable one of ensuring that the experience and results obtained in any part of the Empire are available to any other part.

It is desirable to deal with this point in some detail. There is a natural tendency among administrators to conceive of this as a problem that can be met by an organised interchange of scientific papers, by supplying from a central organisation competent summaries of the present position in a given branch of agricultural research, by issuing full details of new experimental methods, and so on. Such a service would be of great value, especially to the man in the remote parts of the Empire, but it is not his main requirement. He already obtains—usually at his own expense—scientific journals, and he probably conducts a fairly extensive private correspondence with other men engaged on similar work to his own. Although he would welcome any arrangement that supplied him automatically with scientific literature, he needs above all things the opportunity, at the appropriate stage in his work, of personal contact with investigators in his own subject. He may have carried his work to a point where it can only be completed with the resources or the help of some other station, or he may wish to discuss all his data with another worker. His desire, therefore, is for study leave in its widest sense. The need is a universal one; it is felt as much by those enjoying the resources of a well-equipped institution as by the isolated workers.

Any scheme by which this personal contact could be secured would remove one of the greatest obstacles in the path of research workers. By virtue of their position the home authorities have here a special opportunity; and there are already in existence two methods that could be developed to give the desired end. These are the Imperial Agricultural Research Conference and that section of the activities of the Empire Marketing Board that deals with research.

The Research Conference has met only once. The organisation was admittedly experimental, and the delegates came from all branches of the agricultural service. The discussions were correspondingly wide, ranging from research problems through agricultural practice to matters of pure administration. Although there is undoubted advantage in holding a joint conference for those concerned in these three groups, there can be no question that the main value to research workers is in meeting one another, and indulging to their hearts' content in the gentle pastime of picking one another's brains. The success of the conference, even in its experimental form, resulted in a decision to hold a second conference in five years' time in Australia. This is a long interval, but it has one advantage. It allows adequate time for the

careful selection of problems for discussion and for the governments to appoint as delegates those directly concerned in research on these problems. This was not done—indeed it could not be done—for the first meeting, and in some instances delegates from abroad were selected because they were due for leave in any case. It is to be hoped that for future conferences the home authorities will be able to secure the consent of Overseas governments to send the appropriate delegates.

The second direction in which the home Government can help is through the Empire Marketing Board. Although the Board has only been running a short time, it has been peculiarly effective in furthering basic research work both at home and overseas. Its Research Grants Committee has taken an admirably broad view of its functions, for, in addition to financing definite investigations, it is actively exploring the scheme for a chain of central research stations, approved in principle by both the Imperial Conference of 1926 and the Colonial Conference of 1927. It is evident that this proposal contains the possibility of providing some of the fluidity that an Empire Agricultural Service would give. The Board recognises that no cut-and-dried scheme is possible: "Its accomplishment must be an affair of many years and of patiently won experience." An exceedingly encouraging sign to all concerned in research is that the Board is determined to create the stations around the research problems. There is so often a fatal tendency, when money is available, to build an elaborately equipped station, and to collect a staff, who are then instructed in a vague way that they are to begin 'research.' It is not possible to produce advances in science like castings out of a mould. The outstanding research worker is singularly little affected by environmental conditions, be they good or bad. If he is to be used for the best advantage of agriculture, some elasticity of terms of service is essential in order that he may get at grips with the problem that really interests him. A chain of research stations should provide the desired outlet for the best men, who are always few in number.

We have necessarily dealt in some detail with problems of organisation, and it is well to stress once more the grave danger of over-organisation. Research will not give of its best within a fixed framework. The research worker must be free to change the whole plan of his research if conditions demand it. He is not in the least afraid to change horses in mid-stream—it is, in fact, the usual prelude to a solution of his problem. In this his work differs from all forms of political administration, and the administrator who was foolish enough to emulate the research worker's methods would achieve, not success, but a revolution, or at least a riot.

Finally, we would direct attention to one other aspect. The reports on which we have commented deal almost entirely with overseas agricultural research. Great Britain possesses, thanks to the Ministry of Agriculture and the Development Commission, a comprehensive and efficient scheme of agricultural research. Its members have had considerable experience in the difficulties of research, and an encouraging degree of success in their efforts to advance agricultural science and practice. As a result their services are being sought by other organisations, and the exodus from the service to better paid posts has already begun. A steady movement of men to other posts is highly desirable, for it prevents stagnation and brings in new blood. If the proposed developments in the Colonial Empire become an accomplished fact, the demand on the home service for men will be greatly increased, and it may even reach a level that will seriously impair its efficiency.

Egyptian Mathematics.

La science égyptienne: l'arithmétique au moyen empire. Par O. Gillain. Pp. xvi+326. (Bruxelles: Reine Elisabeth, 1927.) n.p.

"HABENT sua fata libelli." The most valuable original document representing the ancient Egyptian mathematics is still the Papyrus Rhind in the British Museum. This papyrus was written at some time between 1788 and 1580 B.C. by a scribe called Ahmes, Ahmesu, or Ahmose, who says that he copied it from an earlier document, to which we may assign a date as early as 1842 to 1801 B.C. Whether it is a pupil's notebook or rather (as M. Gillain suggests) a book of exercises put together for his own amusement by some amateur who was drawing upon his recollections of study at school, but had at hand for reference some manual from which he could make extracts at will, it contains nothing but quite elementary matter, and is, moreover, disfigured by mistakes which show that the scribe at any rate was no mathematician. Yet (while advanced works such as the Porisms of Euclid have perished) fate has preserved this book, and after some 3700 years it is still being actively discussed (it is true that it was only acquired by A. H. Rhind at Luxor in 1858 and was not published until 1874). M. Gillain's bibliography contains the titles of between forty and fifty books or

memoirs dealing with Egyptian mathematics in general or the Rhind Papyrus in particular; and opinions are still sharply divided.

In the handsome volume before us, M. Gillain, while noticing the other original sources (limited to about five, including the Moscow Papyrus not yet published), devotes himself mainly to an elaborate analysis and elucidation of the contents of the Rhind Papyrus. Hitherto the idea has been that the whole of the work in the Rhind has an empirical rather than a theoretical basis; Gillain's object is to prove that the Egyptians had a good grasp of theory as well. He deduces from a number of examples of a certain type the rule on which the solver must have proceeded, and argues that the statement of the rule itself was only omitted because it was well known to everybody. We may concede that the Egyptians had a number of definite rules for the practical working of problems, and to that extent had grasped the principles as well as practice; and Gillain has performed a service in bringing out this fact.

Save in a few exceptional cases of multiplication by 3 and 10, the Egyptian performed his multiplications by successive doubling. He first wrote down the multiplicand, and then below it, successively, twice, four times, eight times, sixteen times it, and so on, writing 1, 2, 4, 8, 16 . . . in a column alongside the products; lastly, he selected powers of 2 which (with or without the addition of 1) made up the multiplier and added the corresponding products. This method of multiplication by successive doubling persisted through the centuries; Michael Stifel used it (1525); and it is still worth while to point out that the 'Russian peasant' system of multiplication which came up as a curiosity a few years ago is only a very handy way of carrying out precisely the same process.

It is characteristic of the Egyptian notation that they had a sign for $\frac{2}{3}$ but for no other fractions except submultiples or aliquot parts (fractions, such as $\frac{1}{3}$, $\frac{1}{5}$, $\frac{1}{29}$, with unity for numerator). When, therefore, their calculations led to ordinary fractions with numerators exceeding unity, they had, before they could write them down, to decompose them into sums of submultiples; this was much facilitated by a regular table, which is set out in the Rhind, giving the decomposition of all fractions having 2 as numerator and the odd numbers from 3 to 99 as denominators (the scribe says "divide 2 by 5," "divide 2 by 17," and so on). The question then arises, had the Egyptians any conception of ordinary fractions such as $\frac{5}{16}$? One recent writer (Neugebauer) apparently maintains that they had not. Prof. Eric Peet, in his recent fine edition (1923), thinks that this by no means follows from the mere fact that they could not write such fractions; and Gillain has now proved conclusively, not only that the Egyptians had a clear conception of ordinary fractions (though they could not write them down), but that they thoroughly understood the operations of adding a number of such fractions or subtracting one from another by bringing them to a common denominator (though the common denominator was not necessarily the least common multiple of the denominators, but might be a smaller number provided that all the numerators could be expressed in integers with submultiples, *e.g.* $3\frac{1}{5}$), and of multiplying two such fractions, and finally that they realised that to divide by a certain fraction meant multiplying by that fraction turned upside down.

Division was performed by means of successive tentative multiplications carried on until the sum of the partial products equals the dividend. (Incidentally it must be said that our division is no less tentative, though, with our notation, it is easier.) The successive multipliers are first 2 and its powers, and, when we have used as many of these as are necessary, we have to find and use fractional (*i.e.* submultiple) multipliers. It is in the course of this operation that it becomes clear that the Egyptian had a clear idea of a fraction in the more general sense and knew how to use it. As a simple case, take the division of 2 by $1\frac{1}{3}+\frac{1}{4}$. (Here the quotient is less than 2, so that the product by 2 does not appear.) The Egyptian writes:

/	1	$1\frac{1}{3}+\frac{1}{4}$	228
	$\frac{2}{3}$	$1\frac{1}{18}$	152
	$\frac{1}{3}$	$\frac{1}{2}+\frac{1}{36}$	76
/	$\frac{1}{6}$	$\frac{1}{4}+\frac{1}{72}$	38
/	$\frac{1}{12}$	$\frac{1}{8}+\frac{1}{144}$	19
/	$\frac{1}{228}$	$\frac{1}{144}$	1
/	$\frac{1}{114}$	$\frac{1}{72}$	2
Total	.	.	$1+\frac{1}{6}+\frac{1}{12}+\frac{1}{114}+\frac{1}{228}$

It is to be observed that the Egyptian places a mark on the left of the particular multipliers which contribute to the total of the quotient; the column on the right shows clearly that he has reduced the fractions in the first five lines of the second column to the common denominator 144, the numbers 228, 152, 76, 38, and 19 being the resulting numerators. Now it is plain that, after the partial product representing $\frac{1}{12}$ of the divisor, the Egyptian considered how much of the dividend (2) remained. For this purpose he used the numerators in the

third column, referring to 144 as the common denominator. Referred to the same common denominator, 2 represents 288; he therefore subtracted from 288 the sum of 228, 152, 76, 38, and 19, which gives 3. Therefore $\frac{3}{144}$ is the portion of the dividend remaining over. As $\frac{1}{8}+\frac{1}{144}$ corresponds to $\frac{19}{144}$, he can clearly obtain $\frac{1}{144}$ by dividing by 19. He accordingly takes $\frac{1}{19}$th of $\frac{1}{12}$, giving $\frac{1}{228}$ in the first column. The remaining $\frac{2}{144}$ he gets by doubling, thereby obtaining $\frac{1}{114}$ in the first column. Thus the total of the quotient is $1+\frac{1}{6}+\frac{1}{12}+\frac{1}{114}+\frac{1}{228}$.

The grasp of the Egyptians over the handling of fractions is further shown by the exceptional case of the division of 1 by $3\frac{1}{3}+\frac{1}{5}$. Here, instead of taking once, then $\frac{1}{2}$, then $\frac{1}{4}$, of $3\frac{1}{3}+\frac{1}{5}$ and so on, in the usual way, so as finally to make up 1, the Egyptian evidently in his mind turned the expression $3\frac{1}{3}+\frac{1}{5}$ into $\frac{106}{30}$ by reducing to 30 as common denominator (he might have made the common denominator 15). Then he recognised that to divide 1 by $\frac{106}{30}$ is the same thing as to multiply 1 by $\frac{30}{106}$. Accordingly he sets to work to find, as a sum of aliquot parts, the result of dividing 30 by 106, thus:

	1	106
	$\frac{1}{2}$	53
/	$\frac{1}{4}$	$26\frac{1}{2}$
/	$\frac{1}{106}$	1
/	$\frac{1}{53}$	2
/	$\frac{1}{212}$	$\frac{1}{2}$

Here, after arriving at $26\frac{1}{2}$, he considers how to work up to a total of 30 in the second column. The deficiency is $3\frac{1}{2}$. He can evidently get 1 by dividing the first line by 106, and then 2 and $\frac{1}{2}$ by doubling and halving respectively. The total quotient is thus $\frac{1}{4}+\frac{1}{53}+\frac{1}{106}+\frac{1}{212}$.

Gillain gives a satisfactory account of the probable method by which the Egyptians arrived at the various decompositions into submultiples of the fractions which we should write as $\frac{2}{5}$, $\frac{2}{7}$ . . . $\frac{2}{99}$. When he comes to the 'hau' calculations, he finds sometimes simple division and sometimes the equivalent of the 'rule of three' where others have seen the method of 'false hypothesis' only. He gives a thorough analysis of this set of problems as well as of the isolated cases of arithmetical and geometrical progression occurring in the Papyrus, and of the various problems of measuring the content of certain vessels, including the parallel case of the cylinder in the Kahun fragments. The book is to be recommended as a thoroughly sound exposition of the subject. T. L. H.

An Indictment of War.

Will Civilisation Crash? By Lt.-Comdr. the Hon. J. M. Kenworthy. With an Introduction by H. G. Wells. Pp. 320. (London: Ernest Benn, Ltd., 1927.) 10*s*. 6*d*. net.

IN this volume by Commander Kenworthy we are reminded of the homicidal tendencies of the constituent parts of the white race, the aggregate effect of which, if unrestrained, must be race suicide and the end of the present phase of civilisation. During the War, latent resources, inherent in civilised man's growing dominion over natural forces, were only partly mobilised in the attempt at self-annihilation. Even so, the rapid development of the mechanical side of war, the enhanced efficiency of the aeroplane as a destructive agent, the invention of land ironclads, the almost incredible increase in the range, accuracy, and mobility of the guns of the heavy artillery, and the use of poison gas, liberated from cylinders or projectiles, had given the armies in the field and civilian populations a foretaste of horrors to come, sufficient, it might be thought, to have created a common will for the outlawry of ordeal by battle.

Most of us who had any experience of warfare thought that once it was over the peoples of the world—particularly the combatant nations—would join together in a mighty effort to repair the ravages of those four and a half years' insanity, and with a more intense zeal and greater wisdom than they had misapplied science would apply the discoveries, the methods, and the outlook of science to the task of making the world more habitable for the human stock. We imagined that Great Britain was pre-eminently fitted to give the lead in this direction. Instead, our politicians provoked an orgy of emotionalism, one section of our countrymen clamoured for the further punishment of the wretched peoples who were unfortunate enough to have been born in and fought for Germany, while another section indulged in hysterical hero-worship of those peculiar individuals in our midst who had refused to share the common burden of citizenship. Statesmen of all nations pandered to the worst passions of the mob and disregarded the solemn warnings and advice of the wise. 'Thieves kitchen' mentality determined policy. Incalculable harm was done to the future peace of the world.

The result is that Europe is now menaced by the existence of a multiplicity of armed camps. Asia is insurgent, Africa is restless—there are ominous murmurings in Morocco, in Abyssinia, in Egypt and the Sudan—and the United States of

America, practically self-supporting, with no obvious enemy, is persuaded that it must occupy the rôle filled by Germany before the last war, and threaten our naval supremacy. Instead of the spirit of militarism having been exorcised, it is now the most powerful influence in international relationships, and has extended to the spheres of industrial and social relationships in each civilised country. The present situation is summed up by Mr. H. G. Wells in a characteristic preface to this book: "I clung to the delusion that at the end of four years of stupid, clumsy, and inconclusive massacre and destruction, the common sense of mankind would say quite definitely 'never again' to any such experience, and would be prepared to revise its ideas of nationality, empire, loyalty, race competition and propagation, soundly and effectively as soon as it could for a moment struggle out of the mud and blood and reek in which it was entangled. . . . My mistake was in attributing any common sense to mankind."

Any survey of the greater part of Commander Kenworthy's subject matter would probably be considered as lying outside the legitimate scope of this journal. Most scientific people prefer that their political appetites should be satisfied by dishes seasoned to their tastes. They, like other men, have their instinctive prejudices, and feel the same sense of irritation at having them exposed as irrational. In their specialised fields of science they could not suffer the partial or subjective treatment of facts, but they obstinately refuse to believe that domestic or international relationships are the concern of science, that the habit of thought inculcated by the study of science should influence their civic as well as their scientific activities. They would be dismayed at the suggestion that the International Research Council should enter the political arena and prepare a memorandum for the Great Powers setting forth in detail the effect of the intensive application of modern scientific discoveries to warfare, or the ameliorative and progressive effects of the proper and thorough application of scientific principles to the production and world-wide distribution of essential commodities. The rationalisation of the world's industries, the essential requirement for world peace, will probably eventually be accomplished because of science, but unless there is a remarkable change of attitude on the part of scientific workers, they will play a very minor part in the determination of policy which brings it about.

Any scientific worker, however, who takes the trouble to read Commander Kenworthy's masterly survey of the present world situation is certain to be struck by the poverty of statesmanship revealed, and with the need for a different kind of leadership. He will be constrained to ask, Who is responsible for the fact that the most civilised nations of the world are spending more time, energy, and thought on preparations for another war of attrition than they are on the development of the world's natural resources? Why is it that the governments of Great Britain and the United States are spending considerably more on naval armaments than they are prepared to devote to the improvement of the social and industrial conditions of their peoples? He may reflect that Great Britain is spending more of the national income on scientific research in connexion with its fighting services than it is on research applied to the development of the potential resources and industries of the Empire: that it haggles over a few millions to be devoted to the construction of railways and roads in the immense tropical territories in its possession, but never seriously challenges greater expenditure on a single battleship, which in any case would be more useless in a future war than in the last: that it spends large sums on training its fighting leaders, but leaves the leadership of industry to chance circumstance: that it makes every endeavour to keep its fighting personnel in a state of efficiency, but does nothing to prevent large numbers of its industrial workers from losing their skill.

The only answer to this indictment is that other nations follow the same tradition, and no one nation dare break with it, least of all our own: that the code of ethics determining individual relationships cannot be applied to international relationships. While we accept this as axiomatic, war remains a possibility, and "nations cannot be blamed for arming themselves with all the resources of science and invention." On our part we must prepare the most effective devices for the wholesale slaughter of our enemies, particularly their civilian populations, because victory in the next war, even more so than in the last, will be achieved by bringing pressure to bear on the enemy populace. We must have command of the air, enormous fleets of aircraft which can be mobilised within a few hours to rain high explosives and lethal bombs on the industrial centres of enemy nations, to destroy their docks, railway centres, arsenals and aerodromes, and to cripple their war-vessels, including their aircraft carriers. As an alternative means of defence we must increase the efficiency and number of our submarines,

and be prepared to strew minefields about every enemy harbour. If we cannot exorcise the war spirit, we must be prepared for the adoption of still more appalling methods of destruction, for example, the liberation of disease germs: already, for this purpose, the systematic study of the most effective means of spreading pestilential diseases is being pursued in the laboratories of more than one country. Tanks and first-class battleships can be left out of our calculations: they would be useless if the other weapons enumerated were perfected.

Commander Kenworthy has fairly accurately diagnosed the causes of war between nations—albeit he ignores one possible cause, the facility with which the force of mob discontents can be diverted from the government responsible to other governments—but his prescription for the prevention and cure of war is even less convincing than his palliative, which is to make war more decent by the abolition of submarine warfare. The only road to peace, he avers, is for "war to be declared a crime and be no longer recognised, in any way or at any time, as a legitimate method of settling international disputes." As Mr. Wells says in the preface, "the ending of war is a far more complex, laborious, and difficult task than mere gesticulations as this imply. A great change is needed in the teaching of history and the training of the young citizen, a substitution of a biological for a merely economic and political conception of human life, before we can begin to hope for the secure establishment of those world controls upon which alone an enduring world-peace can be sustained."

A. G. CHURCH.

Theories of Capillarity.

Kapillarität und Oberflächenspannung. Bearbeitet von Prof. Dr. G. Bakker. (Handbuch der Experimentalphysik, herausgegeben von W. Wien und F. Harms, Band 6.) Pp. xv + 458. (Leipzig: Akademische Verlagsgesellschaft m.b.H., 1928.) 44 gold marks.

PROF. BAKKER has made a very important addition to the literature of capillarity. The author is an authority who has spent upwards of a quarter of a century in mathematical research on the theory, and in the thoroughness and balance with which the mathematical theories are treated his book is probably without an equal. It may well remain the standard text-book on those theories, such as Laplace's, which treat the liquid as a continuum diminishing in density near the surface. In many other branches, also, the subject is dealt with in great detail. There are good chapters on the thermodynamics of surfaces, on the geometrical forms assumed by liquid surfaces, on the measurement of surface tension, and on the numerical results of these measurements. The account of the theory of the various methods of measurement of surface tension is probably unique in its fullness; there are very few omissions, and those only in detail. The researches on the molecular structure of surface films are also given lucidly and thoroughly; this rapidly growing section, however, suffers markedly from lack of attention to literature more recent than 1924. It seems almost a pity that some kind of 'stop-press' notice could not here have been given to developments at least as young as two years old, even if the bulk of the work required four years—as it very well might, so thorough is the treatment—to bring into shape.

Electro-capillarity is not treated, and angles of contact are not explained in terms of adhesions between solid and liquid, an explanation which seems to the reviewer to make them intelligible. The author also follows the usual practice of mathematical treatises of overlooking the experimental fact that the contact angle can have any value between two widely different extremes, according to the tendency of the liquid to move on the surface. This variation of contact angle is a frictional phenomenon between solid and liquid, and it is so far from recondite that it may well be known to any intelligent child who watches drops of rain trickling down an ordinarily dirty window-pane. Its importance for the theory of capillarity is no less than that of friction for statics; and to neglect it experimentally must result—indeed has often resulted—in disaster. Yet its existence is seldom, if ever, even hinted at in the mathematical theory.

