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DEMOBILIZATION AND THE ALLOCATION OF MAN-POWER

THE debate in the House of Commons on November 16, although taking place before the appearance of the second White Paper on the Re-allocation of Man-Power—that dealing with civilian employments—made it clear that, subject to one criticism, the scheme outlined in September for the re-allocation of man-power between the Armed Forces and civilian employment during any interim period between the defeat of Germany and the defeat of Japan (Cmd. 6548. London : H.M. Stationery Office) went far to meet the desiderata laid down in the various statements and reports on demobilization that had previously appeared. Mr. Bevin's speech in particular showed that in its proposals for the orderly unwinding of the man-power of the country, the Government has had the closest regard to such suggestions. It was equally clear from speech after speech that the proposed arrangements met the crucial test almost invariably proposed in such reports : they are readily understood and accepted as fair in the Forces. The debate itself should help to carry that understanding and acceptance a stage further ; for no one who followed it could have any doubt as to the Government's determination that there should be no evasion of the principles laid down, or of the support from all quarters of the House for the view that only on the clearest grounds of public interest should there be any exception to the order of release laid down.

The one major criticism or reservation was that insufficient consideration was given to the claims of men who had served for a long period overseas without home leave. Those claims were pressed on the Government with great skill, sincerity and force, not merely by several serving members but also by others, sometimes perhaps with a zeal which tended to overlook the fact that what was under debate was not demobilization in the true sense, but as the White Paper emphasizes, the re-allocation of man-power. "General demobilization," it is emphasized, "either of the Armed Forces or of war industry, cannot take place until the end of the war against the Axis Powers and their total defeat throughout the world." The Government's plan is framed on the basis that hostilities will end first in Europe, and it relates solely to the interim period between the defeat of Germany and the defeat of Japan. It is governed by the paramount consideration that there can be no break in the war effort after hostilities cease in Europe, and that in association with the other Allied Powers at war with Japan there must be the maximum deployment of the forces needed to bring complete and final victory at the earliest possible moment.

It is, of course, true that if demobilization plans are to be understood and accepted as fair in advance, above all by those most concerned, namely, members of the Forces, they must be prepared and explained long before hostilities come to an end. Any misunderstanding on this point should be removed by the Prime Minister's firmness and explicitness ; but his subsequent announcement on November 17 of the new scheme for a system of short home leave for troops serving overseas goes some way to meet the major reservation in the welcome given to the re-allocation scheme. There are, however, other considerations of special interest here, not all of which were noticed in the debate on November 16.

That debate was under some handicap in proceeding before the publication of the second White Paper (Cmd. 6568. H.M. Stationery Office, November 1944, 2*d*. net.), and before discussing these particular points the two schemes must be briefly summarized. As an essential part of the re-allocation of man-power, the first scheme proposes to continue the compulsory recruitment of men for the Forces in order to bring relief to the men who have served for long periods and enable more of them to return to their homes. It will also be necessary to maintain the requisite control over industry and labour during the interim period, in which there will continue to be heavy and over-riding demands for munitions of war and other essential production.

Until the requirements for the continuation of the war against Japan and for the garrisoning of occupied countries are finally known, the level at which the Armed Forces must be maintained cannot be determined precisely. While re-allocation between the Armed Forces as a whole and industry will clearly be possible on a substantial scale, the Government affirms that military requirements must over-ride all other considerations. The arrangements must also not be too complicated for practical application, and the Government takes the view that a fair and reasonable scheme can best be secured on the basis of release according to age and length of service. It will also be necessary to make limited provision for certain urgent work of reconstruction on which a beginning must be made in the interim period.

The plan accordingly provides for two separate methods of selecting men for return from the Forces. Class *A* will be selected according to age and length of service ; Class *B* on account of their qualifications for urgent reconstruction work. No man will be released or transferred from the Forces if his retention is considered necessary on military grounds, though the Services will make every effort to release men in their turn in whatever theatre of war they may be serving. Men due for release or transfer will be given an opportunity to volunteer for a further period of service.

The number of releases in Class *A* will correspond with the reduction in the strength of the Forces and will be increased in consequence of the calling up of further recruits. Except that men of fifty years of age and more will be treated as a priority class to be released first if they so desire, men will be released by a combination of age and length of war service, on the basis that two months of service is equivalent to one additional year of age. Release will commence as soon as practicable after the defeat of Germany.

The men in Class *B*, who will be specially transferred from the Forces, will be those identified as belonging to particular occupational classes specified by the Minister of Labour and National Service as required for certain urgent reconstruction employments. The Class will also include a limited number of individual specialists, for whose transfer application may be made through Government departments in accordance with existing arrangements. The transfers in this Class will be few compared with the releases in Class *A*, and the number will be determined from time to time by the immediate requirements for reconstruction, and the extent to which those requirements will be met by releases in Class *A* and by transfer from munitions and other work at home. The men will be liable to be recalled individually to the Forces if they discontinue their reconstruction employment.