The appearance of this book may well mark the end of an epoch in the theory of capillarity. Molecules are dominant in nearly all other branches of physics, and they are finding their way into capillarity. They can probably never be fitted into the 'classical' theory, for its structure will scarcely admit any particle so coarse as the molecule is known to be. An important mathematical operation in the classical theory is the application of infinitesimal calculus in a direction perpendicular to the surface, in the region of 'diminishing density'; but since it is practically certain that, if there is a diminution of density, the transition is all over in at most three molecules thickness, the physical meaning of this operation is very obscure. But

the classical theories are not alone in the field; there is now another which harmonises with the rest of modern physics and chemistry. In 1913, Hardy initiated a molecular, chemical theory, and in 1917, Langmuir gave it definite shape. The molecules are in the forefront of the picture, and the macroscopic phenomena are explained in terms of the fields of force of these molecules; moreover, these fields of force are shown to be identical with those which give rise to chemical reactions of all kinds.

All recent developments have shown the great unifying power of this theory; not only has it been the basis for the accumulation of a great deal of knowledge of the two-dimensional state of matter occurring in surface films, but it has shown that the formulæ of organic chemistry really represent the shapes of the molecules, and it has made clear the relations between capillarity, organic chemistry, and crystallography. Beside this living, powerful theory, the classical 'continuum' theory of Laplace seems little more than a mathematical game. Though we need to keep and use the thermodynamics and the calculations of the manifold effects of surface tension—the tendency of liquids to diminish to minimum area—unless the pendulum of physical theory makes an altogether unexpected swing back to continuity instead of discontinuity as the basis, the non-molecular Laplacian theory cannot contribute much to the advancement and unification of knowledge.

These are criticisms of the classical theory, not of its presentation in this book. That could scarcely be bettered; and it is well to have the work of the last century so ably put together. The only danger is lest possibly the reader should feel that the important theories of capillarity are somewhat apart from the rest of physics, and the mathematician inclined for constructive research should fail to realise that the molecular theory of capillarity is in existence, and needs his aid very urgently.

N. K. ADAM.

Commercial Seed Production.

Seed Production and Marketing. By Prof. Joseph F. Cox and George E. Starr. (The Wiley Farm Series.) Pp. xviii+450. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1927.) 20*s*. net.

OF cultural books on gardening and farming there are plenty, and the enthusiast is well provided for, whether his hobby be the growing of vegetables, sweet peas, roses, or choice flowers from seed. But the art of raising new and improved varieties of plants, and the successful production of commercial seed, are subjects upon which comparatively little literature has ever been published, and the vast majority of those who grow or handle flowers or vegetables have little, if any, idea of how the different types and varieties originated, or how seeds of them are produced true to type.

The commercial production of choice strains of seeds is a highly technical business, often dabbled in by amateurs, to their own cost, and understood in its various branches by really few seed-growing experts. It is true that many gardeners or farmers have at some time had experience in the saving of seed of one or more subjects, but to be able to produce good seeds, true to type and of high germination, of the many thousands of varieties listed in seedsmen's catalogues, is a real achievement, and requires long years of careful study and observation. Consequently, any book which will give the garden-loving public even a small idea of how all this work is done, is sure to be welcomed, and read with very great interest.

The new book just issued by Prof. Cox and Mr. Stair is without doubt the best and most complete work on this subject which has been published, and every chapter shows a good acquaintance with the different methods adopted. In the raising of new plants, the modern method of 'single line' selection is described in conjunction with the older one of 'mass' selection, and the effects which are obtained by cross pollination between different varieties give the general reader some idea of the great care necessary in isolating seed crops of different subjects. In every branch of Nature there is a tendency towards degeneration, and an excellent illustration shows how skilled men have to walk carefully over seed crops to detect and remove every plant which shows any variation from the true and improved type. The practical seed grower will find many hints and much information which will be of value to him in the planting, 'rogueing,' harvesting, threshing, and cleaning of the seed, whilst there are many articles and tables of value to the seed merchant.

The book is well written and well printed, and although it is undoubtedly of greater value in America, because many of the subjects described, such as maize, cotton seed, soy beans, cow peas, squashes, peppers, tobacco, lettuces, okra, etc., cannot be seeded commercially in Great Britain, yet it is well worth a place on the bookshelf of anyone interested in the subject on this side of the water.

WALTER F. GILES.

Our Bookshelf.

Chemical Affinity. By L. J. Hudleston. (Monographs on Inorganic and Physical Chemistry.) Pp. vii + 138. (London: Longmans, Green and Co. Ltd., 1928.) 7*s*. 6*d*. net.

THIS useful little monograph has a somewhat misleading title. It would scarcely be expected that a book on the subject of "Chemical Affinity," published in these days when so much is coming to light about the nature of chemical action, would omit all reference to mechanism and confine itself solely to the discussion of the thermodynamics of the subject. With this limitation, however, the author has written a work which will fill a place in the teaching of the subject, and has certainly attained a considerable measure of success in the task which he set himself, namely, to show the practical importance for research and for modern industry of thermochemical methods of approach to chemical problems.

After two comparatively short chapters on classical thermodynamics, Lewis's development of the free energy conception is fully discussed both in relation to the behaviour of pure substances and in the more difficult field of solutions. It is, in fact, as an exponent of Lewis's methods that the author writes, but any criticism of the book on the ground of excessive weight given to this side of the subject is sufficiently rebutted by consideration of the demonstration of the great usefulness of Lewis's treatment of the subject for practical purposes. The chapter which follows on the heat theorem is perhaps too brief to give a student a full comprehension of the importance of the advance made by Nernst. The most useful part of the book is its concluding chapter, in which examples of the application of modern thermodynamics to laboratory and industrial problems are worked out in detail by the aid of energy data which are tabulated in a valuable appendix. These examples will, we venture to think, do more to convince the student of the usefulness of thermodynamics than much disquisition.

A few errors could profitably be corrected in a new edition. On p. 18, "increased energy" is an obvious slip for "increase in the energy," and in the derivation of the heat theorem d/dT of $aTlnT$ is inadvertently given as $alnT$. It would also assist the ready comprehension of the chapter on free energy if the conceptions of heat content and free energy were referred to as new 'functions' introduced by Lewis and not 'terms,' an expression which tends to confusion when introduced into a discussion plentifully adorned with equations.

Gmelins Handbuch der anorganischen Chemie. Achte völlig neu bearbeitete Auflage. Herausgegeben von der Deutschen Chemischen Gesellschaft. Bearbeitet von R. J. Meyer. System-Nummer 6: Chlor. Pp. xvi + xiv + 442. (Berlin: Verlag Chemie G.m.b.H., 1927.) 68 gold marks.

IN the volume on chlorine the high standard of excellence reached in the preceding numbers is well maintained, the literature having been exhaustively reviewed up to June 1927. In accordance with the general plan of the work, the volume deals only with the element itself and with such compounds as it forms with the few elements which precede it in the scheme. After a brief account of the history and occurrence of chlorine, its preparation, manufacture, and physical properties are discussed at great length. The attack upon the problem of the separation of the isotopes of chlorine by several different methods is carefully recorded and an instance is quoted of an unusually high value found by Madame Curie for the atomic weight of a sample obtained from an African desert salt. Otherwise the remarkable constancy in the proportions of the isotopes affords evidence of the enormous antiquity of the existing ratio. Then follows an account of the structure of the atom, the dimensions of the molecule, and the various thermal, optical, electrical, and electrochemical properties, and a preliminary survey of the chemical behaviour of the element towards water, non-metals and metals, and a summary of quantitative methods of analysis.

The remaining four-fifths of the volume is devoted to a consideration of compounds of chlorine. Eight diagrams are reproduced, including those indicating the existence at low temperatures of different hydrates of hydrogen chloride and of perchloric acid. The chemical, physical, and electrochemical properties of hydrogen chloride in the gaseous condition and in solution in water and in other solvents, and of oxides, oxyacids, chlorides, hypochlorites, chlorites, chlorates, and perchlorates have been detailed and classified with meticulous care. Lastly, nitrogenous compounds such as nitrogen chloride, chlorazide, the chloramines, nitrosyl, and nitryl chlorides have come under review, and reference is also made to the single fluorine derivative—fluoronium perchlorate. The careful style of the work and the vast number of references to original memoirs should render the work of immense value to research workers.

The Measurement of Air Flow. By E. Ower. Pp. vii + 199. (London: Chapman and Hall, Ltd., 1927.) 15*s*. net.

THE correct measurement of the flow of air in closed pipe systems as well as in the free air is of considerable importance, and the volume before us attempts the description of the various methods at present in use and the apparatus used, particularly in reference to the motion of air along pipes and ducts. Theory is introduced, as in the chapters in which the theory of the pressure tube anemometer and the vane anemometer are discussed, and in the chapters dealing with the flow through orifices, the Venturi meter and nozzles, but the emphasis is on the instrumental and experimental aspect of the subject. Chap. iii. is a valuable chapter on pitot and static tubes, the results of tests of various types being given. Such instruments only give 'point velocities,' but they are often used for determining the flow along fairly large mine headings, and some readers may be a little disappointed that no hint is given as to

the possibility of determining mean velocities in terms of certain spot readings in such cases. The author, however, does give curves showing the distribution of velocity across, and the relation between the mean and axial velocity in, smooth circular pipes. The chapter on the vane anemometer is full and complete and concludes with the warning that an anemometer should not be used in a pipe the diameter of which is less than six times that of the instrument. The chapter on manometers describes particularly the instruments used in the National Physical Laboratory and will be found useful to many workers. A concluding chapter deals with hot-wire anemometers.

The work is clearly written and will enable many types of workers to obtain accurate information on the design and use of instruments for the measurement of air flow. In many works and laboratories it will be found useful as a book of reference. The bibliography will also be valuable to other workers.

Culture: the Diffusion Controversy. By Prof. G. Elliot Smith, Prof. Bronislaw Malinowski, Dr. Herbert J. Spinden, Dr. A. Goldenweiser. (Psyche Miniatures, General Series No. 18.) Pp. 98. (London: Kegan Paul and Co., Ltd., 1928.) 2*s.* 6*d.* net.

THOSE who wish for a concise statement of varied and opposing views on the 'diffusion' controversy cannot do better than invest in this little volume. Here we have the protagonists brought face to face within one cover. Prof. Elliot Smith opens with an able exposition of his views. He states the position, however, as that of two flatly opposed schools, and regards the acceptance of culture contact by the opponents of his whole theory, or more specifically of his theory of Egyptian origins, as an inconsistency, and not as a recognition of facts. But, as Prof. Malinowski shows in the contribution which follows, the opposing school which Prof. Elliot Smith and his colleagues attack is an abstraction, at any rate at the present day. To contest certain elements in the 'diffusionist' theory is not necessarily to deny the fact of diffusion. Mr. H. J. Spinden follows with a sarcastically scornful, but humorous, survey of the various Schools of Romantic Anthropologists from the time when a knowledge of Adam and Eve and the Tower of Babel was sought among the American Indians. Prof. A. Goldenweiser sums up judicially, but has difficulty in finding a single anthropologist who holds the view attributed to the tribe by Prof. Elliot Smith.

The Annual of the British School at Athens. No. 27, Session 1925–1926. Pp. x+319+30 plates. (London: Macmillan and Co., Ltd., 1928.) 63*s.* net.

SUBSCRIBERS to the funds of the British School of Archæology at Athens, and others into whose hands this volume will come, will regret the revised law of antiquities by which the activities of any one school or group of archæologists have been restricted to two sites of excavation. We miss the smaller 'side shows.' Not infrequently they were stimulating as well as illuminating. It must not be concluded hastily, however, that the present volume is lacking in matter of interest to take their place, while the sites chosen for excavation are worthy of the attention which is now concentrated on them.

The continued excavations at Sparta in 1925–26, which is the chief operation of the School, are here described by the Director; but for the moment interest centres on the work of Mr. Heurtley in Macedonia, which is throwing a flood of light on the racial and cultural movement between prehistoric Greece and the areas to the north. Mr. Heurtley here deals with his excavations at Vardaroftsa, on the banks of the Vardar, which have revealed a local culture primarily Anatolian, but in one period showing traces of northern influence, and later on of Hellenic penetration.

Mexico: Land, Volk und Wirtschaft. Von Prof. Karl Sapper. Zweite, vollständig neubearbeitete Auflage der "Wirtschaftsgeographie von Mexico." Pp. 165+15 Tafeln. (Wien: L. W. Seidel und Sohn, 1928.) 8 gold marks.

THE first edition of this book was published in 1908. The present issue has been completely revised in the light of changes in the economic condition of Mexico. Prof. Sapper writes of a country which he knows well from several visits, and he has the faculty of putting a great deal in a small compass, so that the book, though small in size, gives a comprehensive survey of the geography of Mexico and is in fact one of the most useful volumes on that country available. There are statistical and bibliographical appendices and an economic map.

An Introduction to Chemistry: for Lower Forms of Secondary Schools. By J. Morris. Pp. vii+152. (London: Methuen and Co., Ltd., 1927.) 3*s.*

MR. MORRIS'S book is rendered more than usually interesting by the historical details and short biographies of famous chemists which it contains. In this connexion it should be mentioned that Humphry Davy's name is always incorrectly given, and that the story about phosphorus on p. 131 should refer to Lemery and not Boyle, and that the ignition was accidental. The descriptive part is clearly written and does not cover too much ground, so that the book may be recommended as likely to prove both useful and interesting in junior classes.

Mathematical Preparation for Physical Chemistry. By Prof. F. Daniels. (International Chemical Series.) Pp. x+308. (New York: McGraw-Hill Book Co., Inc.; London: McGraw-Hill Publishing Co., Ltd., 1928.) 15*s.* net.

THIS work should appeal to those students of chemistry who find particular difficulty in understanding the elements of higher mathematics required in the study of physical chemistry. The ground covered is small, but great emphasis is laid on important parts, and the treatment is as elementary as possible. There are good collections of simple examples.

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.*]

The Combustion of Hydrocarbons: Hydroxylation and/or Peroxidation.

THE publication in NATURE of July 7, p. 19, of Mr. A. C. Egerton's recent Royal Institution discourse on "Engine Knock and Related Problems," following upon Prof. H. L. Callendar's paper on the same subject in *Engineering*, pp. 147-8, 182-4, and 210-2; 1927) about a year ago, moves me to direct attention to certain well-established facts in regard to hydrocarbon combustion which seem in danger of being overlooked in the present discussion of the subject.

It may be recalled that in the course of my researches on the subject—chiefly during the years 1900–1906, but also at intervals afterwards—some hundreds of experiments were made upon the combustion of methane, ethane, propane, *n*- and *iso*-butanes, the corresponding olefines (*i.e.* ethylene and homologues) and acetylene, each in admixture with varying proportions of oxygen, and under all conditions from slow combustion at 300° to 400° C., through ordinary flame reactions, up to detonation, including high-pressure explosions. In the 'slow combustion' experiments a number of intermediate products (chiefly aldehydes) were isolated; moreover, the products obtained when the hydrocarbons were exploded with defect of oxygen were shown to be substantially those resulting from the thermal decompositions of alcohols and aldehydes.

Therefore it was concluded that (i.) the slow oxidation of such hydrocarbons as methane, ethane, and ethylene essentially involves successive 'hydroxylation' stages with evolution of heat, accompanied by (according to circumstances) the thermal decomposition of unstable 'hydroxylated' molecules into simpler products, which may afterwards undergo further oxidation in like manner, and (ii.) although the same sequence of changes may not be reproduced exactly in flames, "the immediate result of the initial encounter between hydrocarbon and oxygen is probably much the same in the two cases, namely, the formation of a 'hydroxylated' or 'oxygenated' molecule. At the higher temperatures of flames, secondary thermal decompositions and interactions undoubtedly come into operation at an earlier stage, and play a more important rôle, than in slow combustion; they do not, however, precede the onslaught of the oxygen upon the hydrocarbon, but arise in consequence of it." [1]

For some time after discovering the intermediate formation of large quantities of aldehydes in the slow combustion of methane and ethane, I halted between two opinions as to whether the initial stage involved 'hydroxylation' or the primary formation of an oxygenated molecule:

(i) $CH_3 . CH_3 \longrightarrow CH_3 . CH_2 . OH \longrightarrow CH_3 . CH(OH)_2$

$H_2O + CH_3 . CHO$ etc.

or (ii) $CH_3 . CH_3 \longrightarrow CH_3 . CH_3O_2 \longrightarrow H_2O + CH_3 . CHO$, etc.

[1] Discourse on "Explosive Combustion with special reference to that of Hydrocarbons," delivered at the Royal Institution on Feb. 28, 1908.

At first I was inclined to the latter view (see *Trans. Chem. Soc.*, **83**, 1075-6; 1903), supposing that the oxygen molecule would act as a whole; but as the research proceeded, a great mass of cumulative evidence eventually compelled me to adopt the former. Nor has anything recently published shaken my belief that normally, and for the most part, the combustion process is essentially one of 'hydroxylation,' although it may well be that, in the pre-flame period during the compression stroke in an engine cylinder, a small proportion of the initial molecular collisions produce an unstable peroxide, thus causing 'knocking.' From Mr. Egerton's recent publications (*Aeronautical Research Committee Reports and Memoranda*, No. 1079, issued in December 1926, and his recent Royal Institution discourse) it is not altogether clear to me whether he considers that the *whole*, or only *a part*, of the hydrocarbon burns through 'peroxide' rather than by 'hydroxylation.' It may be stated, however, that in none of my experiments (except one on the slow combustion of acetylene, where the transient formation of a substance which seemed to be a polyglycolide, $nC_2H_2O_2$, was observed) was there any sign of initial peroxide formation.

To summarise adequately the mass of experimental evidence referred to would require far more space than could be given here; but it will perhaps suffice for me to indicate in the following numbered paragraphs (with references to the original papers) a few of the more outstanding facts which must be accounted for by any comprehensive theory.

(1) In 1906, J. Drugman, working in my laboratory, showed (*Trans. Chem. Soc.*, **89**, 939; 1906) that when ethane is subjected to the action of ozone at 100° C.—at which temperature it does not react with ordinary oxygen—ethyl alcohol, acetaldehyde, and acetic acid are all prominently formed, the oxidation proceeding in successive hydroxylation stages, thus:

$$CH_3 . CH_3 \longrightarrow CH_3 . CH_2 . OH \longrightarrow CH_3 . CH(OH)_2$$

$$H_2O + CH_3 . C\begin{matrix}H\\O\end{matrix} \longrightarrow CH_3 . C\begin{matrix}OH\\O\end{matrix}.$$

(2) In our numerous 'bulb experiments,' in which ethane–oxygen, ethylene–oxygen, and acetylene–oxygen mixtures, respectively, reacted in closed vessels at 300° C. and pressures between about 2 and 2·2 atmospheres, there was but little to choose between the observed rapid rates of reaction with hydrocarbon/oxygen ratios of 2 : 1 and 1 : 1, although in each case any excess of oxygen beyond the equimolecular portion slowed down the rate considerably (*Trans. Chem. Soc.*, **85**, 693, 1637; 1904; **87**, 1232; 1905).

(3) The isolation of considerable quantities of acetaldehyde—doubtless arising by intra-molecular change from the unstable vinyl alcohol $CH_2 : CH . OH$—from the products of the slow combustion of ethylene (W. A. Bone and R. V. Wheeler, *Trans. Chem. Soc.*, **85**, 1653-4; 1904; also T. S. Wheeler and E. W. Blair, *Jour. Soc. Chem. Ind.*, 303T; 1922; and 81, 87, and 415T; 1923) accords much better with the 'hydroxylation' than with a 'peroxidation' view of the process.

(4) The persistent formation in all our 'bulb experiments' (*q.v.*) with methane, ethane, ethylene, and acetylene (in all of which formaldehyde was produced intermediately) of large quantities of carbon dioxide simultaneously with carbonic oxide and steam, *in circumstances which absolutely precluded* its arising either by the direct oxidation of carbonic oxide, or by its interaction with steam, could not be explained except on the supposition of its having

arisen by the oxidation of the intermediate formaldehyde in 'hydroxylation' stages, thus:

$$\rightarrow \begin{matrix} H \\ H \end{matrix}\!\!>\!C=O \rightarrow \begin{matrix} HO \\ H \end{matrix}\!\!>\!C=O \rightarrow \begin{matrix} HO \\ HO \end{matrix}\!\!>\!C=O$$

$$\overbrace{CO + H_2O} \qquad \overbrace{CO_2 + H_2O}.$$

(5) In experiments upon the explosive combustion of olefines it was found that, whereas when any one of those examined is exploded with oxygen in the ratio $C_nH_{2n} + \frac{n}{2}O_2$, there is no separation of carbon, and but little (if any) formation of steam, the products consisting almost entirely of carbonic oxide and oxygen, as though produced by the thermal decomposition of formaldehyde, yet *with a more limited supply of oxygen*, both carbon and steam arise simultaneously and in quantity (W. A. Bone and J. Drugman, *Trans. Chem. Soc.*, **89**, 660-682; 1906, where the matter is fully discussed). Indeed, in all such cases, the facts compel us to regard the ratio $C_nH_{2n} + \frac{n}{2}O_2$, which (except in the case of ethylene) is *not* the equimolecular, as being critical in some deep sense. According to my view, it represents the stage at which, from a 'hydroxylated' molecule $C_nH_n(OH)_n$, successive 'formaldehyde groups' may be eliminated and decomposed into $CO + H_2$ ($>CH.OH \rightarrow CH_2O \rightarrow CO + H_2$) without any breaking down at a *less* 'hydroxylated' stage, which would (and actually does) occur, with simultaneous production of carbon and steam, when the oxygen-supply is reduced below the ratio referred to; and anyone carefully studying such facts with an open mind will, I think, realise how incompatible they are with a 'peroxidation' view of the matter.