Further principles regarding re-allocation are laid down in the second White Paper, on re-allocation of man-power between civilian employments, which itself refers to some of the points made in that dealing with Employment Policy (Cmd. 6527. London : H.M. Stationery Office). The task will be to ensure that our limited resources are concentrated first upon those munitions required for the Armed Forces, and, secondly, upon those products which are most important to national recovery and to an improvement in the standards, not of those who can pay the highest prices, but of the community as a whole. The existing system of allocating man-power to the Forces and to the various industries, based on the annual man-power budget and carried out under the present system of priorities, will be continued. It is believed that the only way to avoid serious dislocation and dissipation of our resources on objects of secondary importance, and the production, so far as practicable, of necessities rather than luxuries, is to re-allocate man-power during this interim period on such a planned basis with some control over industry and labour, in accordance with certain established broad principles.

In the man-power sphere the aim must be to seek to mitigate the severity of the existing labour controls, to pay all possible regard to the natural desires of workers to seek work where they please, and of employers to engage labour freely, and to ensure that the workers which are available are employed in the places where, and on the tasks which, they are most needed in the national interest. Accordingly, the Government's policy endeavours to meet such wishes, especially that to return home, so far as is consistent with due regard for the general well being of the country. Subject to the same over-ruling consideration, it will also be the aim to transfer experienced workers back to their former industries. Release of persons in civilian employment cannot be determined purely by redundancy ; over-riding priority will be given to certain classes who, on personal grounds, have a claim for specially sympathetic treatment in the matter of release for retiring from industry or to work nearer their homes.

When these priority classes have been released some establishments, mainly in the munitions industries, will still have redundant labour, while other establishments will be requiring labour. The problem therefore becomes one of transfer of labour, with some of the vacancies of greater importance than others; and in this redistribution of labour it is proposed that, apart from the call-up for the Forces, the two main classes to be released first should be those needed for priority vacancies and those who have worked away from home for more than one year and want to return.

As regards men for the Forces, all men in the age groups 18–27 will be liable for calling up; but those in the range 25–27 will only be called up if there are insufficient men in the lower age-ranges to meet requirements. Deferments will continue to be granted for men with special skill. In the selection of workers for transfer to priority vacancies under redundancy, existing selection procedure, which includes consultation with representatives of employers and workers, will be followed, and a major objective will be to transfer as many persons as possible back to their homes. The priority orders will also be applied where necessary to the transfer of workers to industries which need to maintain or increase their labour force. Registration of young men and women for employment or national service will be continued.

While the Government's proposals aim at effecting the necessary redistribution of man-power on a voluntary basis as far as possible and at narrowing the field of compulsion to the strictest limits, a substantial measure of control over the movement of labour must be retained. The Government desires both to give employers as much freedom as it can in the engagement of workers, and to ease the position of as many classes of workers as possible, especially in the older age groups. Controls over juveniles are to be considered in relation to the whole question of juvenile employment and a separate scheme is being worked out in consultation with the interests concerned, the paramount object of which will be to assist juveniles to the maximum extent possible in the choice of employment with the view of giving them the best opportunities for a permanent and progressive career in life with due regard to individual aptitudes.

It is on this question of education and training that criticism of the two schemes as a whole may well centre. The Government recognizes explicitly that the position of those young people returning from the Forces, who have the first claim to resume their education, must be safeguarded, but neither in the debate nor in the White Papers are the full implications of this policy indicated. The significant omissions are references to the release of teachers, and particularly university teachers, and of students to resume their studies.

That the Government has made no pronouncement on this point is the more important because the case for concessions rests entirely on national grounds. It is supremely important that there should be full and widespread public appreciation of the necessity for Government action, and no room for misrepresentation as favoured treatment for a particular class. Moreover, the demobilization of students of itself will be wasteful unless their release is timed with a view to resumption of their studies at the beginning of a course. Such demobilization, from the national point of view, calls for consideration as part of a national policy for youth, in which registration for national service and liability for enlistment in the Armed Forces must be placed in the long-term perspective in relation to educational policy. A decision on the question of a year or other period of national service as part of our national system must be taken at an early date. The Civil Service National Whitley Council has done well to direct attention to this point in its recent report on the staffing of the Civil Service during the reconstruction period.

The importance of higher education may well need some careful and painstaking explanation to the general public before its bearing on the national welfare is understood. Men released from the Forces cannot be accepted for re-training or for university study unless those required to instruct them are previously released from Government service; further, our whole expansion of scientific and industrial research depends on the orderly demobilization and re-allocation of scientific man-power, in which the release of teachers must have a high priority if the recruits required for industry itself are to be available in three or more years time. It must be remembered that for five years practically no male students have taken a university degree except in medicine and certain scientific subjects. Before the War, Sir Richard Livingstone has pointed out, British universities were training barely enough men for the national needs. In these last five years, except for the small fraction exempted from national service for reasons of health, they have been producing no graduates in subjects of such obvious immediate practical necessity to national life as economics, modern languages and the social sciences, in mathematics, history, law, literature, philosophy; and very few in scientific subjects such as botany, geology, and zoology.

While this gap remains, there will of necessity be grave weaknesses in the Civil Service, the professions, the executive ranks of industry and commerce, and the cultural life of the nation as a whole. The closing of this gap is one of the most important reasons for university expansion, and however swiftly the problems there may be solved and however generous the Government's contribution on the financial side, it will take time to close the gap. The men and women of trained capacity so urgently needed in every branch of the national life cannot be produced to order: three years are required for graduation, and several years more for competence in handling public affairs.

Release for this purpose is clearly a complicated question; only those with very special qualifications as students, such as holders of open scholarships, and men and women who have proved themselves first-class teachers, could be considered for priority release. It is all the more important, therefore, that from the national point of view there should be the minimum interruption of studies consistent with the demands for the prosecution of the War itself. The longer those students who have been called up before completing their courses remain with the Forces, the more wasteful the interruption is likely to be from an educational point of view. Equally, it is important that there should be no further interruptions unless absolutely essential.

It is at this point that, as indicated in three of the articles contributed to the special number of *The Political Quarterly* dealing with the future of the universities, the report of Lord Hankey's Committee is so important. Any preferential demobilization of teachers or university students in Class *B* must clearly be based on the quantitative findings of that Committee as to the probable demand for graduates, and must be related also in some measure to the short-term and long-term development of the universities. Moreover, whether or not the pre-war student population represented, as Dr. Cyril Burt's article suggests, the right proportion of our population qualified to profit by a university education, it is certain, as Sir Lawrence Bragg's article indicates, that not all those best qualified have in fact been included. Apart altogether from Sir Ernest Simon's contention that we have as yet no real evidence as to the proper proportion of the population which is worthy of a university education, the demobilization scheme offers an undoubted opportunity, not only of removing an important bottleneck in reconstruction plans, but also of returning to the university, to the national advantage, some of those promising youngsters of outstanding judgment and intelligence as shown in their record of war service, who through economic or similar reasons have fallen off the educational ladder before reaching the university.

Clearly it might be inequitable to exempt all university students as a class, but the liability to military or other form of national service might well be enforced before or on completion of their university training in accordance with a deliberate national policy on the lines suggested in the Norwood Report and the reports of the British Association Committee on University Education and other bodies. This consideration was not very evident in the debate in the House of Commons on November 16, although Mr. Bevin indicated the Government's acceptance of the view that we must get our educational system going again as soon as possible. Nor was there any reference in the debate to the fact that demobilization of teachers must clearly proceed in stages rather than as one group, in order that the schemes for educational training in preparation for demobilization already announced by the Army and the Royal Air Force (see *Nature*, 154, 525 ; 1944) may not be deprived of the instructors and potential instructors necessary for them to function.

Apart from this, the problem of education and teachers in relation to demobilization was fairly raised in the debate by Prof. Gruffydd, who not only made the point of priority in regard to the national needs—though that might have been more forcibly put—but also rightly directed attention to the age factor : the age-level is rising because we cannot get new lecturers, and if anything is important for reconstruction and for new ideas in the country, it is that the university teachers should be young men with young ideas. Mr. Bevin's reply was satisfactory so far as it indicated the Government's appreciation of the seriousness of the position. It may be doubted whether as large a number will be due for release for the universities in Class *A* as he suggested, and few of those thus scheduled will meet Prof. Gruffydd's criterion on the ground of age. Mr. Bevin stated, however, that the Minister of Education and the Secretary of State for Scotland are ascertaining from the local authorities how many teachers they would get back under Class *A*, and that the Government would then see what number is necessary for the schools and also for the universities.

This is undoubtedly the soundest line on which to proceed to establish the case for release on national grounds ; but while that quantitative inquiry is proceeding, every effort should be made, both by the Government and by other authorities, to make sure that public opinion fully understands what is involved and the national reasons for priority. There must be no room for misunderstandings on this matter such as those which led to the breakdown of demobilization in 1918, and the same care must be taken in connexion with any and every class of specialist due for release in Class *B*. The efforts in regard to training for industry, whether for research or supervision and administration, and the work of Lord Hankey's Committee to which Mr. Bevin paid tribute, may all be frustrated unless this point is amply safeguarded. Every effort must be made to eliminate any suggestion of special pleading and to ensure that the release of teachers and students is in accord with the wise aims of the demobilization scheme and adequate to serve the country's needs, while avoiding any suggestion that professional interests are favoured other than as they first contribute to the national purpose.

STATISTICAL THERMODYNAMICS

Statistical Thermodynamics

Course of Seminar Lectures delivered in January–March 1944 at the School of Theoretical Physics. By Erwin Schrödinger. (Hectographed.) Pp. ii+135. (Dublin : Dublin Institute for Advanced Studies, 1944.) 5*s*. net.

THIS little volume is not an ordinary text-book, dignified, dull and well printed (hence expensive), but an informal communication of ideas, fascinating, amusing and only hectographed (hence cheap). Its origin and background depend on the peculiar character of the Institute where these lectures were given.