(6) During the course of the experiments recently carried out by Dr. D. T. A. Townend in my laboratory on the explosion of methane with up to its own volume of oxygen at initial pressures up to 150 atmospheres (*Proc. Roy. Soc.*, A, **116**, 637-663; 1927)—in which the behaviours of mixtures $5CH_4 + 2O_2$, $2CH_4 + O_2$, $3CH_4 + 2O_2$, $4CH_4 + 3O_2$ and $CH_4 + O_2$ on explosion at varying initial pressures were very thoroughly examined—a series of significant observations were made regarding the ratios of steam formation to the oxygen contents of the mixtures, which, while in accordance with the 'hydroxylation,' would be much more difficult to account for by a 'peroxidation' theory.

(7) The chief difficulty confronting the 'hydroxylation' theory during the earlier stages of our researches was our failure to isolate an alcohol from the intermediate products of the oxidation of a paraffin such as ethane; it diminished in weight when it was found (W. A. Bone and W. E. Stockings, *Trans. Chem. Soc.*, **85**, 722-5; 1904) that, under the experimental conditions, ethyl alcohol is oxidised much more rapidly than ethane; and it became more and more shadowy as the experiments referred to in paragraphs (1) and (2) progressed. In a recent paper by M. Stanislas Landa, "Sur la combustion lente des hydrocarbons" (*Comptes rendus*, **186**, 589; 1928), the results of experiments are described in which the slow oxidation (at 280°–300° C.) of the vapours of liquid paraffin hydrocarbons was studied with the view to discriminating between the 'hydroxylation' and 'peroxidation' theories respectively. After recording the isolation in quantity of both alcohols and aldehydes from the combustion products, the author concludes as follows: "Dès à présent les résultats que j'ai obtenus, résumés ci-dessus, constituent la première démonstration expérimentale de l'exactitude de la manière de voir de Bone sur la combustion lente des hydrocarbures. Mes recherches m'ont en effet permis d'isoler et d'identifier les alcools et aldéhydes dont la présence indique ainsi nettement le processus de l'oxydation."

In directing attention to the foregoing well-established facts, I would repeat that, while not denying the possibility of some small 'peroxide' formation occurring in the pre-flame period during the compression stroke of a petrol-air engine, and thus causing 'knocking,' I still hold that normally, and for the most part, the combustion process is essentially one of 'hydroxylation' and not 'peroxidation.' Nevertheless, as is said on p. 377 of Bone and Townend's "Flame and Combustion in Gases," "The two views are, however, not mutually exclusive, and may perhaps be supplementary; for only a very rash or dogmatic person would nowadays assert that *every* collision between hydrocarbon and oxygen molecules (or oxygen atoms) must always have precisely the same result as regards the particular 'oxygenated' molecule initially produced." WILLIAM A. BONE.

Imperial College of Science,
London, July 17.

PROF. BONE'S summary of the facts in support of the hydroxylation theory of hydrocarbon combustion will be appreciated by all who are interested in the subject. As Prof. Bone notices, I have not been explicitly in favour either of peroxidation or hydroxylation. The experimental evidence does not seem to me to rule out either process completely. Once reaction has been set going homogeneously, it may proceed by a variety of paths. But *initially*, there must be some process more probable than another, and the question is, What is that process? Is the primary step to involve dissociation of the oxygen molecule, as seems to be demanded if the formation of a single OH group first occurs?

The main conclusion from the behaviour of antiknocks is that a chain reaction mechanism is set up depending on the formation of some active product which propagates the chain and which is destroyed by the 'inhibitor' (and probably also by the walls of the vessel). The behaviour of 'antiknocks' and 'proknocks' is somewhat easier to understand if the first step in the combustion process is the incorporation of a sufficiently active oxygen molecule with the hydrocarbon molecule (thereby forming what may be termed a 'temporary peroxide'), the active products formed by reorganisation or decomposition of the compound being able to continue the reaction chain. It might also be held that more than two active molecules must come together as a first step in the reaction process. That view is preferred in the case of hydrogen and oxygen by Hinshelwood and Gibson (*Proc. Roy. Soc.*, **119**, 591; 1918), rather than the collision of a single hydrogen molecule with an oxygen molecule.

Such processes as these do not involve dissociation of oxygen and liberation of a free oxygen atom, and could presumably occur more readily than processes involving dissociation. However, it must not be overlooked that the preliminary activation may not be simply thermal—hydrogen and oxygen, for example, do not readily ignite unless traces of water are present—and a small number of active centres (possibly oxygen atoms produced at the surface of the vessel) may be essential to initiate the reaction, as Semenoff concludes in the case of the oxidation of phosphorus (*Zeit. f. phys.*, **46**, 109; 1927). Further work is needed to elucidate the nature of these initial happenings for the hydrocarbons, but the subsequent consequences, it seems to me, are largely covered by the hydroxylation theory and the work which Prof. Bone did in the first years of the century. A. EGERTON.

Clarendon Laboratory, Oxford.

The Titanium Oxide Bands.

THE fine structure analysis of the blue-green titanium bands, started nearly two years ago (see *Phys. Rev.*, **29**, 212; 1927, abstract 26), has now reached the point where it is possible to draw certain definite conclusions regarding the molecule responsible for the radiation of these bands. These conclusions are based on a complete verification of the combination principle, using some 1500 lines measured in the three bands 0-0, 1-0, and 0-1 (λλ 5167, 4955, and 5448).

Each band consists of three R and three P branches. These six series are nearly, but not exactly, parallel, so that they are continually crossing and re-crossing one another. Due to this fact, almost a majority of all measured lines are blends, and this has made both the empirical and the theoretical analysis unusually difficult. Good values for the triple origin have not as yet been obtained, but the three *heads* of the 0-0 band lie at approximately 19349, 19347, and 19340 cm.$^{-1}$. These will be denoted as the a, b, and c heads respectively. In the case of the P_a and R_a branches, the resulting rotational energy functions fulfil quantitatively the expected relations between rotational and vibrational energy constants, and accordingly one can obtain from these functions very trustworthy values of the moment of inertia. The functions for the other two members of the triplet exhibit small positive and negative deviations respectively from the expected theoretical relations, and these deviations have not yet been satisfactorily explained.

There is no doubt that this band system is due to an oxide of titanium, and our earlier vibrational analysis (loc. cit.) showed that it is due to a diatomic molecule. The new additional fact that the individual bands have a triplet structure is practically certain proof that they are due to a molecule with an *even* number of electrons. Hence they must be due to *neutral* TiO rather than to TiO^+.

It is not possible to carry any of the series within about twenty lines of the origin, due to the close spacing and overlapping of all series in that region. Hence one cannot say definitely that no Q branches are present. But *if* they occur, they must be very short and weak. It is therefore very probable that these bands are due to a $^3P - {}^3P$ transition (like the Swan bands), rather than to $^3P - {}^3S$, or $^3P - {}^1S$. If TiO is similar to CO, the normal level should be ^1S, and on that assumption the lower level of these titanium bands is an *excited* level of the TiO molecule.

The values of the moments of inertia for the upper and lower levels are $(56{\cdot}76 \pm 0{\cdot}03) \times 10^{-40}$ and $(51{\cdot}87 \pm 0{\cdot}03) \times 10^{-40}$ respectively, corresponding to a nuclear separation (r_o) of $1{\cdot}694 \times 10^{-8}$ cm. and $1{\cdot}619 \times 10^{-8}$ cm. The values of r_o are approximately the same as those found for AlO, and are some 15 per cent smaller than had been anticipated for TiO, from a study of the constants of other similar molecules. Hence the TiO molecule seems to be especially firmly bound.

The two band systems of possibly major importance in astrophysics are the Swan bands, found in R- and N-type stars, and the titanium bands, found in M-type stars. The great preponderance of evidence is now that the Swan bands are due to a $^3P - {}^3P$ transition in the *neutral* C_2 molecule, while the above facts indicate that the blue-green titanium bands are due to a $^3P - {}^3P$ transition in the *neutral* TiO molecule. These two band systems, as is well known, never occur together in stellar spectra, a fact usually explained by assuming that one carrier exists in a reducing atmosphere, and the other in an oxidising atmosphere. The above conclusions are in agreement with this assumption.

A. CHRISTY.
R. T. BIRGE.

University of California,
July 7.

Two Lecture Demonstrations in Physics.

(1) Two conducting wires or rods about five feet in length are stretched in a wedge shape, the gap being one-half inch at the bottom and three-quarters of an inch at the top. The upper three feet of the wires are covered with a glass tube. It is well known that if an induction coil is connected to the two wires, the resultant sparks will be carried up the wires by the rising ions; hence the spark will seem to climb the wires. When the spark reaches the top of the glass tube, the ions go out of the end, so that the spark begins again at the bottom. If now the top of the glass tube is tightly corked, the spark when it enters the tube will travel more slowly than along the lower part of the wires, and when it reaches the cork, a layer of ions will stay there, so that the spark, instead of returning to the bottom, will remain just under the cork. With the cork removed, an air blast down the tube will either prevent the spark from climbing or will blow it down the wires.

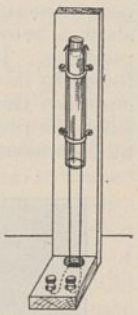

FIG. 1.

(2) Gray, in his book "Gyrostatics and Rotational Motion," has described a top which when rocked will walk in one direction along two parallel wires. When the top reaches the end of the wires, it is necessary to slide it back to its first position. If, however, the top is unbalanced with a small mass M, there will be an average upward force during each half revolution of the top of value $2Mv^2/\pi r$. This will lessen the friction between the wires and the top, so that the top will slide backwards on the wires, provided the wires are exactly horizontal. We have shown before that the top will walk down a pair of inclined wires, since friction on the wires will start and stop precession. Therefore a top may be rigged up on inclined wires as shown in Fig. 2. With the spring extended so that C is well above B, the top will walk from C to B. With the spring depressed so that C is slightly below B, the unbalanced top will slide back

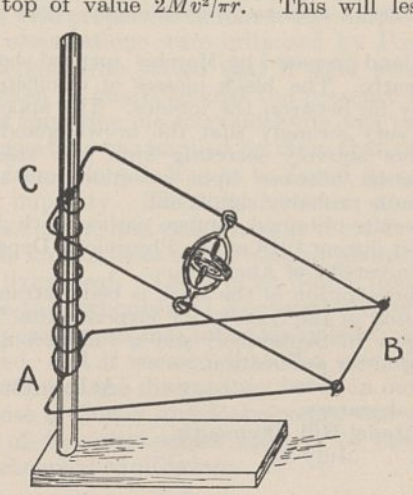

FIG. 2.

from *B* to *C*. The Hurst gyroscopic tops which we use are always slightly out of kinetic balance, so that no mass need be added to produce the backward movement.

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M. C. HOLMES.

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West Virginia University.

Brown Coloration in Interrenal Cell Tissue.

IN a histological investigation of the interrenal of the ray (*R. clavata*), it has been found that while the majority of the glands examined correspond to the usual description of an ochre-yellow body, a minority show a brown coloration apparently due to melanin pigment. In the yellow glands the lipin has been found to be confined to the cells of the lobules which compose the organ, but in the brown glands a considerable proportion of the lipin lies in the interlobular blood-spaces. The photomicrograph (Fig. 1) taken

FIG. 1.—Interrenal tissue of *R. clavata*. × 500.

from a gland prepared by Marchis' method shows this quite clearly. The black masses of osmicated lipin obviously lie between the lobules. The appearances suggest very strongly that the brown glands when fixed were actively secreting lipin into the blood. The relation between lipin secretion and melanin formation is probably significant.

The results obtained confirm earlier work done on the rabbit during 1926 at the Physiology Department of the University of Aberdeen.

A demonstration of the work is being arranged for the meeting of the Society for Experimental Biology at Glasgow in September, and a full account is in preparation for publication.

ALLAN FRASER.

The Laboratory,
Citadel Hill, Plymouth,
July 13.

The Origin and Progress of Mankind.

IN the article under the above title in NATURE of July 21, I am accused by the writer "J. R." of "ignoring a broad biological principle," presumably because I was careful not to confuse the principle of "convergent evolution" with wild theories of "spontaneous generation." Yet in the very next sentence the author of the admonition somewhat inconsequently adds: "The final scientific criterion must be 'Prove all things.'"

I had hoped that by dealing in my Huxley Memorial Lecture with the history of biological and ethnological theories I might exorcise such elements of confusion. For I made it clear that the ethnological dogma of the "independent development of culture" was utterly different from the biological principle of convergence, and was in fact a survival of the pre-Newtonian type of scholasticism, which led men astray precisely because it did not insist upon the principle "Prove all things."

G. ELLIOT SMITH.

University College,
London.

THERE is no analogy between the idea that in similar circumstances similar customs and inventions may have arisen and the discredited biological theory of spontaneous generation, for at whatever stage of human development different communities, as they are known to us, may have left the main stock, they already had behind them a vast background of common experiences, of mental and social development, the basis of their further progress. Granted that as an ethnological dogma the similarity theory has been a bad master, there seems to be no reason why in its proper place it should not be a good servant, and our protest was against the danger of treating as non-existent the common background of humanity and all that it implies.

J. R.

The Instability of a Single Vortex-Row.

IT was shown by von Kàrmàn in a well-known paper that a single row of vortices equally spaced and all rotating in the same sense is unstable; but the constructive consequences of this result seem to have received less attention than the destructive ones. It is shown that a disturbance of the pattern increases with time like $e^{\lambda t}$; λ is greatest when the displacements of consecutive vortices are equal and opposite (Lamb, "Hydrodynamics," 5th edition, p. 209, equation 12). Hence the type of disturbance that develops most rapidly is one that tends to separate the row into two rows, consecutive vortices going into different rows.

Now when a stream is obstructed by an obstacle projecting into it, the free stream line at the edge of the wake degenerates into a row of eddies all of the same sense, and this can be seen to separate in the way just indicated. Some of the eddies are deviated

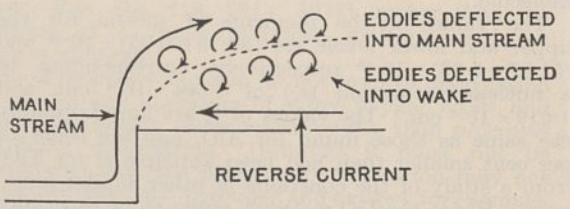

FIG. 1.

into the main stream and swept away in it, while the others enter the dead water, where they produce a circulation with a reverse current near the boundary (Fig. 1). The reverse current often noticed behind the wind screen of a motor car, behind an obstacle at the edge of a stream, or on the lee side of a hill, is thus qualitatively explicable.

HAROLD JEFFREYS.

St. John's College,
Cambridge.

Photosynthesis.[1]

By Prof. E. C. C. BALY, C.B.E., F.R.S., University of Liverpool.

THERE is no process within the confines of chemistry which is of greater interest and importance than that by means of which the living plant prepares the food on which its life and growth depend. This food consists of starch and sugars, together grouped under the general name of carbohydrates, and of certain nitrogen-containing compounds known as proteins. The material from which the plant starts is carbonic acid, or a solution of carbon dioxide, which it obtains from the air, in water which it obtains through its roots from the soil. From this substance alone the plant is able to prepare its supply of carbohydrates, and it is true to say that this chemical process is the fundamental basis of the whole of terrestrial life. This may truly be asserted because the production of the proteins is very closely associated with it and the initial stage is common to the two.

The formation of carbohydrates from carbonic acid when expressed by a chemical equation looks simple enough. There is no doubt that the first product of the process that can be recognised in the plant is a simple sugar, and thus the equation can be written

$$6H_2CO_3 = C_6H_{12}O_6 + 6O_2$$

where the simple carbohydrate is either glucose or fructose. These simple sugars undergo condensation immediately they are formed to give cane sugar or one of the starches, and these changes can readily be written as simple chemical equations.

The mechanism by means of which the plant achieves the synthesis of these complex compounds from carbonic acid has long been a mystery to chemists and to botanists. It is known that the agency used by the plant to effect its purpose is sunlight, and thus the term 'photosynthesis' has been applied to the operation. It is also known that the plant makes use of certain pigments, such as chlorophyll, and it is to these that the colour of the leaves is due. The mystery of it all lay in the fact that no one knew what actually takes place, and, indeed, the more chemists and botanists explored, the more puzzling did the problem seem to be.

Perhaps the most puzzling fact of all is that the plant only makes use of sunlight, when all our previous knowledge of light reactions leads us to believe that such light is quite incapable of inducing photosynthesis. This may readily be understood if the amount of energy involved in the synthesis is considered. It has been proved experimentally that in order to synthesise one gram molecule (180 grams) of glucose or fructose, there must be supplied to the carbonic acid a minimum quantity of energy equal to 673,800 calories. Whilst it is known that the plant manages in some way to absorb the necessary energy in the form of light, the physicist tells us that it cannot absorb directly enough energy from sunlight. Thus the photosynthesis can be brought about by red light of the wave-length 660 $\mu\mu$ when the energy directly absorbed can only be 260,000 calories, which is far below the minimum quantity required.

The experience gained from the ordinary reactions of photochemistry leads to the belief that if it is required to convert carbonic acid into sugars by means of light alone, it will be necessary to use ultra-violet light which is absorbed by carbonic acid, that is to say, light of wave-length 210 $\mu\mu$. It is obvious from this that some unknown factor is operating in vital photosynthesis.

In any endeavour to elucidate the mystery, it is evident that the first line of inquiry must be to study the action of the short wave ultra-violet light upon carbonic acid. This was first investigated by Moore and Webster in 1913, who found no evidence of any reaction taking place. They found, however, that in the presence of certain catalysts, such as colloidal iron hydroxide, small quantities of formaldehyde were produced. Since these results appeared to be at variance with general experience in photochemical investigations, they were again examined some years later in Liverpool, and it was then found that when a stream of carbon dixoide was passed through water irradiated by the light from a quartz mercury lamp, small quantities of formaldehyde were produced. This result seemed to be very satisfactory, since the formaldehyde could be looked upon as an intermediate stage on the way to carbohydrates, especially in view of the fact that Moore and Webster had proved that formaldehyde was converted by light into substances with properties similar to the simple sugars.

Our observations were criticised by Porter and Ramsperger, who stated that if rigid precautions were taken to guard against the presence of every trace of impurity, no formaldehyde was produced. The suggestion was implied by them that the origin of the formaldehyde was to be found in some unknown impurity. There is, however, an alternative possibility, and one which is more in keeping with the known facts of the natural photosynthesis in the living leaf. There is no doubt that in this reaction the carbonic acid is converted directly into carbohydrates and that formaldehyde as such is not produced, and it seemed that the most probable explanation of the discrepancy between our results and those of Porter and Ramsperger was that the action of the ultra-violet light is to establish a photo-chemical equilibrium,

$$6H_2CO_3 \rightleftarrows C_6H_{12}O_6 + 6O_2,$$

which reverts to carbonic acid again in the dark. In the presence of oxidisable impurities a small amount of carbohydrates will be formed, which will be photochemically decomposed to formaldehyde. This decomposition of all the carbohydrates by means of ultra-violet light is well known.

There is no need to give here the details of the experiments which were carried out to test this view, and it is sufficient to say that conclusive proof

[1] Discourse delivered at the Royal Institution on Friday, Feb. 3.

was obtained of the reality of the equilibrium : that is to say, carbohydrates were found to be present in the solution during irradiation by ultra-violet light, and they vanished very quickly after the irradiation was stopped.

This gave us at once a starting point, because it seems evident that if a harmless inorganic reducing agent were added to the solution, carbohydrates should be formed in quantity on exposure to the ultra-violet light. Such a reducing agent is ferrous bicarbonate, and great hopes were raised when it was found that a saturated solution of this compound, which was completely colourless when prepared, gave a copious precipitate of ferric oxide on exposure to ultra-violet light. It was evident that the oxidation took place by reason of the oxygen in the carbohydrate equilibrium in accordance with the equation

$$4Fe(HCO_3)_2 + O_2 = 2Fe_2O_3 + 4H_2O + 8CO_2,$$

and indeed it was found that on evaporation of the exposed solution a simple sugar was obtained. The quantity produced was very disappointing and far less than was anticipated, and the conclusion was forced upon us that some unknown factor was taking part in the process.

During many unsuccessful endeavours to improve the yield of the carbohydrates, it was noticed that the ferric oxide was not produced in the body of the solution, but only on the walls of the quartz containing vessels and on the surface of the iron rods used to make the bicarbonate. This led us to suspect that the surface was a determining factor, and we at once changed the experimental method so as to increase the surface as much as possible. In order to secure this a suspension of pure aluminium powder in water, maintained by a stream of carbon dioxide, was exposed to ultra-violet light. Increased yields of carbohydrates were at once obtained, but it was also found that the best yields were obtained when the aluminium powder had been allowed to coat itself with hydroxide by remaining in contact with the water before the exposure to light. This latter observation very materially changed our ideas, since it established the fact that the surface phenomenon is of far greater importance than the reducing action, and indeed raised the question as to whether the latter plays any rôle at all in the process.

In order finally to decide this question, an aqueous suspension of pure and freshly prepared aluminium hydroxide, maintained by a stream of carbon dioxide, was exposed to ultra-violet light. There was obtained after filtration and evaporation of the solution a quantity of carbohydrates equal in weight to that produced when aluminium powder was used. This conclusively proved the fundamental significance of the rôle played by the surface, and at the same time the reducing action was found to be entirely unnecessary. Identical results were obtained with other powders, such as aluminium, zinc, and magnesium carbonates.

During the course of these experiments it occurred to one of my students (Dr. W. E. Stephen) that if a green powder were used in place of the white ones the photosynthesis might take place in visible light, the green colour being suggested by the green colour of the plant-pigment chlorophyll. This was found actually to be the case, since a suspension of nickel carbonate maintained by a stream of carbon dioxide in water, on exposure to the light from an ordinary tungsten filament lamp, gave a larger yield of carbohydrates that any of the white powders in ultra-violet light. We soon found that there was no especial virtue in the green colour, and that equally good results were given by pink cobalt carbonate.

Apart from the interest which accrues from the fact that the photosynthesis is thus achieved in a way which shows a real analogy with the natural phenomenon, the method with a coloured surface and visible light has the very material advantage in that the danger of photo-chemical decomposition by ultra-violet light is completely eliminated, with the result that the products are obtained in a purer state.

From the above description of the direct photosynthesis of carbohydrates from carbonic acid in the laboratory, several points arise which require discussion and explanation. In the first place, it may be stated that the most rigid control experiments which we could devise have definitely established the fact that the carbohydrates are not due to the presence of impurities.

One of the greatest difficulties met with in this work was the preparation of the various materials used for the surfaces, since it is absolutely essential that these be completely free from any trace of alkali. It is well known that when metallic hydroxides and carbonates are precipitated they tend to absorb the alkali, and the removal of this is extraordinarily troublesome. The absence of any alkaline reaction in the filtrate after the powder has been boiled with water is no criterion of purity, and the only satisfactory method is to pass carbon dioxide into a suspension of the powder in water for two hours in the dark, and the filtrate after concentration must yield no weighable quantity of alkaline carbonate.

It was frequently found that the carbonates of nickel and cobalt, even when completely freed from alkali, were entirely ineffective in promoting photosynthesis. These can, however, be activated either by heating to 120° or by exposure in thin layers to ultra-violet light, and this fact afforded a very convincing method of carrying out controls. A quantity of one of these inactive powders gives no trace of carbohydrates when exposed to visible light in the manner described. The same sample of powder when activated and used in the same apparatus, with the same water, the same light, and carbon dioxide from the same source, gives a good yield of carbohydrates. So, once and for all, is all doubt removed as to the possible effect of impurities.

For the benefit of those who may wish to repeat these experiments, it may be stated that more recently it has been found possible to prepare nickel carbonate by a new method which is free from the objections characteristic of its precipitation by means of alkali carbonate. A solution of carbonic acid in conductivity water is electro-

lysed, the electrodes being made of nickel plates. The current is taken from a 220-volt circuit, and sufficient resistance is intercalated to reduce the current density to from 1 or 2 amp. per sq. dcm. The electrolyte is cooled by glass coils through which a stream of water is maintained. With electrodes 190 sq. cm. in area it is possible to prepare 30 gm. of pure carbonate in 24 hours. The carbonate should be collected every day by filtration, and it is advisable to clean the electrodes with emery paper every third day.

To sum up the results, so far as they have been described, it has been found possible in the laboratory to produce carbohydrates directly from carbonic acid by a process which is physically similar to that of the living plant. The essential difficulty in our understanding of the natural photosynthesis has been solved, namely, the use of visible light as the agent in a process which the elementary laws of photochemistry taught us to believe could only be achieved by means of ultra-violet light. As so often happens, the explanation when found is very simple. The great amount of energy required to convert the carbonic acid into carbohydrates is supplied to it in two portions, one by the surface and the other by the visible light.

Nothing has been said, so far, of the actual carbohydrates which have been photosynthesised in the laboratory. Although as yet our information is still meagre, there is no doubt that the photosynthetic syrup is a mixture containing glucose or fructose, or both. There are also present more complex carbohydrates, which can be resolved to the simple sugars by the action of dilute acid. The analogy with the products of natural photosynthesis is too close to be passed by without comment.

Although it has not as yet been possible to carry out a complete analysis of this syrup, owing to the difficulty of preparing a sufficiently large amount, interesting information has been gained from the investigation of the sugar syrup obtained by the action of light upon formaldehyde solution. This has been pursued during the last three years. We owe a debt of gratitude to Sir James Irvine for the signal help he has given us in this work. He himself was the first, in association with Dr. Francis, to prove that glucose is one of the substances actually produced. By oxidation of the sugars to the acids by means of bromine, and the crystallisation of the salts of these with brucine, cinchonine, and quinine, we have obtained *d*-erythronic and probably also *d*-gluconic acids. This not only confirms Irvine and Francis in their proof of glucose, but it also proves that fructose is formed just as in the living plant. In addition to that, there is produced a mixture of complex acids which afford convincing evidence of the synthesis of complex carbohydrates.

Although it may be thought that the use of formaldehyde as the starting point takes away something from the interest, yet it must be remembered that it makes but little difference whether in actual fact we start from carbonic acid or formaldehyde. Without doubt the first substance, transiently formed in either case, is the same, namely, activated formaldehyde which polymerises to the sugars.

The similarity between the vital and the laboratory processes is not confined to the fact that the products from the two are the same. Botanists tell us that in the living plant the photosynthesis takes place on a surface; so also is a surface necessary in the laboratory. It has been found possible to compare the quantities of carbohydrates synthesised for equal areas exposed to light in the case of living leaves and the glass vessels of the laboratory. These quantities are about the same. Some plants produce more and others produce less than we are able to synthesise. This similarity may be emphasised, because surely Dame Nature in the living leaf has produced the best machine she could for her purpose of food production for her children of the vegetable kingdom.

There is yet another striking feature which is common to photosynthesis *in vivo* and *in vitro*. The light must not be too strong in either, for if it is too strong, then harmful results at once supervene. This is due to the poisoning of the surface by the oxygen which is set free. In both cases this poisoning slowly rights itself, and in both the synthesis must not proceed at a greater rate than that of the recovery of the surface from its poisoning.

In fine, so far as we have been able to carry the investigations, the processes in the living plant and in the laboratory show most striking resemblance, not only in the compounds which are formed, but also in every feature which is characteristic of them.

For my own part, I would go further than this, because I believe that these experimental results help us to gain some understanding of the chemistry of life, the chemistry which is so different from that of man's achievements with his test tube, flask, and beaker. Within the confines of vital chemistry, reactions take place which are so far outside our own experimental experience that it came to be believed by many that they were under the control of a mysterious force, to which the name of *vis vitalis* was given. We have considered one of these processes: the condensation of the simple sugars, glucose, and fructose, to form cane sugar, starch, and inulin. No one has yet succeeded in effecting these syntheses in his laboratory, but it would seem that something of that nature takes place in our photosynthesis. Why, then, is it that even this step forward has been gained?

The one lesson that we have gained from photosynthesis is, that the definitive factor is the very large amount of energy which must be supplied to the carbonic acid before the synthesis of the simple sugars takes place. The means of supplying that energy do not concern the argument. The synthesis proceeds at an energy level which is far higher than is the case in the reactions of ordinary chemistry, and the sugars are formed at that high energy level. I myself believe that the condensation reactions to give the more complex carbohydrates are those which are characteristic of the simple sugars when they exist at the high energy

level. The reason why no one has succeeded until now in inducing these reactions to take place is because no one has hitherto been able to supply the large energy increment necessary.

I believe that we find in this the key which unlocks the door of vital chemistry, and that the chemistry of all life is one of high energy, our laboratory experience being confined to the chemistry of low energy. From this viewpoint I see a wondrous vista unfold itself, wherein new understanding, new hopes, and new possibilities reveal themselves. Health and vitality must essentially depend on the high energy level being maintained; any lowering of that level will lead to poor health and weak vitality. Knowledge comes to us of the means whereby the high level may be kept unimpaired. The most important sources from which we can absorb high energy are fresh food and ultra-violet light. From one we learn the necessity of the rapid distribution of our food supply before its high energy is lost; from the other we gain a real understanding of the benefits of ultra-violet light therapy, and, more important still, of the dangers of its misuse. We gain an insight into the chemistry of vitamins, which in the light of our new knowledge reveal themselves as stores of high energy, which yield their energy to restore and maintain the vitality of decadent tissues.

A vision thus comes to us of a new chemistry with limits far flung beyond those which constrain our knowledge of to-day, a chemistry which will embrace and co-ordinate not only the properties of inanimate matter upon this earth, not only the wondrous mechanism of the life of man in health and in disease, but in addition the stupendous marvels of the birth and growth of the worlds outside our own. From those who would decry this as a mere speculation I beg forgiveness, and plead that speculation based on sure experimental fact is the life-blood of true scientific research.

Industry and Research.[1]

By Sir RICHARD THRELFALL, G.B.E., F.R.S.

ONE of the things that strikes a chemist or physicist when approaching the biological sciences is the narrow range of temperature within which alone the phenomena of life occur. A chemist's attention might also be directed to the fact that his medical adviser has to carry a thermometer graduated to fiftieths of a Fahrenheit degree, with a range of, say, eight or ten degrees, in order to investigate the state of health of his patients, whether he practises in Greenland or Ceylon, and only requires one thermometer wherever he is. Human beings can and do exist over a range of, external temperature of more than one hundred Fahrenheit degrees, that is to say, over a range of, say, one hundred times the roughly permissible body temperature variation. How is this possible? It is only possible because man himself has invented means of narrowing the range so as to get within the limits of his own temperature regulation; in other words, he has invented fire, clothing, and housing. Moreover, human beings require food, and they can find it in some form, directly or indirectly, wherever the sun shines, but not always in a form in which they can assimilate it, so that in effect the supply is limited and competition for it ensues. This has most probably led to human creatures occupying areas where food is available, though climatic conditions are very unfavourable.

It is at least a plausible view that man's struggle with Nature is due to his being driven or tempted to follow the food supply, and by intelligence leading to invention, has devised means of overcoming climatic difficulties, particularly in the supply of heat to his body and its conservation therein. The aspect of the matter which interests us now is the supply of heat by oxidation of carbon and hydrogen in the neighbourhood of the body—not within it—together with the supply of light by which mankind's working life is increased.

Inventions such as the use of fire were made before records were kept, but we have copious records of later inventions, and very likely the earlier ones came about in a fundamentally similar way, as assumed and put forward by Charles Lamb in his "Dissertation upon Roast Pig." First comes the chance observation by an individual gifted enough to seek for its implications; then the endeavour to reproduce the phenomena by copying the original apparatus; then the attempt to distinguish essential from unessential parts of the process leading to a working theory; and finally, the improvement and simplification of the operation under guidance of the theory, which itself is subject to continual extension and improvement. These remarks apply to a fundamental invention, not to productions of improvements which rest on the successive observations and thought of many individuals. I cannot think of any discovery made in my time that does not rest to a greater or less extent on previous work.

Both academic and technical progress has been made throughout the ages, and indeed until within the last twenty years or so, by the efforts of individuals who were usually engaged in, and were paid for, quite other matters than the making of discoveries. Indeed, I remember the time—not so very long ago—when research was looked upon by the majority of quite educated people as a sort of hobby to be indulged in by those whose means permitted them sufficient leisure. So far as I know, the Royal Institution was one of the first places where physical and chemical research was looked upon as the primary duty of the professor, though, of course, the endowment of learning, that is, the careful investigation of what much earlier people had written or said, is a very old idea.

Looking back over the history of civilisation, it

[1] From an address delivered on the occasion of the opening of the new research laboratories of the Gas Light and Coke Co., Fulham, London, on July 26.

seems amazing that so much thought and time should have been spent over the study of the opinions of people whose sources of information were so meagre, while the whole vast subject of the study of the phenomena of the habitable world was left severely alone. No doubt an explanation can be thought of, but the history serves as a warning of how difficult it is to overthrow a false standard of intellectual activity after it has once become established, and particularly after it has attained the dignity of being a 'vested interest.'

Let us turn to the history of our own art, that of carbonising coal. Passing over previous limited attempts, I direct attention to the fact that Boulton and Watt's factory near Birmingham was illuminated by gas—presumably as a demonstration—by Murdoch at the celebration for the Peace of Amiens in 1802. In Thorpe's "Dictionary of Applied Chemistry," 117 years later, Dr. Harold G. Colman, a recognised authority, writes as follows: "Up to within the last few years the method of manufacture of coal gas has remained in its general principles almost identical with that employed by Murdoch and his immediate successors (prominent among the latter being Samuel Clegg, senior, and his son, Samuel Clegg, junior), although in detail and in the magnitude of the operations great change has taken place."

Whatever the reason may be, the fact remains that during the prosperous days of the nineteenth century the gas industry, like many others, did not devote much time or money to 'work for the future,' the term by which a chairman of the old Edison Co. in U.S.A. denoted research. Meanwhile—I need not repeat the well-worn tale—Germany had fought its way into competing with England's foreign trade by proceeding in what they would call a 'rational' manner, alike financially, commercially, and technically, and especially by 'working for the future' they improved the present in all directions. During the War, this process, long appreciated by the few, penetrated even into political circles, and there was some searching of heart as to why industry in Great Britain had not also 'worked for the future.' In view of the fact that several millions a day were being spent on the War, those in authority decided that some moderate sum might be spent in an endeavour to put the position of research in scientific, and particularly technical, matters on a better basis. After a time, during which the ground was surveyed, the policy settled down to creating institutions devoted to the study of matters supposed to be beyond the scope of individual effort, and encouraging the members of various industries to combine for research purposes, a sum of one million pounds being devoted to the assistance of the latter. The new venture, born in the Education Department, was placed under the Lord President of the Council for administrative purposes, with Sir William McCormick as executive chairman and Sir Frank Heath as secretary, and an advisory council of scientific men and industrialists.

As one who has had a continuous but small part in its development, I may say that, subject to the strict but sympathetic attitude of the Treasury, its own frugality, and the interest shown in it by successive Lord Presidents, whatsoever success the Department may have attained has been mainly due to the wisdom and work of the chairman and secretary.

The activities of the Department of Scientific and Industrial Research are, of course, adequately described in the annual reports, but there are one or two points to which I might refer. In the first place, the guiding principle has always been rather to induce the industries to do things for themselves than to attempt to do scientific work for them. The idea was that if only those who conduct manufacturing operations could be brought to value doing work for the future by investigation, they would willingly continue such work without external pressure. The difficulty would lie in creating initially a receptive state of mind, a difficulty so great that it could only be overcome by actual demonstration. From this it was hoped there would arise in time such a body of enlightened opinion that nobody would dream of conducting a manufacture without the assistance of systematic research. There is scarcely any industrial operation, perhaps no such operation at all, which would not benefit if it were systematically investigated. For example, to take the gas industry, which has been in existence now for something like a century and a quarter, one of the surprises of my life was to find that it was the opinion of the leaders of the technical side of the industry that research was required into the working of ordinary horizontal gas retorts, and I noticed some two years ago that the chairman of Imperial Chemical Industries stated in his annual address that research was still needed in relation to the ammonia-soda process.

Another matter which was forced upon the Department's attention at a very early date was the difficulty of finding properly equipped young men to carry on the investigations it was proposed to set going. It always used to be said that the rapid progress made in the dye industry in Germany was largely due to the fact that their system of education produced many more young men capable of scientific employment than were available in England. Very likely there is some truth in this. At all events, when the Department began to seek for workers, it was faced with a very great difficulty in finding them. Accordingly, and with the consent of the Board of Education, a system was instituted by which promising young graduates were assisted to continue their training for two or three years, during which time they underwent a sort of apprenticeship in research work under their own teachers. Great care was exercised both in the selection of the candidates and in watching their careers, as much as £50,000 a year being spent on this activity at one time. The results, I may say, have on the whole been entirely satisfactory, but I have always felt that the pursuit of science, either pure or applied, could not become a reasonable profession until a sufficient number of reasonably good openings was assured.

able profession until a sufficient number of reasonably good openings was assured.

In the course of my life, particularly as a fisherman, I have noticed what great observational powers are possessed by many people who would not describe themselves as in the least scientific, and I have gradually come to the conclusion that there is plenty of raw material among the young men and women of Great Britain, which only needs reasonable encouragement to form the personnel of a large research army. In short, parents must be assured that science as a profession is worth following from the financial point of view before their sons and daughters will be allowed to embrace a scientific career.

In establishing new laboratories there are two things to be considered—equipment and personnel. Of these, incomparably the more important is personnel, for the best equipment differs from the worst only in saving time for those who are using it. During recent visits to America I have taken the opportunity of conferring with the heads of many large industrial laboratories in that country, with the view of ascertaining the lines on which such laboratories are best conducted. I may say that I had very decided views of my own on the subject after spending something over half a century as a laboratory worker, and I was pleased to find that these views were entirely corroborated. In a word, it amounts to this, that everything turns on the personality of those at the head of the laboratory; that is to say, it depends on qualities with which the chief was endowed by Nature and not upon the knowledge he may have acquired. Of these qualities, enthusiasm for the work is the most important. Service should be looked at before remuneration. There should be personal contact between the director and the worker, and I personally, if forced to choose, would select an enthusiastic director rather than a distinguised exponent of the science he professes.

I have heard a good deal about team work of late years, but I have never understood exactly in detail what this term is held to mean. Of course, a large number of people may be employed to study different aspects of any particular phenomenon. Does team work mean that they are to exchange their ideas freely?—if so, it can do nothing but good. On the other hand, does it mean that workers are expected to conceal their identity in the presentation of results?—if so, I think that one great incentive to every worker is withdrawn. I propose as a more effective alternative to the elimination of the man whose attitude is, "I said it first," that all workers should make it a point of honour, and I speak to senior workers more particularly, to make a habit of giving, if anything, more credit rather than less to those who work under or with them, for any advance that may be made by their conjoint efforts.

Obituary.

Prof. S. S. Neustruev.

IN the sudden and unexpected death of Prof. S. S. Neustruev, of the University of Leningrad, on May 24, whilst on an expedition to Kirgizia, soil science has suffered another severe loss. Neustruev, like Glinka, who predeceased him by only a few months, was one of the greatest representatives of the school of Dokuchaiev, a school which is responsible for most of the modern views on soil genesis and classification.

Neustruev was born in Murom in 1874, and graduated in the physico-mathematical department of the University of Moscow in 1898. He was then appointed to the staff of the soil department of the Zemstvo in Samara, where he worked until 1906, and whilst there he published several papers dealing with the soils of Samara, particularly from the geological point of view.

During 1906 and 1907, Neustruev was investigating questions of soil structure, and from 1908 to 1914 he was a member of the botanical and soil expeditions sent by the Emigration Department and the Dokuchaiev Committee to Turkestan. His time spent in Turkestan was very fruitful, and he published numerous monographs and articles. For his first report he received an award from the Royal Geographical Society.

From 1915 to 1918, Neustruev was the leader of the Orenburg soil expedition of the Dokuchaiev Committee, and then for some time worked in western Siberia. In 1922 he became secretary of the Dokuchaiev Soil Committee and editor of its *Bulletin*. Under his supervision classes in geography were started, which later developed into the geographical faculty of the University of Leningrad. In recent years he led two important expeditions for the Academy of Sciences to Kasakstan and Bashkiria. In 1924–25 he took part in a detailed soil geological survey of the neighbourhood of Leningrad, and in 1924 he also conducted investigations in the northern Caucasus.

Neustruev was one of the Russian delegates to the International Congress of Soil Science in Washington in 1927, and those who took part in the excursion across America will never forget his unfailing courtesy and the painstaking care with which he explained the Russian views on the field study of soils. At this Congress he was chosen to edit the International Soil Map of Asia.

In April 1928 he was elected chairman of the Leningrad organising committee and vice-president of the general committee for the second International Soil Congress which is to be held in Russia in 1930, and of which he was to be chairman of the committee on the genesis and classification of soils.

Neustruev was a man of high culture, an accomplished linguist, and altogether a most attractive personality. He has left a scientific legacy of about 100 publications. Many of these deal particularly with south-eastern Russia and Turkestan, but he has also left a number of papers of more general interest, such as his essay on the "Classification of the Processes of Soil Formation"

(*Bull. of the Geogr. Institute*, June 1926) and "Genesis of Soils" (*Proceedings of the Washington Congress*, 1927).

Probably Neustruev was the greatest authority on the soils of deserts and the dry southern steppes, and the great group of grey soils known as Serozyoms (literally raw earths) were named by him. As soil scientist, geologist, and geographer he was an outstanding figure, and his kindly presence will be greatly missed at the next international meeting, for the success of which he had been working so hard. W. G. OGG.

WE regret to announce the following deaths:

Dr. R. E. Allardice, emeritus professor of mathematics at Stanford University and formerly of the Department of Mathematics of the University of Edinburgh, on May 6, aged sixty-six.

Prof. Gunnar Andersson, professor of economic geography in the Commercial High School, Stockholm, and author of numerous works on plant geography and related subjects, on Aug. 5, aged sixty-three years.

Prof. F. S. Carey, formerly professor of mathematics in the University of Liverpool, on July 26, at sixty-eight years of age.

Mr. D. C. Davies, director of the Field Museum of Natural History, Chicago, since 1921, aged sixty-two years.

Dr. William Dyson, emeritus professor of medicine, University of Sheffield, on July 9, aged seventy-eight years.

Prof. William Esty, head of the electrical engineering department at Lehigh University, known for his work on dynamo machinery and the resistance of insulating materials, on July 7, aged fifty-nine years.