The Dublin Institute for Advanced Studies, housed in one of the pleasant Georgian buildings forming Merrion Square, has at present only two departments, the School of Gaelic Language and the School of Theoretical Physics. The staff of the latter consists of the director, Erwin Schrödinger, and one professor, Walter Heitler, both known well enough in the world of mathematics and physics to need no introduction. The building contains a small but well-selected library, a lecture room and very comfortable rooms for the professors, students and guests. Lectures and seminars are given, not according to a fixed time-table and syllabus, but in response to the inclinations of the teachers and the demands of the students. All these attractions are crowned by the non-existence of examinations and degrees—an ideal place for scientific work.

My knowledge of these circumstances is due to the fact that I had the honour of taking part in one of the summer schools at the Institute (July 1943), together with Mrs. K. Lonsdale (Royal Institution, London) and P. P. Ewald (Belfast). These well-attended lectures and discussions on recent research on X-rays were conducted in the typical manner of the Institute—informal, but extremely informative for the students and the lecturers as well. No account of these courses has been published; but those of the previous year, given by Eddington and Dirac, have appeared in print.

The volume at present under review conveys an idea of the *ordinary* courses given at the Institute by its own staff. The programme is best explained in the words of the author himself: "Not a first introduction for newcomers to the subject is intended, rather a 'repetitorium'. The wording is extremely shortened about well known stories to be found in every one of a hundred textbooks, but more extended on some vital points, usually passed over in silence in all but large monographs (as Fowler's, Tolman's)".

The main feature is the systematic use of Gibbs' virtual assembly and the justification given for it. To quote again: "Here the N identical systems are mental copies of the one system under consideration —of the one macroscopic device that is actually erected on our laboratory table. What on earth shall it mean physically to distribute a given amount of energy E over these N mental copies?". This question (given here verbatim to illustrate the style of the book) is answered thus: The N identical systems loosely coupled are considered as a heat-bath of constant temperature and any one of them as the one actually existing. As experience shows that the nature of the heat-bath has no influence on the behaviour of a system in contact with it, this assumption is permissible, and it has great advantages with respect to simplicity and clarity of the argument: the number N can be made arbitrarily large; in fact, one can always use the limit $N \to \infty$, so that there is no question about the applicability of Stirling's formula for the factorials of occupation numbers; and as each single system is macroscopic, no question about the individuality or indistinguishability of the members of the assembly can ever arise —as it does according to the 'new statistics' if single particles are considered as elements.

In this way the statistical considerations become very simple indeed; one has in all circumstances a Boltzmann distribution of macroscopic elements, but each of these elements is a system described by quantum laws, with a set of (discontinuous) energy states. Schrödinger gives a careful account of the two well-known ways of treating such an assembly, the method of the most probable distribution and the method of mean values due to Darwin and Fowler. The exact relation of these two methods is one of the weak points in most of the ordinary text-books, and a careful study of Section VI, p. 41, of Schrödinger's lectures is recommended to all who aim at a real understanding of physical statistics.

The first method is by far the simplest one, but can scarcely be considered as satisfactory in itself; Schrödinger proves it by demonstrating the identity of its result with that of the second method, which can be rigorously established. This result consists in the definition of the 'sum-over-states' or 'partition function' from which all thermodynamical properties can be derived by simple mathematical processes. The method of Darwin and Fowler for evaluating this sum as a residue (Cauchy's theorem) of a properly constructed generating function is called by Schrödinger a "sublimely excellent device"; and he adds: "But I beg you to keep those two things apart in your mind: *the general proof is done with*. When we use complex integration in what follows, it is *not* in the way of giving an example of the general method, only in the way of using a similar mathematical device or tool for evaluating certain sums-over-states. It is truly necessary to emphasize this point. For when a man has first explained a general method, then deals with particular examples and, in doing so, uses well-nigh the same mathematical device, you are almost bound to think that he does that, quâ applying the general method to the special example." I have quoted this sentence because it sets out a general rule for the teaching of science, which is violated in innumerable lectures and text-books.

The second half of the book contains applications to the n-particle system, mainly to the ideal gas. The 'new' statistics of Bose-Einstein and Fermi-Dirac appear as an immediate consequence of the way the total energy of a system of n particles is assumed to depend on the energy levels of the single particles. Great stress is laid on "the failure of the classical theory" (p. 90) as expressed in Gibbs' paradox.

In the last section the theory of radiation is treated, first in the ordinary way leading to Planck's formula. The appearance of the infinite zero point energy then gives the cue for the introduction of a modification of this theory suggested recently by Peng and me. (It was in fact the first published account of it, based on letters, as our paper appeared some months later.) Whether these ideas have any future remains to be seen; I am rather sceptical, since Peng has meanwhile discovered that the difficulties of the ordinary field theories which were to be remedied by the new assumption (divergent integrals in the expressions for the interaction of different particles) are only due to bad mathematics and can be avoided without a new physical hypothesis.

Can scientific writing ever be called a work of art? There are doubtless many people who would claim this title for their own writing, as is illustrated by the true story of the young mathematician, let us call him Paul Lucky, who once went to Rome to attend an international mathematical congress. Not being interested in relics of the ancient world and the Renaissance, he spent all his time in lecture rooms, until his friends insisted that he ought to visit the Sixtine. There he stared awhile at the famous ceiling and said: "Not so bad. But if this chapel and all its paintings crumbled to dust, Paul Lucky's uniformization theorems will still stand."

Well, if there are other passports into the artists' elysium than durability, such as greatness of conception, harmony of structure, charm of expression, I do not know whether Paul has a chance of admission. But I think Schrödinger has; for he writes not only to instruct but also to please. I hope that many readers will enjoy this little work as much as I did.

MAX BORN.

THE CHEMICAL BOND, IN THEORY AND EXPERIMENT

Valency : Classical and Modern

By Dr. W. G. Palmer. Pp. x+242. (Cambridge : At the University Press, 1944.) 10*s*. 6*d*. net.

THERE is no branch of chemistry in which greater progress has been made in the last twenty years than the study of valency. A full understanding of the principles of chemical combination demands a versatile mind : for it needs to be familiar with what we may call pure chemical reasoning and experiment ; it must be on friendly terms with most, if not all, of the tools of modern physics (X-rays, electron scattering, vibration and rotation spectra, electric oscillations, and so on) : and lastly, it must not despise mathematics (did not Dirac say, in effect, that all chemistry is a branch of mathematics ?). He who writes a book about valency must decide from the start what kind of approach he will make. To be all-inclusive would require more space than the bare 250 pages which Dr. Palmer has allowed himself ; some selection has to be made.

"Valency : Classical and Modern" is a book about chemistry : it is written by a chemist for chemists. But it has this advantage over the old type of chemical treatise, that all other aids to understanding are welcome. So there are paragraphs about the measurement of dipole moments and the interpretation of spin and term diagrams, not usually found in such books. It is hard work fitting everything in, especially when the general approach is historical, so that space is also granted to Dalton and Berzelius. Indeed it is quite remarkable how much information is to be found in this little book. Thus we begin with a historical account of the ideas that led chemists to associate a definite valency (or several possible valencies) with a particular atom. This leads to the periodic system, though it is still unnecessary to introduce specifically electronic theories. The next chapter is devoted to various methods of determining structure and valency ; these include stereochemistry studied optically, electric moments, electron diffraction and infra-red spectra. Having established our tools, we are prepared to accept the results that they give, group by group of the periodic table, in the following pages.

So far there is scarcely a mention of electrons ; for example, bonds are polar because some unspecified charge is unsymmetrically distributed. But this is not sufficient ; a theory of valency is needed, and in the next forty pages the electron spin theory is expounded. This involves us in descriptions of atomic *s* and *p* states and *s*-*p* hybridization. It is all rather condensed ; but everything of importance at this level is included. No wonder that Dr. Palmer claims for these first chapters that "they present a compact but elementary account of classical and modern conceptions of valency . . . not overstraining the capacity of candidates for University examinations of the standard of Part 1 Natural Sciences Tripos at Cambridge". The claim is fair, though he would need to be a good candidate who really understood some of the quantum theory explanations.

There remain about a hundred pages. These are devoted to a series of special problems, with a distinctly more advanced flavour. It is good to see explained the failure of the octet rule for heavier elements : and even better to see so much space devoted to the method of molecular orbitals. Indeed, this is one of the very few chemistry text-books where the advantages of the molecular orbital theory are recognized. There is a lot to be said in favour of the theory if we want a simple visual clear-cut explanation of the multiple links of carbon, revealed, for example, in benzene and other aromatic substitutions. There is a final section on hydrogen bonds.

This latter part of the book is obviously more advanced than the first. It is a pity that it is marred be several mistakes. In one or two places the author appears confused in his description of allowed molecular orbitals. All this is probably explained by the present national circumstances, which make the very appearance of the book a matter for congratulation, but the mistakes (the reviewer has found more than half a dozen significant ones) ought to be corrected as soon as possible.

In conclusion, one cannot help comparing this book with Pauling's classical "Nature of the Chemical Bond". Dr. Palmer's historical approach first introduces the electron-pair bond on p. 112 : Pauling introduces it in his first paragraph. The first method is valuable in showing how chemists have thought through their problems to their present knowledge, the second shows how they do think. Pauling has an axe to grind ('resonance, more resonance' is his meat and drink, as they will probably be his last words). But there will be many who will appreciate Palmer's book just because, having no such single idea, he can be fairer to all points of view. Yet this new book lacks the grand scale and manner which have rightly made Pauling's book so famous : "Valency : Classical and Modern" is a sound workmanlike book, but it is not a classic.

C. A. COULSON.

ELECTRICITY IN PEACE AND WAR

Electricity and its Application to Civilian and Military Life

By Charles A. Rinde. Pp. xii+467. (London : George Allen and Unwin, Ltd., 1944.) 25*s*. net.

THIS book is written round the United States War Department's outline, "Fundamentals of Electricity", and provides a broad foundation for the fields of specialization suggested by the various technical and field manuals. But its use is not confined to war-time applications of electricity. It is recognized that the same basic principles underlie civilian uses of electricity, and both civilian and military applications are stressed throughout.