Prof. Jinzo Matsumura, for nearly thirty years director of the Botanic Gardens, Koishikawa, and professor of botany in the Imperial University, Tokyo, on May 4, aged seventy-three years.

Mr. S. B. Parish, honorary curator in the herbarium of the University of California and an authority on the flora of southern California, on June 5, aged ninety years.

Dr. Charles Platt, emeritus professor of biological chemistry in the Hahnemann Medical College, Philadelphia, aged fifty-nine years.

News and Views.

IN January last, a conference was appointed to examine the situation which had arisen out of the competition between the beam radio telegraphic services and the submarine cable companies. Representatives of all the interests concerned gave evidence before the conference. In England the beam radio stations are owned and worked by the Government, whilst in the dominions they are operated by private companies. Except in the case of the beam radio service to Canada, where the rates are the same as by cable, the radio service is cheaper than that given by the cable companies. After discussing five possible ways in which the situation might be dealt with, the conference has unanimously recommended the formation of a 'communications' company, to which the cable and radio companies concerned could sell all their communication assets for shares. This company will also acquire the Government cables and the lease of the Post Office beam services. The latter will be for 25 years at a rental of £250,000 per annum. The recommendations of the conference have been accepted by Parliament. This we regard as satisfactory, as experience has shown that the development of a new method of communication, the technique of which is still almost in its infancy, requires initiative which government departments rarely show. Sufficient safeguards are made to prevent the system becoming a monopoly. A standard net revenue has been fixed, and half of all the net revenue in excess of this either goes to cheapening the rates or to such other purpose as the advisory committee may approve. In the future the communications company will be a great imperial utility corporation, managed privately, but under rigorous public control.

WISE words of caution are addressed to those enthusiastic game preservers who would destroy root and branch any creature regarded as a pest, by the "Committee on Species destructive to Game," appointed by the National Game Conference of the United States. The Committee, the report of which appears in *California Fish and Game* (April 1928, p. 134), found it impossible and undesirable to draw up a list of species which should be classed as destructive or to recommend definite measures of destruction, because conditions and circumstances varied so widely, that a species harmful in one area might be perfectly innocuous in another. It is stated that "in the absence of basic knowledge, prejudice has had full sway and has led unthinking people to commit deeds harmful and, when carried to extreme, disastrous to game conservation." In the control of animals that are truly game destroyers, locality must be first considered, and "the matter of control of enemies of game must be looked at from every angle by game breeders and sportsmen, since other important agencies enter into the problem." Where conflict of interests occurs, as may happen between agriculture and game conservation, it is recommended that only the individuals actually attacking game should be killed; the Committee is definitely against the system of paying bounties, and stands by "local control under proper legal supervision."

ON Aug. 1 the East Africa Archæological Expedition left England for Africa. Its object is to continue the investigations in the Elmenteita-Nakuru area of Kenya Colony, where, in 1926–27, Mr. L. S. B. Leakey made his remarkable discoveries bearing upon the antiquity and distribution of early man in Africa. These are reviewed by Mr. Leakey in an article contributed to the *Times* on the day the expedition sailed, in which he points out that while it is at present impossible to relate the Pluvial Periods of Equatorial Africa to the Glacial Epochs of Europe, they are at least pleistocene. Further, that of the skulls from Elmenteita which are held to resemble the Combe Capelle skull of Lower Aurignacian age, one

bears a close resemblance to the Oldoway skull discovered in Tanganyika in 1913, where of the associated fossils at least 50 per cent are pleistocene. Mr. Leakey now makes the interesting suggestion that the Elmenteita culture represents a south-eastward extension of the Capsian culture from the Sudan at the beginning of the last Pluvial period, while the fragmentary human remains from the earlier periods may turn out to be the earliest examples of *homo sapiens* as yet known. Mr. Leakey refers to other problems calling for investigation which need not be enumerated here; but it will be seen that the expedition has the prospect of much useful and valuable work before it. The limit, indeed, seems to be set only by the amount of the funds available, admittedly at present very far from adequate. The expenses of this year's expedition are being met with the assistance of the Royal Society and the Percy Sladen Trustees.

A MEETING of the Astronomische Gesellschaft was held at Heidelberg on July 18–21. Coming so soon after the meeting of the International Astronomical Union at Leyden, a large number of British and American astronomers were able to attend. The important question of the re-observation of the A.G. Catalogue by photography was fully discussed, and a number of interesting communications on various subjects were read. Dr. Max Wolf invited the members to tea at the Königstuhl, and they were shown round this beautiful observatory. The members were welcomed by the State university and municipality, and were entertained at a dinner at the Molkentur, at which the Rector of the University, the president of the Astronomische Gesellschaft, the Astronomer Royal, Prof. Schlesinger, and M. Mascart spoke. An invitation by the municipality of Stuttgart included a visit to Weil der Stadt, where Kepler was born. A wreath was placed on his statue by Dr. Max Wolf, and short addresses were given by Dr. Wolf and Prof. Eddington. At Stuttgart a demonstration was given of the Planetarium. The meeting terminated with a visit to Mannheim, by kind invitation of the municipality. On the journey to or from Heidelberg many of the members, by kind invitation of Prof. Kohlschütter, visited the observatory of Bonn and saw the instruments and observatory of Argelander.

A CORRESPONDENT in Southern India has forwarded an account from an Indian newspaper of phenomena observed in a village in Central Travancore early in June of this year, which indicates that a tornado visited that village. The account describes the passage of a "cylindrical column of water 20 to 30 feet high" across a paddy-field, the column "emitting fire and making a dreadful noise," and the ground is said to have been torn up so as to leave a deep well-like hole. It is presumed that the "column of water" was in reality a column of cloud (the 'funnel' cloud of the tornado), that the fire was the lightning which so often accompanies such a cloud, and that the noise was caused by the extreme violence of the wind, and perhaps also to some extent by the thunder. It is known that tornadoes occur occasionally over most of the temperate and tropical parts of the world, their true 'home' being the U.S.A. east of the Rockies. The climate of India as a whole, except during the rainy season, is normally too dry to favour this occurrence.

ON July 31 the Rt. Hon. the Earl of Balfour, as president of the Committee of the Privy Council for Scientific and Industrial Research, held an informal reception at the Forest Products Research Laboratory recently erected at Princes Risborough, Buckinghamshire, for the Department of Scientific and Industrial Research. The object of the reception was to bring to the notice of all interested the facilities existing in the new laboratories for scientific and technical investigations aiming at the conservation and efficient use of the timber supplies of Great Britain, both home-grown and imported, and to enable visitors to see the important work already in progress. About 140 guests attended, representative mainly of timber merchants and users. Representatives of Dominion Governments were also present.

THE Forest Products Research Laboratory, which was completed and equipped during the past year, is now fully in operation. It comprises sections for the study of timber seasoning, timber mechanics, timber physics, wood technology, entomology, wood preservation, wood-working, and timber utilisation. Investigations on behalf of the Laboratory are also carried out at the Imperial Forestry Institute, Oxford (wood technology and chemistry), the University of St. Andrews (chemistry), and the Imperial College of Science and Technology, South Kensington (mycology). The work of the Laboratory is under the immediate direction of Mr. R. S. Pearson, director of Forest Products Research, and the general programme of work is supervised by the Forest Products Research Board, under the chairmanship of Sir James C. Irvine, vice-chancellor and principal of the University of St. Andrews.

AT the request of the governors of the Royal Veterinary College, Camden Town, the Minister of Agriculture and Fisheries has appointed a Departmental Committee, under the chairmanship of Sir Charles Martin, director of the Lister Institute, "to consider and report generally on the reconstruction of the Royal Veterinary College and the probable cost; and in particular on the questions what accommodation should be provided, having regard to the training to be given; whether that accommodation can and should be provided on the present site; if not, where the College should be transferred; and what arrangements should be made in respect of the Animal Pathology Research Institute now situated at the College, if it appears necessary to change the existing arrangements."

A MEMORIAL to Thomas Telford, the famous road-maker and engineer, erected in his native parish of Westerkirk, Dumfriesshire, was unveiled on Aug. 3 by the Duke of Buccleuch. Telford was born in 1757, and his constructive works included the suspension bridges over the River Conway and the Menai Strait, the Caledonian and Ellesmere canals, and nearly one thousand miles of main road, with more than twelve hundred bridges, in Scotland.

AN enthusiastic group of naturalists a few years ago combined to issue the *Journal of the East Africa and Uganda Natural History Society*, No. 30 of which has just reached us. In view of the changes which inevitably follow upon the spread of civilisation, the recording of native faunas while aboriginal conditions still exist, becomes a matter of historical importance, and this Society is to be congratulated upon the thoroughness with which it is accomplishing its task. The present number continues Dr. von Someren's well-illustrated accounts of the butterflies and the birds of Kenya and Uganda, in which life-histories and habits receive as much attention as systematic description. An article on fishing in the Kavirondo Gulf, Lake Victoria, by C. M. Dodds, has interest for the naturalist, and ought to be invaluable to the ethnographer interested in the peculiar apparatus of traps, nets, hooked lines, and fishing spears employed by the natives in carrying out a fairly extensive fishery. Already civilisation is telling upon the native ways, for it is stated that in 1921, when the industry was more flourishing than it is to-day, up to 20,000 nets were imported from Ireland.

THE increasing attention which is being paid to the grazing possibilities and the mineral wealth of Canada's Arctic territories, is illustrated by a special number of the *Canadian Naturalist* (March 1928), which is entirely devoted to an article by Mr. E. M. Kindle on "Canada North of Fifty-Six Degrees." This includes the northern part of the great provinces, and the whole of Yukon and the North-West territories, much of which are known by the misnomer of the 'barren lands.' The numerous illustrations in the article are particularly striking. It is also announced that investigations into the value of those northern lands for reindeer are continuing. Messrs. A. E. and P. T. Porsild, who have been engaged on the work since 1926, have reported favourably on the region east of the Mackenzie delta. The annual patrol ship of the Canadian Arctic islands has left Sydney, Nova Scotia, for the north. Various researches will be carried out during the cruise.

"AGRICULTURAL Research in 1926" is the second of a series of annual publications issued by the Royal Agricultural Society for a twofold purpose; first, to record the results of research work, not necessarily from Britain only, in a concise form suitable to the practical farmer, the county organiser, and those engaged in the education of agricultural students; secondly, to prevent the loss to sight of valuable work owing to diffusion in publication. Definitely negative results are also included because of their importance from the practical point of view. The success of the first volume shows that such a type of publication is appreciated. The present number consists of seven reports, written by well-known research workers on such widely different subjects as crops and plant breeding, dairy husbandry, agricultural economics, agricultural engineering, animal nutrition, soils and fertilisers, and veterinary science. It is impossible in a few words to indicate the scope of the publication, but as an example of investigations on subjects which closely touch the daily life of the community, the production of Grade "A" (tuberculin tested) milk, the factors affecting the amount of fat in cow's milk, and taints and flavours in milk and dairy produce are among the questions discussed under dairy husbandry, while an account is given in the report on veterinary science of the progress of the work on foot-and-mouth disease. Although no method of cultivating the virus outside the body has yet been discovered, much important work has been done with regard to its survival in carcases subjected to various treatments. Ample references are appended under each report, so that further information may be obtained if desired; the publication will serve as a useful source of reference to research workers.

THE third annual meeting of the eastern section of the Seismological Society of America was held on April 30–May 2, in the University of Virginia at Charlottesville. At different meetings, papers were read on general seismology, practical and experimental seismometry, and the earthquakes of the United States. As regards the instruments to be used, the Wood-Anderson torsion seismometer has established its place as the best instrument for recording near earthquakes or those with origins not more than 1500 miles distant. For teleseisms, the Wenner seismograph has proved its value, especially for measuring the azimuth of a distant epicentre. The earthquakes of the United States were considered in several papers. Dr. F. L. Hoffman concludes that the earthquake hazard to the Panama Canal is apparently of no serious importance. Prof. S. Taber shows that, in the Atlantic states, earthquakes are scattered and do not recur along faults as on the Pacific coast, but that in shocks of the same intensity the former disturb areas from 5 to 25 times as great as the latter.

THE sixth Annual Report of the Safety in Mines Research Board, recently issued (London: H.M.S.O. 9*d*. net), records the work of that organisation during 1927. The extensive character of the work can be inferred from the expenditure, which exceeded £52,000, mainly derived from the Miners' Welfare Fund. Some of the work is carried out under the direct supervision of the Board, and other problems are examined with its support at universities and other institutions. Among the subjects of study are explosions of gas and coal dust, the spontaneous ignition of coal, mechanical and electrical engineering problems, rescue apparatus, safety lamps, and investigations of a medical and physiological character. These are under the oversight of the Health Advisory Committee and are typified by work on nystagmus and the injurious effects of certain rock dusts. During the year eleven reports were issued, and numerous publications have been made through other channels. Two features which attract attention are the intention to issue popularised accounts of the work or the benefit of operative mine workers and the organised collaboration between the Board and the U.S. Bureau of Mines.

DR. J. MACMILLAN BROWN points out an error into which the reviewer of his book in NATURE, April 28,

p. 665, has inadvertently fallen. In "Peoples and Problems of the Pacific" (vol. 1, pp. 187, 188), Dr. J. Macmillan Brown gives what may be regarded as authoritative evidence of the submergence of an island called Tuanaki, which was "asserted to be situated not more than 200 miles to the south or south-west of Rarotonga," or, "according to most reports, it lay to the south-east of Rarotonga, between that island and Mangaia." William T. Brigham says in his "Index to the Islands of the Pacific Ocean" (p. 159, 1900): "*Tuanaki*, or Reid, atoll in the Raeffsky group, in the north, uninhabited, 16° 41′ S., 144° 14′ W."; "*Tuinaka*, or Reid, of the Paumotu archipelago. North-west point is in 16° 37′ 17″ S., 144° 13′ W." Dr. Macmillan Brown informs us that "the two are evidently the same island, as I can testify having passed it in my voyagings through the Paumotus, and the proper name is 'Tuinaka'; it is still uninhabited, like nearly half of the Paumotus." Evidently Dr. W. T. Brigham, "as a rule the most trustworthy of authorities," has been misled in this matter, as was also the reviewer, who followed him.

THE report of the New York Aquarium for 1927 marks the close of a quarter of a century since the administration of the Aquarium was taken over by the New York Zoological Society and since Dr. C. H. Townsend was appointed director. The report, written in the director's absence on the Galapagos Expedition, by Charles M. Breder, contains strong remarks about the "pernicious difficulty" of working "on extremely meagre amounts of money, resulting in an unfortunate but necessary attitude towards disbursements," but notwithstanding it shows that very great progress has been made during these twenty-five years in adapting the aquarium to meet modern conditions. In particular, the improvement of the building itself seems to have been appreciated by the public, for a considerable increase is shown in the annual attendance, which reached a total of 2,129,305, or 5834 individuals a day. There is no detailed statement of the cost of running the Aquarium, but it would appear from a short note that the receipts from the City of New York and from the New York Zoological Society amount to about £15,000.

THE scientific work accomplished by the Smithsonian Institution, and described in its twelve series of publications, is well known and appreciated by all scientific workers, but the extent of the Institution's efforts to interest the public of the United States in its activities is less well known, and is an object-lesson which scientific institutions in other countries cannot afford to ignore. One of its two annual publications devoted to the enlightenment of the people contains simple accounts of the *Explorations and Field-work of the Smithsonian Institution*. The volume for 1927 contains 188 pages, at least half of which are filled with reproductions of photographs. It describes thirty various explorations launched by the Institution for objects which range from anthropological studies of early man in Europe, and of living American Indians and Eskimo, to archæological excursions in China, geological trips in the States, zoological and botanical journeys to South America, Siam, Sumatra, and elsewhere. The extent and number of the explorations suggest almost unlimited financial resources, but the preface specifically states that the Institution has almost no unrestricted funds for field-work. Practically all the expeditions sent out each year are made possible either through the help of generous friends and patrons, or through co-operative arrangements with other scientific agencies whereby costs and collections are shared. British institutions have yet much to learn in this method of adding to scientific knowledge.

THE latest catalogue (No. 309) of second-hand scientific books and serials offered for sale by W. Heffer and Sons, Ltd., 4 Petty Cury, Cambridge, includes among its 1800 items a selection of works from the library of the late Sir Arthur E. Shipley, books used by the late Sir Harry H. Johnston, and a number of duplicates from the Balfour Library, Cambridge. Readers interested in almost any branch of science should obtain a copy.

THE Kaiser-Wilhelm-Institut für Silikatforschung in Berlin-Dahlem, founded in 1926, under the direction of Dr. W. Eitel, has recently issued a volume containing twenty papers, previously published elsewhere, dealing with the work of the institute. Most of the papers are concerned with the crystal structure of various minerals and organic compounds, but some are of more general interest. The volume should prove to be equally interesting to both chemists and geologists.

THE Section of Geodesy of the International Union for Geodesy and Geophysics has recently issued, as Tome 4 of its *Publications*, a collection of the general reports presented at the second assembly of the Union at Madrid in 1924. The subjects dealt with at length are precision levelling (by Lallemand), determinations of latitude, azimuth, and longitude (by Jolly), isostasy (Bowie), and projections and computations (Roussilhe). There are also short reports on the deflection of the vertical (de Graaff Hunter), the intensity of gravity (Soler), earth tides (Lambert), and the stability of the earth's angular velocity (E. W. Brown).

APPLICATIONS are invited for the following appointments, on or before the dates mentioned: An inspector under the Ministry of Agriculture and Fisheries, for the purposes of the Diseases of Animals Acts, 1894–1925—The Secretary, Ministry of Agriculture and Fisheries, 10 Whitehall-place, S.W.1 (Aug. 20). A junior engineering assistant in the water department of the County Borough of Wolverhampton—The Town Clerk, Town Hall, Wolverhampton (Aug. 20). A working instructor in automobile engineering in Loughborough College Works Departments—The Registrar, Loughborough College, Leicestershire (Aug. 21). A woman lecturer and organiser in hygiene and infant welfare work under the Somerset County Council—W. G. Savage, County Health Department, Boulevard, Weston-super-Mare (Aug. 23). An agricultural analyst for the county of Dorset—The Clerk of the County Council, County Offices, Dorchester (Aug. 25). A lecturer in scientific German at the Northern Polytechnic, Holloway—The Clerk, Northern Polytechnic, Holloway, N.7 (Aug. 29). A professor

of mathematics in the University of Melbourne—The Agent-general for Victoria, Victoria House, Melbourne Place, Strand, W.C.2 (Sept. 3). A full-time lecturer and demonstrator in anatomy at the University College of South Wales and Monmouthshire—The Registrar, University College, Cardiff (Sept. 7). Keepers of, respectively, the departments of botany and vertebrate zoology of the Museums, Liverpool—The Director, Free Public Museums, William Brown Street, Liverpool (Sept. 10). A lecturer in organic chemistry in the department of organic and applied chemistry of the Sir John Cass Technical Institute—The Principal, Sir John Cass Technical Institute, Jewry Street, E.C.3 (Sept. 12). A senior member of the staff of the British Launderers' Research Association, for carrying out technical investigations connected with the laundry industry—The Director of Research, British Launderers' Research Association, Hill View Gardens, Hendon, N.W.4. A laboratory assistant at the Royal Gunpowder Factory—The Superintendent, Royal Gunpowder Factory, Waltham Abbey, Essex. An assistant lecturer in the department of biology of the Huddersfield Technical College—The Director of Education, Education Offices, Huddersfield. A full-time teacher of subjects in mining courses at the Barnsley Mining and Technical College—The Principal, Harvey Institute, Barnsley. The Gardiner professorship of physiological chemistry in the University of Glasgow—The Secretary of the University Court, University, Glasgow. An evening teacher of machine design and machine drawing at Goldsmiths' College—The Warden, Goldsmiths' College, New Cross, S.E.14. A teacher of practical mathematics at the Croydon Polytechnic—The Principal, Central Polytechnic, Scarbrook Road, Croydon.

Our Astronomical Column.

THE DEGREE OF ACCURACY OF METEOR OBSERVATIONS.—Mr. A. King contributes a paper on this subject to *Mon. Not. Roy. Ast. Soc.* for May. He considers (1) observations by experts in this work, (2) those by people who know the stars, but are unpractised in meteor work, (3) those by quite unskilled observers. Twenty-four meteors in class (1) show very satisfactory accordance; the heights at commencement of path range from 93 to 45 miles, those at end from 80 to 25 miles; the velocities are in close accord with those calculated on the parabolic assumption, allowance being made for the earth's attraction. From the comparison of the results of different computers, the probable errors of heights and radiants are within a fraction of a mile and a degree respectively.

The results in class (2) are considerably less precise. The uncertainty of the radiant is now 3° or 4°. Class (3) is of value only when a very large number of observations is available; the errors then tend to cancel out. As an example, nearly 300 observations were available of the Yorkshire fireball of Sept. 6, 1926. Mr. Denning and Mr. King differed only by 2° in the radiant. Prof. Shapley has lately urged more careful study of meteors, hoping that the study may lead to important results in stellar physics.