The central theme unifying the book is the electron and the control of electrons, and quite rationally the electron is first introduced in the chapter on electrostatics, which comes quite early. It is excellent to find more than customary prominence given to the subject of X-rays, for, as the author very rightly says, "the X-ray is no longer merely a means of examining broken bones".

The text is simply written and easy to follow ; it is thus very helpful to those students without previous knowledge of the subject. Many experiments are suggested for the student to carry out, and at the end of each chapter a useful set of questions and problems is provided. There is an abundance of illustrations, and the well-drawn and simple diagrams are a valuable asset to the book which, in spite of war-time conditions, is beautifully produced ; a disadvantage is its rather high price.

SCIENCE AND INDUSTRY IN NATIONAL SECURITY*

By THE HON. ROBERT P. PATTERSON
U.S. Under Secretary for War

THERE is a great voice in the world to-day, the voice of science and technology. It is a voice heard since ancient times but never until to-day has it spoken with such authority, have its words been so filled with promise, has it been listened to with such hope; and in no country in the world does the voice speak so eloquently as in the United States.

Science and technology have changed and are changing the lives of all men. Not a single aspect of our society but feels their advance. The things we make and use, the food we eat, the clothes we wear, the way we travel and communicate, the houses we build, the way we cure and prevent disease, the way we fight—and the way we shall win—have all been fashioned by science. Both war and peace move under the sign of research, discovery and invention.

While our thoughts and energies must still be devoted without stint or limit to the task of defeating Germany and Japan, second place in our thought and planning should be directed to the problems of the future. How shall we repair the ravages of war? How shall we create a society in which full production and full employment can be maintained? How shall we promote and maintain the security of the United States—and thereby contribute to the peace of the world—so that no aggressor will dare again to jeopardize our status as a free people. It is on the last question, on the part which science in industry can play by developing our resources, and advancing our technology in the interest of national security that I would speak.

I conceive the term national security to embrace a wider field than the maintenance of an adequate army, along with the development of powerful and effective weapons; because, in working on the normal products of peace, we at the same time make an essential contribution to our military strength. First, then let me briefly consider national security in its wider sense.

It is to the interest of all that America's scientific men engaged upon both pure and applied research should turn our swords into ploughshares as successfully as they have turned our ploughshares into swords. We shall need the development of new aeroplanes and helicopters, light metals and plastics, television and radio, new foods and medicines as much as we have needed and still need combat aircraft and jet propulsion, heavy armour and new explosives, radar and 'walkie-talkies', high-calorie rations, penicillin and blood plasma. I do not doubt that after victory we shall need the products of peace even more, for ours is not an aggressor country with imperialistic aims; the ideals of our nationalism are the ideals of peace and security.

To get the most out of all science, whether devoted to peace or war, there are certain things to be kept in mind. For one thing, research and development in industry, as in the university, flourish best in an atmosphere of complete freedom; control will wither science by destroying its precious essence of originality and spontaneity. If I were to add to the four freedoms of the Atlantic Charter, I might suggest a fifth—freedom of inquiry, experiment and research.

With that principle in the forefront of our thought, I think we must concede that in view of its position in the modern industrial State, in view of the way science is woven into the cloth of our society, it cannot be left unorganized and unsupported save by sporadic benefactions. A few of the great industries of the United States have been able to establish magnificent laboratories, and the discoveries and inventions flowing from them in a ceaseless stream have enriched our lives in peace and contributed heavily to our ultimate victory in this War. The laboratories of the universities of the United States, especially in the field of pure science, have steadily broadened and deepened the foundations on which all applied science must rest. The laboratories of the Federal Government, in the fields of agriculture, public health, medicine, meteorology and the development of the tools of war have also made an enviable record.

Essential as these contributions have been, we cannot afford to look exclusively to the laboratories and workshops of our major industries, universities and the Federal Government. While important scientific advances are not often made in attic, cellar or barn, as was the case not so long ago, we must not permit the precious stream of discovery flowing from smaller industry and smaller educational institutions to be dammed up by neglect. Small business needs technical information; universities not possessed of vast endowments need help; scientific research and development are of national interest, and whether they be devoted to national defence, public health, public housing or to normal scientific activity for commercial purposes, they must be encouraged, and if they need help they must have it.

Dr. J. B. Conant in a recent address said that the future of the physical sciences depends on the "number of really first class men" that can be turned out by our educational institutions. He urged that talented young men and women be afforded unhampered opportunity for research in both industrial and university laboratories; he advocated Federal scholarships for high-school graduates of technological promise, thus creating what he called "a scientific reserve" for national security. Without considering the exact means required to assure educational opportunities for young men and women of scientific promise, I am in full agreement with Dr. Conant's view as to the need and urgency.

Certain aspects of research, apart from the development of weapons, must, it seems to me, continue to receive Federal support or be carried on by the Federal Government. Agriculture, public health and housing fall in those categories. Certain economic problems also are in need of the clear light of science. The Federal Government, with unique access to full statistical data on population, manufacturing, crops, markets, methods of distribution, is in a position to help shed that light.