ϵ AURIGÆ.—Mr. P. Doig contributes a note on this interesting variable star to *B.A.A. Journal*, No. 7. It is of special type *F*5, and Miss C. Payne has deduced from the spectrum the absolute magnitude −4·0. Its normal apparent magnitude is 3·3; it drops to 4·0 at minimum; the period during which the light is below normal is 700 days, for 300 of which the light is constant at its minimum value; the interval between minima is more than 27 years—the longest period known. Miss Payne's value of the absolute magnitude gives a distance of nearly 1000 light-years; from the statistics of giant stars, Mr. Doig estimates a diameter 50 times that of the sun and a mass 35 times that of the sun. The variation of light has usually been ascribed to eclipse; on this assumption Prof. Shapley found that the radius of the primary is 0·03 of the major axis of the relative orbit. The estimated diameter given above makes the semi-major axis of the orbit 4 astronomical units. This with a period of 27 years gives a mass 1/11 of that of the sun; according to Eddington, this is less than the minimum possible mass for a star (which is about 1/7 of the sun's mass); it is in any case incompatible with an absolute magnitude −4. These considerations throw grave doubt on the hypothesis that the variation is due to eclipse. At the moment no other plausible explanation suggests itself.

LICK OBSERVATORY CATALOGUE OF RADIAL VELOCITIES.—The observation of radial velocities has been one of the chief branches of work at the Lick Observatory. Volume 16 of the *Publications* of the observatory contains the results in the form of a catalogue of the radial velocities of 2400 stars. Those south of declination −20° were observed by the D. O. Mills expeditions to Santiago, Chile, which began in 1903 and went on for the remainder of the period covered by the catalogue, which extends from 1896 to the end of 1926. The larger part of the volume contains the separate daily results for each star, together with notes on peculiarities of spectrum and on the lines employed: the catalogue proper only occupies a few pages at the end.

Variable velocity is established for 351 stars in the catalogue, and is suspected for 81 more. The variation is clearly shown in the case of Procyon; the observations of this are combined in groups; the extreme values are −4·28 km./sec. for the period 1903–6, and −1·60 km./sec. for the period 1918–23. The centre of mass of the first component of Castor has the value −1·2 km./sec., that of the second component +6·0 km./sec. Polaris has been observed more than five hundred times; the details are not given, but it is noted that the period of the short variation is 3·96809 days, the longer period being probably greater than thirty years. There are numerous observations of both components of α Centauri. The radial velocity of the system is given as −22·2 km./sec. The radial velocity of Arcturus is unexpectedly small, considering the star's large proper motion. The mean of 56 determinations is −5·35 km./sec. The catalogue is practically complete down to magnitude 5·5, there being only 69 stars absent. Most of these have been observed elsewhere; some are difficult to measure.

The introduction contains much interesting matter; for example, the endeavour to make a hole in the middle of the original 36½-inch mirror, which resulted in the mirror flying to pieces under internal strains. Fortunately, a better mirror was obtained from the St. Gobain Co.

Research Items

THE INTER-SEX PIG IN MELANESIA.—In *Man* for July, Mr. J. H. Baker describes customs in which the inter-sex pig plays a part in the New Hebrides. Inter-sex mammals are particularly abundant in this area. Among them the pig exhibits a complete range of variation in the external parts from the female anatomy to a fairly complete approach to the male. Internally, only male organs occur. The inter-sex has an important social significance. They are highly valued, being worth half as much again as the male. Their chief use lies in their function in the pig-killing feasts, by which a man rises in the five ranks of precedence. A certain number of male and inter-sex pigs must be killed at each step. As the native does not breed pigs systematically and on a large scale, it is necessary that he should borrow on these occasions. But anyone who is unpopular will not be able to obtain a loan. One method of obtaining pigs is by extorting payments of pigs to avert ill caused by the magic powers of the extortioner. He may threaten the owner with injury to health, or even with death. It comes about, then, that only popular men or those feared for their magic powers are able to obtain the pigs necessary to rise in rank. The promotion takes place at a ceremony which includes a night-long dance. The pigs are killed at this ceremony, but not eaten. Indeed, the inter-sex is never eaten except by women and children. Loans of pigs, which are the standard currency, involve a complicated system of interest, as a loan has to be repaid with a pig of the size which the loan pig would have attained in the interval had it been allowed to live.

OSIRIS AND THE TREE AND PILLAR-CULT.—In *Ancient Egypt* for June, Sir Flinders Petrie discusses the relation of the Osiris legend and the pillar cult—a question bearing upon the suggested connexion between Egyptian civilisation and the Caucasus. The legend that a tamarisk tree grew round and enclosed the body of Osiris and was afterwards cut down by the king and used as the pillar of his house, finds a parallel in two Georgian folk-stories previously recorded in *Ancient Egypt*. Georgia is thus linked with the Osiris legend both by ancient geography and modern folk-lore. The actual remains consolidate the legend and give it a real basis. The Osiris worshipper must have been as early as the Badarians, for corn was grown and ground by them. As there are no figures of an earlier race except the steatopygous, that was probably the race reclaimed by Osiris from cannibalism, and the practice must have been known to the Badarians from the allusions to it in the Book of the Dead, which refers familiarly to the kingdom of Osiris. The Badarian type of skull being near the Dravidian and early Hindu, there is a presumption that both races originated from some common centre probably in Asia. Putting legends and remains together, the position is that a people living in Georgia possessing agriculture and some civilised arts moved into India and Egypt through Syria, bringing with them myths of the home-land and connected with the principal places between the Black Sea and the Caspian, and possessing a civilisation which decayed in Egypt but upheld the ideals of Osiris and Isis. The worship passed through Syria, Byblos becoming its centre. In Canaan the typical worship was connected with the grove sacred to the goddess and the pillar of wood or stone. The tree (*asherah*) is best explained by the continuance of the worship in which holy trees are thought to be the habitation of a spirit or saint. It may have influenced Christianity and explain the saying of Jesus :

> "Raise the stone and there shalt thou find me,
> Cleave the wood and there am I."

PRESSURE AND PHYSICAL AND MENTAL EFFICIENCY.—Report No. 37 of the Aeronautical Research Institute, Tokyo Imperial University, records an experimental study of the effects of low barometric pressures and oxygen deprivation upon the efficiency of mental and physical work. The research has been very carefully conducted, and control experiments carried out and reported in full. The results seem to show that both physical and mental efficiency are decreased as a consequence of the lowering of the barometric pressure, but from the first group of experiments one cannot determine whether this is due to the decrease of pressure or to the lack of oxygen coincident with the decrease of that pressure. Some further experiments on admittedly too few subjects do seem to indicate that the decrease in efficiency is due to the lack of oxygen rather than to the low pressure in itself.

A NEW LETHAL FACTOR IN CATTLE.—A striking case of a recessive lethal factor in Swedish Holstein-Friesian cattle has been described by Mohr and Wriedt (*Jour. of Genetics*, vol. 19, No. 3). Matings of heterozygous bulls to their daughters produce one hairless calf in seven (98 : 12 or 14) according to expectation. The calves have a pink colour owing to the blood-vessels, and the skin is in an embryonic condition except a few areas on the muzzle, eyelids, ears, and legs, which produce hairs. Their teeth and hoofs are normal, but they die a few minutes after birth. The condition was at first supposed to be due to foot-and-mouth disease, but has since been clearly traced to inheritance from one or more heterozygous bulls of high phenotypic quality, who spread it in the herds as a recessive character. Hairlessness is known to occur in man, dogs, horses, rats, mice, goats, and other animals, but is not usually accompanied by lethal defects. Five lethal factors are now known in cattle, and three, or probably four of them, occur in the Holstein-Friesian. This suggests the necessity for using breeding tests to determine whether lethal recessive factors are present in the animals to be used for breeding purposes.

NATURAL HISTORY OF ANGOLA AND RHODESIA.—Fascicule 3 of volume 4 of the Report of the Mission of M. de Rohan-Chabot to Angola and Rhodesia in 1912–1914 (Paris : Paul Geuthner, 1925, 150 francs) has recently come to hand. The expedition was inaugurated under the auspices of the French Ministry of Public Instruction and of the Geographical Society of Paris, and most of its explorations were carried out in Angola, a region rarely visited by French naturalists. The greater part of this finely illustrated publication is occupied by reports by various specialists on the Coleoptera, an order of insects which is shown to exhibit a markedly endemic character in the region concerned. Other reports deal with the Hymenoptera, Arachnida, and non-marine Mollusca and the ferns. In most cases the collections reported upon are relatively small, but they provide a welcome addition to our knowledge of a little-explored region.

INDO-AUSTRALIAN WASPS.—The supplement to vol. 9 of *Treubia* (January 1928) is devoted to a comprehensive monograph of the Scoliid wasps of the Indo-Australian region by Dr. J. G. Betrem, of the Landwirtschaftlichen Hochschule at Wageningen, Holland. This monograph, which occupies nearly four hundred pages, is prefaced by an admirably illustrated account of the general anatomy of these insects and a short dissertation upon their biology. Most of the remainder of the work is devoted to

descriptions of the various species and, in drawing up these, the author has had access to material from many of the great museums of Europe and the Orient. In the concluding chapter there is a general discussion of problems suggested by the geographical distribution of these wasps in the region under consideration. The work is of importance to all entomologists interested in Aculeate Hymenoptera.

IS THE MALARIA PARASITE INTRACELLULAR ?—It is usually stated that the malaria parasites live intracellularly in the red blood corpuscle, but after a series of investigations extending from 1911 to 1920, Dr. Mary R. Lawson concluded (1920) that "all malarial parasites are extracellular, that is, they are attached to the external surface of the infected corpuscle and each parasite destroys several red corpuscles," and this view has been supported by at least two subsequent workers. Herbert L. Ratcliffe (*Amer. Jour. Trop. Med.*, 7; 1927) has carried out investigations on blood taken directly from canaries infected with *Plasmodium præcox* and from man infected with tertian malaria (*P. vivax*), fixed in Bouin's or in Zenker's fluid, dehydrated, embedded and cut into thin serial sections (1½–2μ thick). In no case was he able to find a parasite extracellular or even deeply embedded in the surface membrane; they are intracellular.

PLANKTON MOVEMENTS.—The *M.B.A. Journal*, N.S., 15, 2, contains an account by F. S. Russell of the vertical distribution of *Calanus* by day from April to September of 1926. There is a diurnal descent from April to June and ascent from July to September. Measurements of the specimens revealed two broods of different sizes, the 'small' brood being dominant from July to September and apparently reacting differently from the 'large' brood, which had tended to avoid the increasing light in the spring.

CONDITIONED RESPONSES IN FISH.—Many of Pavlov's observations on the behaviour of dogs under experiment have been found by H. O. Bull to be reflected in fish (*M.B.A. Journal*, N.S., 15, 2). By association with food he trained *Blennius* to detect a momentary increase of 0·4° C. in the temperature of the surrounding water (and/or the induced convection currents), and a momentary decrease of so little as three parts of salinity per 1000. His wrasses learned to discriminate between different coloured lights or between one or two sources of light, but not readily between differences in intensity of one light. Other experiments using slight electric shocks revealed some colour discrimination in blennies and sensitiveness to a vibratory stimulus in *Crenilabrus* and *Anguilla*. The paper is valuable and important.

MINUTE AMERICAN LAND SNAILS.—Mr. H. Burrington Baker has of late devoted his attention to the anatomy of minute American land snails. His paper on some Mexican forms previously confused with the genus *Thysanophora* (*Proc. Acad. Nat. Sci. Philad.*, vol. 79), has now been followed by one on minute American Zonitidæ (*ibid.*, vol. 80). The author gives a standardised nomenclature as adopted by him for the parts of the genitalia, which if it does not commend itself to other anatomists at least enables those who consult his work to follow his descriptions with understanding. A series of more or less well-known genera and species are dealt with anatomically, some for the first time, and though no new species is put forward, the familiar *Helix minuscula*, Binney, is now made the type of a new genus *Pseudovitrea*.

ORTHOPTERA OF POLAR SIBERIA.—The Yakutsk Commission of the Russian Academy of Sciences has published an interesting list of Orthoptera of the Yakutsk republic by Miss E. F. Miram (*Matériaux de la Commission pour l'étude de la République Iakoute*, part 24; Leningrad, 1928). Materials for the list have been collected by several expeditions of the Academy, and the list includes as many as 35 species, which is a high figure considering that Orthoptera are a group closely connected with warm and dry conditions of existence. Out of these, two species proved to be new to science (*Podismopsis jacuta* Mir. and *Prumna polaris* Mir.). The last named of the two new species is distributed northwards up to the Polar circle, together with *Podisma frigida* Boh. and three species of *Acrydium* (*Tetrix*); there are also four species of *Acrididæ* (*Podismopsia poppiusi* Mir., *Gomphocerus variegatus* F.W., *Podisma koeppeni* Zub., and *Acrydium fuliginosum* Zett.), which extend their area well beyond the Polar circle.

TREE GROWTH AND CLIMATIC CYCLES.—An article recently published as a *News Bulletin* by the Carnegie Institution of Washington, D.C., describes the remarkable correlation existing between annual ring formation in trees and climatic cycles. The work is mainly due to many years of patient effort on the part of Prof. H. E. Douglass, of the University of Arizona, who examined large numbers of yellow pines from the arid region of northern part of the State. The variation in the annual rings of individual trees over considerable areas exhibited such uniformity that the same rings could be identified in nearly every tree, and the dates of their formation established with practical certainty. In dry climates he found that ring thicknesses are proportional to rainfall, with an accuracy determined for recent years of seventy per cent. As this accuracy presumably extends over centuries, the tree records can be expected to give indications of climatic cycles and of past climatic conditions. As the result of more recent investigations of tree groups in Western United States and Europe, Douglass has found many interesting correlations in the tree records of widely separated localities which may throw some light on the world climate of the past. Following similar lines of investigation, Dr. Huntington of Yale and his assistants have measured the rings in the stumps of 451 *Sequoia* trees, the dates of cutting of which were known. Some of the trees were only a few hundred years old when cut, nearly a hundred were close to two thousand years of age, three had lived to more than three thousand years, while the oldest registered 3210 rings. From the measurements obtained, Huntington has been able to construct a climatic curve "fairly reliable," he believes, back to a date before the beginning of the Christian era, and "moderately reliable" running back several hundred years further. Dr. Antevs, a Swedish worker, has now made a re-examination of Huntington's *Sequoia* material which relates to the period from 1000 B.C. to the present time, and although his methods in constructing a climatic curve were entirely different, the curves of climatic fluctuations correspond in striking degree with Huntingdon's results.

COTTON BREEDING IN NIGERIA.—The Empire Cotton Growing Corporation has just published a short report on the work in cotton breeding and seed supply carried on at its farm at Daudawa in Northern Nigeria (London, 1928; price 2*s*.). Broadly, there are three cotton belts in Nigeria—southern, middle, and northern, widely different in climate, agricultural practice, and political development. The southern belt grows a number of native cottons, which at best do not rise above the standard of American 'middling.' Local weaving absorbs most of the output. Southern farmers would readily grow for export

if provided with a cotton suited to their agricultural conditions and able to command a fair premium over their present varieties. From one distinctive native variety the Agricultural Department has produced by selection a strain of cotton which promises to succeed as an export cotton over considerable areas of the southern belt. The middle belt is least developed of all, but systematic investigations have been commenced on the lines which have brought success in the south. In the northern belt the American cotton 'Allen' has steadily spread in cultivation since 1912, thus creating an expanding export trade. Full export exploitation of the northern belt may demand, however, for certain areas some other variety, and investigations into the possibility of producing an improved strain of 'Allen' are already being pressed forward. In the northern belt, the question of seed supply is of some complexity. Careful study of all the facts suggests that a comprehensive organisation for seed supply is necessary. This report sets out in detail the scope and form of an appropriate machinery. It is concluded that the Corporation farm at Daudawa should endeavour without delay to produce annually 1000 acres of cotton for seed supply. The necessary expansion might be along a number of different lines, and involves intricate questions of labour and administration. Future development of the Nigerian cotton industry hinges largely on plant breeding, and for that reason the latter half of this report is devoted to a review of current problems and investigations in cotton breeding.

TOPOGRAPHIC MAPPING.—"Topographic Instructions of the United States Geological Survey, Topographic Mapping," is the title of a useful small volume that has been published as *Bulletin* 778 E of the United States Geological Survey. The book gives full instructions for field and office work, including a description with plates of all the symbols used. The work is naturally intended for officers of the United States Survey, but the instructions given should prove useful in any part of the world. The matter with regard to office work is particularly interesting, since it is not usually published in so great detail in volumes on map-making.

PHYSICS AND CHEMISTRY OF THE SANDY BEACH.—In two recent papers, Mr. J. Ronald Bruce makes some interesting contributions to the little that is already known about the biologically important physical and chemical factors of the sandy beach. The papers embody work done at Port Erin, and in the first of them ("Physical Factors on the Sandy Beach." Part 1. Tidal, Climatic, and Edaphic. *Jour. Marine Biol. Assoc.*, vol. 15, No. 2) several important points are discussed. Figures are given to illustrate the sudden change in the temperature and salinity of the shore as the rising tide washes over it. Samples of sand from different stations on Port Erin beach were separated by sieving into various grades, and the rate of evaporation, the water content at saturation, and the rate of capillary rise were determined for each grade, as well as for natural ungraded samples. It was found that while the natural ungraded sand had a much lower water content per 100 volumes of wet sand than any of the graded samples, the rate of capillary rise through it was much more rapid than through the graded samples. Grade has apparently little influence on the rate of evaporation from the surface of wet sand. The second paper ("Physical Factors on the Sandy Beach." Part 2. Chemical Changes—Carbon Dioxide Concentration and Sulphides. *Ibid.*), apart from a consideration of the rôle of calcareous matter in the sand as an alkali reserve, is devoted largely to an investigation into the constitution of the 'black-layer' which is reached at a varying depth below the surface. In this connexion an iodometric method for the determination of sulphides in sand is described, and the formation of the ferrous sulphide, to which the black colour is due, is discussed. It appears that the formation of the ferrous sulphide is associated with lack of oxygen and with bacterial action, but the precise nature of the reaction is not yet understood. The presence of organic debris seems to be essential to the reaction. Finally, a diagram is given to indicate the probable cycle of reactions through which sulphur passes on the sandy beach.

THOMAS RECORDING CALORIMETER.—The Gas Regulation Act of 1920 made provision for the continuous recording of the heating value of town's gas when satisfactory calorimeters became available. Since then much effort has been devoted to the design of suitable recording apparatus. Seeing that penalties are dependent on deficiencies in the calorific value of gas supplied, the need for vigorous sifting of the claims advanced by inventors is evident. A report has been issued (*Fuel Research Technical Paper*, No. 20. London: H.M.S.O. 9*d.* net) on the "Thomas Recording Calorimeter" introduced by the Cutler-Hammer Co., New York, and made in England by the Cambridge Instrument Co. One great difficulty of the problem is the fact that the instrument must follow and record the changes of the quality of the gas, and at the same time allow for changes of its temperature and pressure. The method adopted in this instrument is to employ air in excess as the calorimetric medium for absorbing the heat developed in the combustion of the gas. As the air/gas ratio by volume is kept constant, the temperature rise of the products of combustion should depend on the calorific value only of the gas, and this temperature rise is recorded by resistance thermometers. On gas of a steady calorific value the recorder agreed with a Boys' calorimeter to within 1 B.T.U. per cub. ft. When fluctuations occurred there was a time lag which was particularly in evidence when the fluctuations were of short duration. The recorder tended to smooth out the peaks and valleys, so that the mean value of the record was approximately correct. The calorimeter has since received official approval of the Gas Referees.

THE DISINTEGRATION OF CARBON.—*Mitteilung* No. 213, from the Vienna Radium Institute, contains an account of new work done by H. Pettersson on the supposed disintegration of carbon nuclei by α-particles made possible by the development of a technique for preparing relatively large quantities of polonium, equivalent now in α-ray activity to as much as 7 mgm. of radium. A sheet of graphite was bombarded with the α-rays from one of these sources, and the secondary rays emitted from it at an angle of about 150° with the incident beam, which were presumably mainly H-particles, were examined by the method of scintillations. Their number fell off rapidly when the air range of the α-particles was cut down by absorbing screens from 3 cm. to 2 cm., showing directly that the slower α-particles do not eject any considerable number of protons of air range less than 5 mm., and implying that an α-particle cannot effect a disruption unless its velocity exceeds some minimum value, which is more than is required in the case of alumimium, according to work by E. A. W. Schmidt in the same laboratory. As is well known, the Austrian results are not universally accepted, but detailed reports of this nature must ultimately decide between their claims and those of the Cambridge and Berlin schools.

The Seventh International Congress of Photography.

THE seventh International Congress of Photography was held in London on July 9–14, a period of three years having elapsed since the last Congress was held in Paris, in June 1925. The Royal Photographic Society, which is the premier photographic society of the world, made itself responsible for all the arrangements, and about twelve months ago it started the work of preparation, an organising committee being appointed which comprised representatives not only of photographic societies and associations, but also of the various scientific societies of Great Britain. The chairman of this committee was Sir William Pope, and the secretary, Dr. W. Clark.

As in the case of previous congresses, the seventh consisted of three sections, dealing respectively with: (1) Scientific and Technical Questions, (2) Pictorial Photography, (3) Bibliography, Record Photography, History, etc. Section (1) was divided into four subsections, dealing respectively with (*a*) Theoretical Aspects of Photography, (*b*) Photographic Practice, (*c*) Scientific Applications of Photography, and (*d*) Industrial and other Special Applications of Photography. The mere names of the sections and subsections indicate the wide scope of the subjects under consideration, although it hides such important applications as kinematography, colour photography, and photo-engraving processes, which were included under 1 (*d*). Special committees were in charge of each section and sub-section, and well-known workers in the different subjects in various parts of the world were invited to send in communications. As a result, some seventy papers were received from workers in England, the United States, Germany, France, Italy, and Switzerland, so that copious material was received for discussion at the various sectional meetings.