Nothing I have said should be construed to mean that in any of these fields the activities of the Federal Government should preclude or foreclose the research and development of private industry or the universities. In normal research and development during peace, the larger share must be contributed by the citizens and not by their Government. That is compatible with the view that in certain types of research the Federal Government must serve the needs of

* Address at the Silver Anniversary Forum on "The Future of Industrial Research", arranged by the Standard Oil Development Company, on October 5.

science. It must act as a stimulating force, it must furnish scientific information, it must lend financial support if it be needed.

In many scientific inquiries there is room for a co-ordination of effort. If it be deemed wise, the Federal Government might be called upon to participate in that function. There is urgent need for the fullest possible exchange of information between scientific workers in industry, academic centres and the Federal Government. How to achieve that co-ordination and a free exchange of data is a basic problem which has not been thought out to a satisfactory conclusion, although much work has been done upon it.

If I may sum up, the job of normal peace-time research is a private job, not a government job. Those branches in which the Government will continue in the principal role are well known; in no way do they conflict with the scientific functions of industry or university. What the Government may do, if it is called upon, is to furnish information and financial support. It may offer counsel, even leadership. It must not, in the normal researches of peace, assume control.

Up to this point I have been talking largely of scientific and technological research which, though of major importance in the national interest, will go on with or without any further plans we may make. But their advance will be facilitated if the factors to which I have briefly alluded are recognized and met.

Research and development devoted to the weapons, tools and techniques of war present us with a tougher problem. Such research will not go on to the extent required for our national security unless support, guidance, even control emanate from central mechanisms.

In time of war, when the nation's existence is in danger, no body of men responds more generously, with greater energy and zeal to the needs of their country than scientific men and technicians. That was our experience in the War of 1914–18; it is also our experience to-day. Industries and universities have turned their laboratories inside out to give their country what it needed, whether they were summoned or not. Men and women who people those laboratories have given us more than we dared hope for. Thousands of lives of our fighting men have been spared, most of the wounded restored to health. Our troops have been equipped with weapons equalling or surpassing those of the enemy; final victory has been brought immeasurably closer, as a result of the efforts of scientific men and technicians.

With all our grumbling, good-natured or otherwise, the fact is that on the home front in the United States we have scarcely felt the War, and that too is in large part to be ascribed to the efforts of our scientific workers.

But when peace comes, ours being a peace-minded nation, we shall have the greatest difficulty in keeping even a small portion of our best scientific brains on the job of maintaining the weapons of our Armed Forces at the high peak of effectiveness they now occupy; unless a suitable programme is evolved to draw and hold scientific men of the highest level, they will not be available for Government service in peace-time to supply the Armed Forces with the best science has to offer. They will return, as is only natural, to the industrial laboratories and the universities they came from. Nor will it be possible in the Government laboratories that will be continued in peace to carry through all the research in ordnance, aviation, radar, rockets and new weapons, in the many specialized nutritional, physiological and other fields which underlie the waging of modern total war. The research facilities and the scientific man-power prerequisite to these activities will simply not be available to the Government in sufficient degree. No acts of Congress or of the executive branch of our Federal Government can alone meet this deficiency. At almost every point of maintaining the technological strength of our Armed Services—whatever mechanism we devise to achieve this end—we shall have to turn to the research laboratories and the research workers of industry and the universities to fulfil our needs.

To some extent, as I mentioned at the outset, our task is made easier—paradoxically, I may say—because modern war is total war. In other words, much of the research carried on by industry and universities to meet the needs of peace will meet the needs of war if this tragedy should be thrust upon us again. In the field of chemicals, rubber, synthetic oil fuel, electrical instruments, engineering products, medicines, light and heavy metals, and food products, research for peace is research for national security. Also in the case of certain end products of purely military use, the intermediary products may be suitable for civilian consumption.

Research and development in connexion with most weapons are in a unique category. A host of factors stand as obstacles where the help of industry and the universities is concerned. Among these are the specialized tools and machinery required, the extensive proving grounds and test plants, the heavy expense, considerations of secrecy, the tenuous and inadequate liaison, during peace, between private industry and the Armed Services, the indifference or hostility of public opinion towards the development of war weapons in times of peace, the competing demands for commercial products.

Aware of the gravity of this problem and anxious to find at least a partial solution, some of the leading men of the National Academy of Sciences, the National Research Council, the Office of Scientific Research and Development and members of the Armed Services engaged upon research and development, have for some time past been weighing the merits of alternative plans for an organization which in the post-war world will deal with military scientific research and attempt to assure to the Armed Services the scientific help and interest required of industry and the universities. I would like to mention briefly some of the questions which this group has had before it, because I believe that these questions are in almost all respects similar to those which industry must answer in developing its policies for research and development pointed towards national security.

The first question is how shall we obtain for the Federal Government the full-time or consulting services of scientific men on the highest level.