The meetings were held at the Imperial College of Science and Technology, South Kensington, and the Congress was opened on the morning of July 9 by Sir William Pope, who had been elected president. A large and representative gathering of workers associated with the science of photography, including delegates from the United States, France, Germany, Belgium, Italy, Switzerland, and Russia, was present, and the president was supported on the platform by M. L. P. Clerc (France), Prof. R. Luther (Germany), M. Callier (Belgium), Dr. C. E. K. Mees (America), and Mr. F. F. Renwick and Dr. T. Slater Price (Royal Photographic Society). The president, after welcoming the delegates from overseas, referred to the progress achieved since the days of the first international congress, held in Paris in 1889, and to the services rendered by photography in everyday life, as, for example, in the daily and illustrated Press. More particularly he emphasised the increasing importance of photography in its scientific applications. Whole branches of modern science are founded on photographic methods and depend for their existence on photographic aid: examples may be given in the methods of X-ray crystal analysis introduced by Sir William Bragg, and the spectroscopic study of the aurora borealis. Again, photography is an indispensable instrument in working out the conclusions of modern physics. In another direction kinematography is a popular triumph of photography, with the promise of coming new developments in talking films and films in natural colour. The president finally referred to the fact that modern photography depends mainly on the sensitiveness of silver salts, and suggested that investigation of other substances, which are known to be light-sensitive, might reveal other possibilities of practical application to photographic use.

The president then declared the Congress open, and invited the members, before the sessions of the various sections opened in the afternoon, to visit a new feature of these international congresses, namely, an exhibition of examples of nature photography, photographic survey and record work, photo-micrography and colour photography in the shape of both transparencies and prints, scientific photographs and apparatus, etc. There was also a collection of examples from British and American workers of commercial and advertising photography; in addition, many trade firms, British, American, and German, had exhibits.

Following the usual custom, the various sectional meetings, at which the proceedings were conducted in either English, French, or German, were presided over in turn by delegates chosen from the various countries represented. As can be seen from the list published in NATURE of June 23, p. 1007, the papers even in each section extended over a wide range of subjects. In many cases they gave rise to lively discussions, but their full value will only be appreciated after they, together with the discussions, have been collected together and printed in the *Proceedings* of the Congress. It may be said, however, that the riddle of photographic sensitivity and of the latent image still seems to be very far from solution. It was hoped that one of the chief objects of the Congress would be achieved, namely, the standardisation of sensitometric measurements. At the Paris Congress various recommendations of the English committee were accepted (see NATURE, **116**, 224; 1925), but were only to come into force after a period of six months if they were not objected to by any national committee. Objections were raised, however, by the committee of the Optical Society of America, more particularly with respect to the standard light source to be used, with the result that international agreement was still wanting. At the present Congress the American Committee put forward definite proposals with respect to the standard of photographic light intensity. These gave rise to a lively and animated discussion, but since they had been sent in too late for them to receive due consideration from the other national committees, it was not possible to come to a definite decision at once. The following resolution was, however, passed. It is given here because of its importance to all users of the photographic plate in scientific investigations, and it is hoped that any reader interested will send criticisms to the secretary of the National Committee on Standardisation, Dr. Slater Price.

"This meeting of the 7th International Congress recommends to the National Committees that the photographic unit of intensity for the sensitometry of negative materials shall be defined as the intensity of a source of radiation having a luminous intensity of one international candle, and produced by a grey body at a colour temperature of 2360° K., together with a selectively absorbing filter made up as follows: Two solutions compounded according to the following formula, the complete filter to consist of a one-cm.[1] layer of each solution contained in a double cell made by using three plates of borosilicate crown glass (refractive index, D line = 1·51), 2·5 mm. thick.

SOLUTION A.

Copper sulphate ($CuSO_4$, $5H_2O$)	3·707 grm.[2]
Mannite $C_6H_8(OH)_6$	3·707 grm.[2]
Pyridine (C_5H_5N)	30·0 c.c.
Water (distilled) to make	1000 c.c.

[1] Tolerance in thickness shall be ±0·05 mm.

[2] For practical purposes an accuracy to the second place of decimals is probably sufficient.

SOLUTION B.

Cobalt ammonium sulphate ($CoSO_4$, $(NH_4)_2SO_4$, $6H_2O$)	26·827	grm.[2]
Copper sulphate ($CuSO_4$, $5H_2O$)	27·180	grm.[2]
Sulphuric acid (Sp. gr. 1·835) .	10·0	c.c.
Water (distilled) to make	1000	c.c.

It is recommended that the foregoing resolution shall come into force as a decision of this 7th International Congress if and when ratified by the National Committees represented at this Congress."

Bearing on sensitometric questions were several papers from the Eastman Kodak laboratories relating to the expression of plate speeds, the relation between time and intensity in photographic exposure, developers for sensitometric standards, a suggested systematic nomenclature for photographic sensitometry, etc., on which no definite decisions could be made, and which will form a valuable nucleus for discussion at the next congress.

The German delegates (Profs. Luther, Lottermoser, Eggert, Weigert, and Dr. Lüppo-Cramer) concerned themselves chiefly with papers touching some aspect of the riddle of photographic sensitivity, as also did the English delegates. Dr. Hamer gave an admirable summary of our present knowledge of desensitisers, and emphasised the caution with which reports on these substances should be received. Dr. Toy summarised his work on the mechanism of latent image formation (see NATURE, **120**, 441; 1927: **121**, 815; 1928) and also gave a valuable report on "Turbidity," which he had drawn up in conjunction with Messrs. Davies, Crawford, and Farrow, and which should also be of use in other industries besides the photographic industry.

The present writer is not fully acquainted with the work which was accomplished in other sections of the Congress, since he was mainly concerned with Section 1 (*a*). These sections were occupied more particularly with the applications of photography, and dealt, to a great extent, with a review of current practice and recent developments. The kinematographic group was occupied largely in the question of standardisation, and was able to put forward definite recommendations which should contribute in particular to the spread of motion-picture work among others than makers of drama films.

In addition to the various meetings of the sections there were three special lectures which members of the Congress were invited to attend. These were: "Pictorial Photography: the Relation of Technical Advance to Further Artistic Achievement," by F. C. Tilney; The Hurter and Driffield Memorial Lecture, by Dr. S. E. Sheppard, who took the latent image as his subject; and "Physics in Photography," by Dr. C. E. K. Mees. The first two were held at the Royal Photographic Society, and the last, at the invitation of, and in co-operation with, the Institute of Physics, at the Institution of Electrical Engineers. There were also motor-coach excursions to places of interest, visits to such places as the Elstree Studios, Amalgamated Press, Northcliffe House, etc. Of course there was the usual banquet, which was held on the Wednesday evening, July 11, with the president in the chair.

Especial mention should be made of the collection of British pictorial photographs and photographs of pictorial and historical interest, which was exhibited at the Royal Photographic Society, and of historical photographic apparatus exhibited at the Science Museum, South Kensington. Apart from members of the Royal Photographic Society, most people in Britain are unaware of the valuable historic collections, both of photographs and apparatus, which are to be found in the rooms of the Royal Photographic Society.

The final meeting of the Congress was held on Saturday morning, July 14. Sir William Pope was unanimously elected the president of the Permanent Committee of International Congresses of Photography, while Dr. Clark, according to precedent, was elected general secretary of the Permanent Committee. An invitation was received from the German delegates to hold the next Congress in Dresden in 1931; this was unanimously accepted. The opinion expressed by the foreign delegates was that the Congress was the most successful which had ever been held and that a standard had been set which it would be difficult to maintain. One very noticeable feature of the Congress was the cordiality prevailing between the delegates of the various nationalities present. Although agreement could not be reached upon all questions of standardisation, much was gained in social intercourse and private discussions, all of which will have its effect in future congresses.

The Great Perseid Meteor Shower.

THIS shower comes this year under rather favourable conditions, the moon being a mere crescent and not capable of interference with the display. In 1921, on Aug. 12, there was a brilliant exhibition of the meteors at about 2.30 A.M. This corresponds to Aug. 11, 1928, 9 P.M. There should be many meteors, therefore, in the evening, though the fact that the radiant is low will operate against a plentiful shower.

It will be important to notice the horary rate of appearance of the meteors, so that the time of maximum and its strength may be ascertained. The apparent paths of all the brighter meteors should be recorded accurately for the purpose of affording data for the computation of their real paths in the air. Those of the meteors which are directed in their flights from other systems than the Perseids should be specially registered, for more investigation of the secondary showers of this period is needed.

There are already many Perseid observations, and the drifting radiant has also been fully discussed. Its duration seems to extend from June 25 to Sept. 5, and the motion of its radiant is directed from 356° + 39° to 92° + 62° during the 72 days.

This shower is one of the oldest recorded in historic annals, for its initial mention is dated A.D. 714. Yet more than 1000 years elapsed before the month was specially recognised as a notable one for its meteors. The early returns of the display occurred in July, but the effects of precession have carried it forward until at the present time its chief exhibition comes on Aug. 11.

The parent comet, 1862 III, discovered independently by Tuttle and Swift in America, is a periodical one with a time of revolution about 120 years. The period of the meteors is doubtful, but there are indications of 105 years, answering to some of the best of the ancient and modern displays. I investigated the records, and found a shorter period advisable, namely, 11·72 years, which shows a singular agreement with many of the brighter and more abundant returns. The last fine shower occurred in 1921, so that if the latter period is admissible there should occur good showers in 1933, 1945, 1956, etc. This system apparently forms a complete ring, but the meteors are evidently more thickly condensed at some points of the orbit than at others.

W. F. DENNING.

University and Educational Intelligence.

APPLICATIONS are invited by the Huddersfield Education Committee for the following research scholarships at the Technical College, Huddersfield: The Drapers' Company's Research Scholarship in Dyeing, value £100 a year with remission of fees; The Joseph Blamires Research Scholarship for Research in Colour Chemistry, value £100 a year with remission of fees; and The British Dyes Research Scholarship for Research in Colour Chemistry, value £75 a year with remission of fees. Further particulars and forms of application may be obtained on application to the Technical College, Huddersfield.

DR. RONALD H. PURCELL, who was recently elected by the Trustees to a Beit Fellowship for scientific research, having declined the award owing to his acceptance of a Ramsay Memorial Fellowship, the Beit Trustees have awarded the vacant fellowship to Mr. E. C. S. Megaw, of Belfast, for research in the Electrical Engineering Department of the Imperial College of Science and Technology under Prof. Fortescue on "Properties and behaviour of the thermionic valve, particularly as a generator of radio frequency alternating current, with the object of effecting improvements in the design of the valve and its associated circuits and of increasing the existing knowledge of their functioning." Mr. Megaw was educated at Queen's University and Municipal College of Technology, Belfast.

THE report of the work of the Department of Petroleum Technology of the Sir John Cass Technical Institute for the session 1927–28 has been published, and shows every evidence of continued progress at this school. The laying down of a well-equipped petroleum laboratory, referred to in the previous report, has been fully justified by the considerable increase in the number of students attending the practical class in examination of petroleum and its products, to the extent of duplicating the normal course in this subject. The courses of lectures given include general oil technology, introduction to the chemical and physical properties of petroleum, properties and examination of petroleum, and applications of engineering and mechanical drawing. In the latter connexion the comment is rightly made that a general knowledge of the generation and transmission of power, such as is provided by this course, is essential to those clerical branches of the industry the work of which deals, *inter alia*, with engineering supplies, and it is to be hoped that this course will be more widely attended by petroleum technology students in future. Nowadays most of the larger concerns in the oil industry demand some relevant technical knowledge from their clerical staffs; advancement and promotion, in fact, are probably based more on this qualification and its practical value than on any degree of mere clerical efficiency. There is clearly no excuse for anyone, at least in London, who does not seek to equip himself with this additional knowledge. A further encouraging feature of the session's work is the initiation of research in special problems by the more advanced students; this is a particularly healthy sign, and it is to be hoped that this development will expand greatly in future.

A SURVEY of higher education in the United States during the years 1924–26, published as *Bulletin No. 34*, 1927, of the United States Bureau of Education, deals at length with the causes that have combined to provoke re-examination and re-statement of the fundamental objectives of higher education in that country. Under the pressure of unprecedented increase of student enrolments, rising costs, and political action, many institutions have been constrained to restrict within limits much more precisely defined than formerly the scope and character of their objectives. Others, and notably Catholic Church colleges for both men and women, which are being enlarged and multiplied throughout the States, attempt to meet the situation by extraordinary energy in providing increased opportunities for their increasing numbers. The survey gives prominence also to the growth of systematic and scientific study of methods and procedures. This is exemplified in the emergence of the new profession of educational adviser to the president of a university and the setting up of research bureaux in the larger universities. More and more are specific educational problems submitted to carefully planned co-operative investigation. In order to avoid waste of effort owing to the lack of a central clearing agency for such work, it is desirable, says the report, that frequent periodic reports of studies completed or under way should be embodied in a publication. It is interesting to compare with this part of the survey the remarks made by Sir Michael Sadler on Dec. 29 last in his presidential address to the Conference of Educational Associations on the neglect of scientific research in education in England, and the lack of scientific record and observation of the many educational experiments now going forward.

ADULT education in Yorkshire is reviewed in a report recently issued as *Educational Pamphlet No. 59* (pp. 54, price 1*s.*) by the Board of Education. The non-vocational adult classes of Yorkshire comprise more than 10,000 students—about one-fifth of the total number in England and Wales. They include: university tutorial classes (1500 students), W.E.A. one-year and terminal classes (3600), similar classes organised by the local education authorities (5000) and other bodies (200), and 25 university extension courses. Of the various subjects studied, literature has in recent years become the most popular. Other favourite subjects are economics and industrial history, music, ambulance and first aid, home nursing and hygiene, and psychology. Classes in natural science are not so numerous, but have been successfully conducted, several being in their third or fourth year. In 1926–27 there were 10 classes in biology, 2 in geology, and 2 in general science. Laboratory accommodation is provided at Leeds and Sheffield by the universities, and elsewhere by secondary schools, local resources being supplemented by the microscopes, slides, and material conveyed by the lecturer to the various centres. It is clear, says the report, that the 173 classes, comprising 5000 students, provided directly by the local education authorities, are reaching a body of people whose requirements are not met in any other way—notably people for whom book-learning has no attractions. Half of these students are manual workers, more than a quarter are women whose main occupation is household duties, and most of the remainder are engaged in clerical occupations or teaching. The subjects studied by them are chiefly ambulance and first aid, etc. (47 classes), music (34), home-nursing and hygiene (28), handicrafts (21), literature (13), and dressmaking. The report is not merely statistical, but includes a critical survey of the adult education movement and estimates the value of its achievements and prospects.

Calendar of Customs and Festivals.

August 15.

THE ASSUMPTION OF THE BLESSED VIRGIN MARY.—"The greatest of the festivals the Romish Church celebrates in her honour"; but it is to be noted that though the ritual is ecclesiastical in the main, the festival is essentially popular in character. At Marseilles, for example, a festival was held on the highest of the mountains outside the town where there once stood the chapel of "Notre Dame des Anges," destroyed in the revolution. Here the peasants from all the country round assembled in their best clothes and spent the day in sport. One of the most celebrated and elaborate of these festivals was held at Messina. It was known by the name of "bara," from an erection of about fifty feet in height which was carried in procession. This erection represented Heaven, and was divided into several stages. On these children represented the Virgin and Child, cherubim and seraphim, and the apostles, while four children were attached to the principal radiating arms of a revolving sun.

At Dieppe a Guild of the Assumption was founded in 1443 in memory of the defeat of the English. For the feast a girl of exemplary character was chosen to represent the Virgin, and six others, her handmaids, represented the "Daughters of Zion." A St. Peter, specially associated with the Virgin, was chosen from the clergy, while the laity furnished the remaining eleven apostles. On the day preceding the feast, the Virgin was laid in a cradle resembling a tomb and carried to the Church of St. Jacques. On the morning of the 15th, a procession, including the dignitaries of the town and youths of both sexes, dressed to represent their patron saints, escorted the Virgin with her attendant handmaids and apostles from the church of St. Jacques to the church of St. Remi, where a *Te Deum* commemorated the defeat of the English. During the service a representation of the Assumption took place on a scaffold reaching nearly to the dome of the church. On this, God and a number of angels appeared. An essential part of the representation was a buffoon who came out at the moment a pasteboard figure of the Virgin, which had been substituted for the girl personating her, after being elevated to the upper stages of 'Heaven,' disappeared behind the clouds and the angels extinguished their tapers. The buffoon, after various capers, in the course of which he simulated death, took refuge beneath the legs of God, where his head alone showed.

In Italy in ancient times, on Aug. 13, a Feast of Diana was celebrated by the husbandmen to secure the fertility of their crops—as the peasants nowadays invoke the Virgin at the Assumption to give prosperity to their vines—and the shrine of Diana in the Grove of Nemi was visited by a multitude of pilgrims who invoked her as the goddess of fertility. At Nemi, Diana was associated with a priest-king, and it is at least a coincidence that in the Christian observance the Virgin should also be associated with a male figure—at Dieppe St. Peter, who is specially set apart from the other eleven apostles, and later with the buffoon, who in his antics and his simulation of death recalls the pantomimic fertility figures of pagan and popular observance. It is generally agreed that these elaborate Assumption festivals of Roman Catholic countries mark the adoption of the fertility festival of a pagan goddess represented at Nemi by Diana. The late date of the institution of the Assumption—it is said to be of the seventh century—and its association with a fifteenth-century foundation in France, point to a popular festival of long standing and deep rooted, which the Church had finally to recognise and accept.

The Assumption of the Virgin and the Dianic festival appear to belong more particularly to the southern area of Europe. In Britain the Assumption is also associated with fertility, but in connexion with first-fruits. It was customary in some localities for all fruits, vegetables, and herbs to be taken to the church on this day and consecrated against evil. Thereafter charms could be wrought by their means, and if thrown in the fire they effectively drove away witches and other evil things.

On Aug. 15 the Minstrels' Feast took place at Tutbury, in Staffordshire, when Needwood Forest had to supply two bucks, one for the feast held at the Castle, and one for the prior of the Abbey. A buck's head was carried in procession decked with bacon and pease, each one taking a part in the procession carrying a green bough. At the church a mass was said, and each minstrel offered a penny. On the following day a court was held, at which a king of the minstrels of Derbyshire and Staffordshire for the following year was elected. All undertook to abide by his rule. After a dinner the prior of the Abbey gave a bull, which was let loose when the tip of his horns, his ears, and tail had been cut off, his body smeared with soap, and his nostrils filled with pepper. If any minstrel could cut a piece from his hide before he crossed the Dove he belonged to the king of the minstrels; if not, he was returned to the prior. In the former case he was baited three times with dogs.

August 16.

ST. ROCHE OR ST. ROCK.—Smitten with pestilence while on a pilgrimage to Rome, he was cured by the intervention of an angel and became the patron of all afflicted with the plague. His festival was kept in England as a wake or harvest home, dances taking place in the churchyard in the evening.

August 18.

ST. HELENA.—It has been suggested that, as in the cult of St. Helena, Empress of Constantinople, her festival falls on this day, it is therefore to be associated with an older cult, that of the Twin Brethren, Castor and Pollux, the one divine, the other human. This might well arise from a confusion with Helen, their sister. The Byzantine calendar, as well as others, records the festivals of twin saints on this day, namely, Florus and Lorus. The Russian peasants regard these saints as the patrons of horses, while in the Greek Church they are twin brethren who were stone masons. In the Syrian Church they are also twins. The Dioscuri, Castor and Pollux, were patrons of horses and of building, as well as connected with the sea; but, in addition, their cult was closely related to that of the sky-god, as their name Dioscuri indicates. It has therefore been suggested that their cult survives in the cult of some of the twin or coupled saints, of whom there are several examples in the Christian calendar. For example, Cosmas and Damian, patrons of sailors, and also popularly invoked as healers; Protasius and Servasius, the Tergemini at Langres, Nearchus and Polyeuctes, as well as St. Thomas, especially in connexion with his activities in India, and his relation to Christ. There are Indian and Persian parallels, such as, for instance, the Vedic Açvinau, the horsemen of the sun, while beliefs relating to twins among primitive peoples also point in the direction of a belief in the supernatural origin of at least one member of the pair, and of a sky and fertility cult. (*See* J. Rendel Harris, "Boanerges," Cambridge, 1913.)

Societies and Academies.

PARIS.

Academy of Sciences, June 11.—The President announced the death of Luigi Bianchi, Correspondant in the section of Geometry.—**Mandelbrojt**: Remarks on the theorem of composition of normal families of functions.—**E. Cartan**: Complete orthogonal systems of functions in certain closed Riemann spaces.—**Frontard**: The profiles of coherent soils with a plane surface of slip.—**Th. De Donder**: The extension of the Einstein gravific to thermodynamics.—**E. Pierret**: The realisation and working of a new oscillator producing very short waves. In an earlier communication a means of obtaining very short waves (14 to 18 cm.) has been described, for the good working of which two absolutely identical valves are required, a condition difficult to realise. An apparatus giving similar waves, but requiring only one valve, has now been constructed and details are given.—**Edmond Rouelle**: The use of the ferromagnetic frequency demultiplier as a phase multiplier.—**A. Turpain** and **R. de Bony de Lavergne**: An ultramicroscope of very reduced dimensions and the researches possible by its aid.—**L. Décombe**: Electrified spherical pellicles and the Compton effect.—**Edmond Bayle** and **Lucien Amy**: The use in analysis of a mercury cathode with falling drops. A diagram is given of an apparatus for delivering the mercury drops rapidly and at a constant rate of flow. Examples are given showing some applications of the apparatus to analysis.—**G. Siadbei**: A new photographic sensitometer. The apparatus described gives quantitative measurements on the homogeneity of the photographic emulsion and its relations to light.—**Marcel Frilley**: The spectrography of the X-rays by crystalline diffraction. Completing an earlier communication, some fainter lines in the X-ray spectrum of RaC have been recorded, one of which has a wave-length as short as 16 UX (770 kilovolts).—**W. Broniewski** and **L. Sliwowski**: The structure of the tin antimony alloys. Earlier work on these alloys has led to rather indefinite results. The authors' work includes measurements for a series of alloys of the electrical conductivity, the thermo-electric power, the temperature coefficients of the electrical resistance, and of the thermo-electric power, the E.M.F. of solution, the coefficient of expansion, and its variation with temperature, the hardness, micrography, and thermal analysis. Only one compound is clearly indicated, Sn_3Sb_2.—**J. Huggett** and **G. Chaudron**: The thermomagnetic study of ferric oxide attracted by the magnet. Malaguti's oxide, at a sufficiently high temperature is irreversibly transformed, with heat evolution, into ordinary ferric oxide, not attracted by a magnet. Traces of impurities modify the phenomenon considerably.—**Mlle. J. S. Lévy**: Adsorption in binary systems.—**J. W. Nicolaïeff**: The allotropic modifications and solid solutions of phosphorus. Measurements of density, vapour pressure, temperature of inflammation, and melting-point prove the existence of four allotropic modifications of phosphorus, which form between themselves a continuous series of solid solutions. Red phosphorus is not one of the allotropes.—**Ch. Courtot, L. Nicolas**, and **Tchang Han Liang**: Contributions to the study of diphenylene sulphide.—**Mme. Ramart-Lucas** and **Anagnostopoulos**: The comparative stability of different isomers according to their absorption spectrum. Transpositions in the series of the 1-aryl-2-phenyl-2-ethyl-1-butanols. **P. Carré**: Benzylchlormethyl oxide: the formal of benzyl alcohol.—**Marc Chambon**: A new synthesis of tropic acid. Bromophenylacetic ester,

$$C_6H_5 . CHBr . CO_2C_2H_5,$$

is condensed with trioxymethylene in benzene solution in the presence of finely divided zinc. The yield is over 50 per cent. of the theoretical.—**Const. A. Ktenas**: The presence of alkaline lavas in the northern Ægean sea.—**Marcel Casteras**: The structure of the Besséde (Aude) massif and on its tectonic relations with the massif of Saint-Barthélémy (Ariége).—**Georges Corroy**: The vertebrates of the Lorraine Trias.—**S. Thoulet**: Submarine basins produced by subsidence.—**Henryk Arctowski** and **Edward Stenz**: The fall of dust in Poland on April 26–28, 1928. This dustfall, the first on record in Poland, gave deposits varying from 2 grams to 31 grams per square metre. Reasons are given for supposing that this dust was carried from central Russia.—**Ch. Maurian** and **L. Eblé**: The diurnal variation of magnetic disturbance at the Val-Joyeux, near Paris. The daily magnetic disturbance was independent of the solar activity. There is a marked minimum throughout the year at about 8.0 A.M., with two maxima at 1.0 P.M. and 10 P.M.—**Marcel Mascré**: The staminal tapetum and pollen grain of *Arum maculatum*.—**A. Maige**: The physiological conditions of the unilocular or plurilocular amylogen reaction of the plasts.—**A. Demolon, H. Burgevin**, and **G. Barbier**: The clay colloids and solutions of soils.—**J. Chaussin**: Study of the internal medium in the different organs of the potato in course of development.—**G. Th. Dornesco**: Researches on the morphological constituents of the fibrous cells of the hepatopancreas of the crayfish, and, in particular, on the relations of the Golgi apparatus and the vacuome.—**Auguste Lumière** and **Mme. Grange**: The comparative alexic powers of the sera of arterial blood and venous blood. The alexic power of these sera is dependent, at least in part, on the amount of carbon dioxide present.—**J. M. Le Goff**: The differential vasodilating action of cobalt and nickel chlorides. Although the toxic action of nickel is identical with that of cobalt, there is a marked difference between the effects of the intramuscular injection of salts of these two metals; a cobalt salt produces expansion of the blood vessels and redness in the face, nickel salts are without action. Considering the close chemical relations of these two metals, this physiological difference is remarkable.—**Maurice Piettre**: Some chemical and physical properties of the proteins of the serum. The proteins cannot be considered as buffer substances, this function apparently belonging to the mineral or organic impurities which are normally present.—**V. Chorine**: The immunisation of the caterpillars of *Galleria Mellonella* against *Bacterium galleria* No. 2.

Academy of Sciences, June 18.—**Marcel Brillouin**: Mixed conditions at the frontiers. Oceans and continents. Static tides.—**P. Villard**: The chemical actions of radiations. Remarks concerning an interpretation. Discussion of a recent communication by H. Belliot on the action of light on a photographic plate.—**Charles Moureu, Charles Dufraisse**, and **Marius Badoche**: Autoxydation and antioxygen action. The catalytic actions of phosphorus. Details of experiments on the oxidation of furfurol by gaseous oxygen, alone, or in presence of 1 per cent. of solid white phosphorus.—**A. Blondel**: The transformation of a luxmeter into a brilliancy meter.—**René Maire**: The vegetation and the flora of the Hoggar (Central Sahara). The study of the flora of Hoggar shows that it is formed of tropical and Mediterranean survivals, for the most part adapted to present conditions. Many of these represent survivals from a climate much more moist than exists at present. These conclusions are in agreement with those drawn from geological, geographical, and zoological data.—**Louis Blaringhem** was elected a member of the section of

botany, in the place of the late L. Guignard.—**W. A. Tartakowsky**: The determination of the totality of the numbers represented by a quaternary positive quadratic form.—**Sophie Piccard** and **D. Mirimanoff**: Binomial curves.—**J. v. Neumann**: The theory of games of chance.—**V. Hlavatý**: The coefficients of Ricci.—**Marcel Vasseur**: The permanent conjugated systems in the deformation of a surface.—**Paul Alexandroff**: The frontiers of connected domains in space of n dimensions.—**B. de Kerékjártó**: An elementary demonstration of a theorem of translation due to M. Brouwer.—**Léon Pomey**: A general property of differential equations (ordinary or partial) and of integral equations.—**D. Th. Egoroff**: Some points of the theory of integral equations with fixed limits.—**Benjamin Meisel**: The torsion of prismatic bodies.—**J. Schokalsky**: The oceanographic expedition to the Black Sea.—**Raoul Ferrier**: The amperian in the theory of spectra.—**A. Bogros** and **Y. Rocard**: Remarks on the Raman and Cabannes-Daure effects.—**J. Cabannes**: The experimental laws of the Raman effect and the theories of light.—**Mlle. M. Hanot**: Researches on the hydrogen lines in the electric arc. The arc between metallic electrodes in hydrogen is rapidly extinguished and a special device required to overcome this difficulty is described.—**H. Volkringer**: Continuous spectra and band spectra of zinc vapour. For low vapour pressures, a spectrum is obtained which appears to be connected with the line spectrum; with higher vapour pressures of zinc a band spectrum is formed between 2975 A. and 4800 A.—**Jean Becquerel** and **W. J. de Haas**: The decomposition of the Faraday effects into two phenomena of different origins. Diamagnetic rotatory polarisation and paramagnetic rotatory polarisation.—**Mme. Irène Curie**: The number of ions produced by the α-rays of RaC′ in air.—**Maurice Auméras**: The state of ionisation of solutions of hydrogen sulphide.—**Paul Riou** and **Paul Cartier**: The influence of viscosity on the absorption velocity of carbon dioxide by solutions of neutral sodium carbonate. Viscosity may have some influence on the velocity of absorption of a gas by a liquid, but in no case is it the main factor.—**Pierre Brun**: The heat of formation of partially miscible water alcohol mixtures.—**Joseph Loiseau**: Contribution to the study of the copper alloys by the diffraction of the X-rays. Copper and two brasses, 67/33 and 60/40, were examined from the point of view of the changes in the Laue radiograms brought about by annealing from different temperatures.—**Albert Roux** and **Jean Cournot**: The crystallographic study by means of the X-rays of the structure of simultaneous metallic deposits of two metals. The spectra of the simultaneous deposits are not simply the spectra of the two metals superposed, showing that during the deposition the two metals form either a solution or compounds.—**L. Andrieux**: The preparation and properties of a cerium boride. The electrolytic bath consisted of mixtures of cerium oxide, boron trioxide, and cerium fluoride; these were found to give homogeneous liquids at a temperature of about 1000° C. Electrolysis gave violet-blue crystals of the boride CeB_6. Better yields were obtained when the cerium fluoride was replaced by lithia and lithium fluoride.—**Jean Savard**: Absorption curves of the pulegonols. Description of the changes brought about in the absorption spectrum by conversion from the ketonic to the enolic form.—**Mikaïlovitch Jélénko**: Earthquakes in Bulgaria in 1928; the geological situation of the devastated regions and various dislocations.—**C. Dauzère** and **J. Bouget**: The intense ionisation of the air in places frequently struck by lightning. It has been proved that there are certain spots in which the ionisation of the air in the neighbourhood of the soil is more intense than that observed in the neighbourhood, at the same altitude and under the same physical conditions. Places which are frequently struck by lightning coincide with these spots of maximum ionisation, the situation of which depends on the geological constitution of the soil.—**J. Bougault** and **E. Cattelain**: New researches on the etholides of the waxes from Coniferæ. Juniperic acid has been proved to be present in the wax from certain Coniferæ, but in proportions too small to serve as a base for the preparation of compounds possessing the odour of musk.—**H. Janvier**: The regime of *Opisthopatus Blainvillei*.—**A. Mordvilko**: A new contribution to the study of anolocyclia in the Pemphigians of Pistachia.—**René Hazard**: The cardiovascular action of tropinone.—**J. E. Abelous** and **H. Lassalle**: The action of the aqueous extract of nerve substance on the excitability of the nervous system.—**Mme. M. Phisalix** and **F. Pasteur**: The action of ultra-violet rays on the serum of *Vipera aspis*.—**W. Kopaczewski**: The electrocapillary penetration of colouring matters into the cell.—**Marcel Avel**: Nutrition and sexuality in Lumbricus.—**S. Posternak**: The limit of degradation of the lectotyrines by trypsin.—**Raymond Poisson**: *Eccrinopsis Mercieri*, a parasite of the rectum of *Oniscus asellus*. Its evolutive cycle.—**E. Nicolas** and **J. Lebduska**: The comparative study of the action of urea and of thiourea on the development and vitality of bacteria. Thiourea has a toxic action, definitely greater than that of urea, on the development and vitality of the micro-organisms examined. A similar effect has been proved by E. and G. Nicolas for plants, although less marked. On the other hand, for animals the toxicity of urea is greater than that of thiourea.—**Henri Jean Frossard**: A mechanical theory of deafness, its rational treatment and prophylaxy.—**G. Delamare** and **C. Gatti**: The evolution of the cysts of the Paraguay Piedra.

LENINGRAD.

Academy of Sciences (*Comptes rendus*, No. 4).—**S. Bernstein**: The sums of dependent quantities.—**N. N. Kalitin**: The variation in the total intensity of the solar radiation during the solar eclipse of June 29, 1927. Determinations of the variation and discussion of results.—**P. J. Schmidt**: A rare Japanese shark, *Calliscyllium venustum* Tanaka. Supplementary description, with figures.

Comptes rendus, No. 5.—**B. Koupletsky**: The mineralogical composition of apatite-nephelic rocks from the Khibin tundra. Quantitative mineralogical analyses of apatite rocks from the Khibin mountains show that in some of them apatite predominates, while in others its place is taken by nepheline; other minerals present are egirin, sphen, biotite, and titanomagnetite.—**V. Sukatchev**: Flora of post-tertiary deposits at Troitskoe near Moscow. A study of fossil plants found in various layers of the deposits shows that they correspond to three climatic phases. The first was a cold phase, with a predominance of *Picea obovata* and *Pinus sylvestris*. The length of this period is estimated at about 4000 years. Next came a warmer phase when oaks (*Quercus pedunculata*) predominated, while other broad-leaved trees, like *Acer*, *Alnus*, *Fraxinus*, *Betula*, etc., were also abundant; this phase lasted about 1500 years. The third period, the length of which is estimated at about 3000 years, corresponded, perhaps, to a steppe period, but no fossils of certain age were found in the corresponding layers.—**B. Vishnevsky**: Contributions to the study of blood groups in the peoples of Russia. Agglutination reactions of the blood of some thirteen different nationalities were studied and preliminary figures and classification are offered.—**B. Zemliakov**:

Prehistoric man in north-west Russia in relation to the geological history of the region during the post-glacial period. A study of pottery and other objects found in eleven different places and correlation in the development of the technique of their production with geological periods.

Comptes rendus, No. 6.—**G. Gamburtsev**: Apparatus for the mechanical determination of elements of the magnetic and gravimetric field produced by an infinite cylinder of arbitrary section.—**V. Kustov**: Analysis of the water of an arsenic containing spring in Caucasus. Water of a spring in the Araxes valley contains 0·048 gm. per litre of Na_2HAsO_4, which is one of the highest known figures of arsenic content in mineral waters.—**V. Lodyzhenskaya**: Transplantation of regenerated extremities of axolotl. Experiments were made with transplantation of regenerated extremities while still in the stage of a bud. It was found that the buds are already strictly determined as regards their orientation (anterior, posterior, left or right) after the second day.

ROME.

Royal National Academy of the Lincei, April 1.—**C. Somigliana**: Normal gravity and Helmert's formula.—**U. Cisotti and B. Finzi**: Observations on Straneo's note on the Kutta-Joukowski theorem. The validity of the exception to this theorem indicated by Cisotti is upheld.—**L. A. Herrera**: Imitation of organic forms by means of albumen (2). When drops of natural egg-albumen are dropped from a height on to the surface of hydrochloric acid or Merck's solid egg-albumen, or flakes of dry egg-white are deposited on the surface of the acid, forms develop which closely resemble those of infusoria.—**M. Pascal**: The rectilinear laminar profile. A new proof of the non-existence of Cisotti's exception to the Kutta-Joukowski theorem is developed.—**L. Laboccetta**: Analytical expression of discontinuous physical magnitudes or functions of discontinuous variables and diagrams corresponding therewith.—**A. Rosenblatt**: Pistolesi's note on a supposed exception to the Kutta-Joukowski theorem. The author replies to Pistolesi's recent criticism of his demonstration of the non-applicability of the Kutta-Joukowski theorem in exceptional cases and insists on the significance of the formula developed in his previous note. In reply to Pistolesi's note, Cisotti has lately communicated certain considerations on the method of evaluating the resultant of the dynamic actions affecting an indefinite plate subjected to a translatory-circulatory current investing it and surrounding it, and has expressed the opinion that Pistolesi does not take into account, in an orthodox manner, the singularities at the extremities of the plate.—**G. Krall**: Limits of the dynamic effort in dissipative systems.—**F. Rasetti**: Enlargement of spectral lines. Due importance has perhaps not been attached to the influence, on the broadening of spectral lines, of the perturbation produced in an emitting atom by similar neighbouring atoms; for a phenomenon analogous to resonance, such perturbation would be far greater than that due to atoms having different proper frequencies, and might result in sensible alteration of the frequencies emitted, and hence in broadening of the line. A brief outline of the theory of the phenomenon is given, together with the results of experiments on sodium, these indicating that the depth of the luminous vapour cannot explain the widening, unless the existence of the resonance effect is assumed.—**A. Carrelli**: Relativity in five dimensions.—**G. Todesco and B. Rossi**: Study of imperfect metallic contacts. Pélabon has recently shown that an imperfect contact between two electrodes of the same metal but of different shape may serve for the rectification of oscillating currents, and hence may replace the crystal or thermionic valve detector. By means of an apparatus with steel electrodes which allow of constant contact resistances of some hundreds of thousands of ohms being obtained, the characteristic curves for these contacts have been investigated. Such a contact does not follow Ohm's law, but its resistance diminishes as the current intensity increases. This variation in resistance, which is perfectly reversible, is, however, accompanied by an irreversible diminution in resistance whenever the current traversing it exceeds, in absolute value, the maximum previously reached during the experiment. Further results show that the passage of a current, even of extremely low intensity, through the imperfect metallic contact, coheres it, rendering it inactive to rectification. In order that the latter may occur, it is necessary that the contact should resume immediately its original resistance. This may happen, in particular, when, as with Pélabon's contacts, the electrodes possess a certain mobility which permits of the continuous interruption of the incipient process of coherisation.—**O. Specchia**: An interferential method for the measurement of the magnetic susceptibility of liquids. The method described represents a modification of the Fabry-Quincke method.—**M. L. Pagliarulo**: Considerations on F. P. Mazza's criticism. Mazza's criticisms of the author's work on the rotatory dispersion of the alkyl aspartates are invalid, since the experiments were carried out with all the precautions necessary to ensure accuracy of the results.—**F. Principi**: Miocenic deposits between the valleys of Senio and Sillaro.—**L. Settimj**: The chemical composition of certain Italian milk foods. Results are given of analyses of Roman *ricotta*, which is made by heating whey, obtained by the coagulation of milk by rennet for making cheese, to 75°-80° in the presence of an organic or mineral acid and thus precipitating the protein substances, and of the somewhat similar material known as *mozzarella*.—**P. Pasquini**: Experimental investigations on the embryology of the echinoderms (2). Polar differentiation of the ova of *Arbacia punctulata* Grey, centrifuged immediately after fertilisation.

Official Publications Received.

BRITISH.

Royal Society of Arts. Cantor Lectures on Scientific Foundations of the Refining of Petroleum, delivered before the Royal Society of Arts on January 16th, 23rd and 30th, 1928. By Dr. A. E. Dunstan. Pp. 95. (London.) 3*s*.

Forestry Commission. Report on Census of Woodlands and Census of Production of Home-Grown Timber, 1924. Pp. 68. (London: H.M. Stationery Office.) 1*s*. 9*d*. net.

Annual Conference of the Universities of Great Britain and Ireland, 1928: Report of Proceedings. Pp. 43. (London: Universities Bureau of the British Empire.) 1*s*.

The Journal of Physiology. Author Index to Volumes 1 to 60. Issued by the Physiological Society and published as a Supplement to *The Journal of Physiology*, June 1928. Pp. ii+235. (London: Cambridge University Press.) 25*s*. net.

The North of Scotland College of Agriculture. Calendar, Session 1928–1929. Pp. vii+127. (Aberdeen.)

Indian Central Cotton Committee: Technological Laboratory. Bulletin No. 15, Technological Series No. 10: The Effect of using Unbalanced Drafts instead of Balanced Drafts in the Spinning Preparation for Spinning Tests. By A. James Turner. Pp. ii+30. (Bombay.) 1 rupee.

Is an International Language Possible? A Lecture delivered before the Annual Conference of the Société Internationale de Philologie, Sciences et Beaux Arts, London. By E. Sylvia Pankhurst. (Interlingua Pamphlets, 1.) Published for the Academia pro Interlingua, British Section. Pp. 29. (London: Morland Press.)

Transactions and Proceedings of the New Zealand Institute. Vol. 59, Part 1. Pp. iv+211+33 plates. (Wellington, N.Z.)

South Australia. Annual Report of the Director of Mines and Government Geologist for 1927. Pp. 22. (Adelaide: Harrison Weir.)

University of Reading: The National Institute for Research in Dairying. Annual Report, for the Year ending 31st July 1927. Pp. 70. (Reading.)

Educational Broadcasting. Report of a Special Investigation in the County of Kent during the Year 1927. Pp. ix+80+xxxii. (Dunfermline: Carnegie United Kingdom Trust.)

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FOREIGN.

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Ministry of Agriculture, Egypt: Technical and Scientific Service. Bulletin No. 74: The Fusarium Disease of Cotton (Wilt) and its Control. By Tewfik Fahmy. Pp. vii+106+48 plates. (Cairo: Government Publications Office.) 25 P.T.

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Société des Nations: League of Nations. Institut International de Cooperation intellectuelle. Bulletin des Relations scientifiques. 3e année, No. 2, Juin. Pp. iv+51-119. (Paris: Les Presses universitaires de France.) 8 francs.

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Diary of Societies.

SATURDAY, AUGUST 18.

NORTH OF ENGLAND INSTITUTE OF MINING AND MECHANICAL ENGINEERS (Newcastle-upon-Tyne), at 2.30.—Annual Meeting.

CONGRESSES.

AUGUST 12–18.

INTERNATIONAL CONGRESS OF ENTOMOLOGY (at Cornell University, Ithaca, New York).

AUGUST 20–25.

INTERNATIONAL CONGRESS AGAINST ALCOHOLISM (at Antwerp).—Sir Arthur Newsholme: The Alcohol Question and Social Hygiene.—Prof. Firket: The Concentration of Alcohol in the Blood and the Diagnosis of Drunkenness from the Medico-legal and Insurance Aspects.—Prof. Laitinen: Recent Experiments on Alcohol and Heredity.—Dr. Puusep: Changes in the Endocrine Glands in the Descendants of Alcoholics, the Endocrine Glands and Inebriety, the Permeability of the Meninges in Alcoholics, and the Excitability of the Cerebral Tissue in the Descendants of Alcoholics.—Prof. H. Emerson: Results of American Prohibition from the Hygienic Aspect.—Drs. Vervaeck and Meeus: Social Effects of the Belgian Liquor Law of 1919.—Dr. Dahlgren: Alcoholism in Russia.—Drs. Bellin du Coteau and Bergeron: Alcohol and Sport.