It has been suggested that we need an agency, with distinguished leadership, such as we now have in the Office of Scientific Research and Development, and with ample funds, to promote precisely those branches of research and development which will effectively contribute to our military strength. For this is the type of research which if left unattended and unsupported cannot flourish. Between the War of 1914–18 and this War the funds made available for research and development in the military sphere were wholly inadequate. They are adequate now, but they must be kept so. The adequacy of Federal appropriations to promote military research will determine, in large measure, the contribution that can be asked of private enterprise in terms of personnel and laboratory facilities. While the arguments for the creation of the new agency are impressive, I do not believe that such an agency would fully solve our problem. For the problem is essentially one of men and women, not of organizations. We must have sincere and spontaneous interest in research aiming at national security, and this does not grow out of organizations and subsidies alone, however important these may be.

An important obstacle in enlisting the aid of industry is the difficulty of liaison and interchange between the military services and industry. How can we best meet that problem, recognizing that there is one sphere fully and properly under military control, another fully and properly under private control, but there is a large area of both spheres common to both ? It is manifest that if industry's help in weapon development is needed, so far as the work requires, the military must take industry into their confidence, and vice versa. There must be an avenue between industry, university laboratories, government laboratories, and the Armed Services, and there must be no one-way signs upon it. How can we best achieve this end, not theoretically, but in day-to-day work ?

How shall extensive work in weapon development be financed ? To this there is no simple answer. No industry, however large, can be expected without government subsidy to undertake elaborate research for the weapons of war, especially the accelerated and ceaseless research peculiarly required in this field. How shall this subsidy be administered ? What is its probable magnitude over the next ten or twenty years ?

Financing by way of subsidy or contract payments will, I recognize, often not be enough. We shall need other forms of incentive, financial in character or otherwise. Over and above that, we shall need the approval, the sympathy, the leadership from civilian as well as military circles to enlist public opinion in support of a sound programme.

I know that the exchange of patents and licences in connexion with research on military products is many-sided and troublesome. I mention it also because of its particular concern to industry. I believe, however, that a solution for that question will not be difficult to find, once a basic framework for the entire research and development programme in the post-war world is erected.

What research facilities can and should the Government provide for industry and universities in the United States ? We cannot expect that the research facilities of the Federal Government will be increased after the War ends. We cannot expect, on the other hand, that even the largest industries will be able to provide the proving grounds and more especially the test plants, so that we can convert the successful solution of laboratory problems to successful solutions in production. Proving grounds will doubtless be made available to industry. What of pilot plants ? These questions are, of course, intimately related with the problem as to what research functions in the development of weapons the Federal Government itself ought to continue to perform.

Planning for the results of science is unwise, for results cannot be anticipated. But we must not forgo plans for research, suggestions in definite fields in which valuable results may reasonably be anticipated.

My friends who are scientific workers tell me that so rich and limitless, so untapped are the possibilities of science that the discipline of planning consists as much in saying what roads ought *not* to be followed as what roads ought to be. At every stage of developing our research on weapons we must have a standard of values, so that although research would not be confined, lesser problems would be subordinated to questions of vital national need. That standard of values must be keyed to the current strategic thoughts of our military leaders and must be accessible to the leaders of research. If the link fails in either respect, we cannot expect to gain the full benefit of our vast research machinery. Repeatedly this War has shown that science leads tactics ; this will be fully as true in wars of the future. We will make our plans to suit our weapons, rather than our weapons to suit our plans.

The U.S. War Department has grown increasingly aware of the need for research and development in connexion with new weapons. In partial response to that need there was created within the War Department, more than a year ago, the New Developments Division. This Division is charged with functions relating to the initiation and co-ordination of research and development and the expeditious application of new weapons, devices and techniques. It has proved its usefulness, and will, I hope, continue to do so in increasing measure. Its working relationship with the two scientific agencies to which we all owe so much, the National Research Council and the Office of Scientific Research and Development, has at all times been close and effective. I realize that this Division marks only the beginning of the road to our goal. For in every one of its activities, after the War as now, the War Department must train its men, shape its plans and its actions so as to reflect the most recent advances of science. It must not lose sight of the fact that significant discoveries and inventions are usually the matured products of years of thought and experiment, with innumerable disappointments and failures along the way.

In my judgment a single unified defence agency combining the Army and Navy would go far towards solving many of the problems to which I have referred. The establishment of a corps of scientifically trained officers, for which persuasive arguments have been offered, is only one step of many which the creation of a unified defence agency would facilitate. It is a step which merits serious attention, whether or not a peace-time scientific agency, of the kind I mentioned before, is created. It envisages the training of a group of talented young scientific men, and others with professional skills, within the existing framework of the Armed Services, as an integral part of the U.S. Army and Navy. Members of this group would have their regular basic military training at the academies. Once their talents were demonstrated, they would be given full opportunity to keep pace with the advance of science by postgraduate work in universities and industry. They would be assigned to the research and development branches of the several services in accordance with proved ability. They would grow within the services, be acquainted with their problems and contribute not only in terms of professional skill, not only in propagating the views of science, but also in linking the scientific and technical activities in universities and industry with the parallel activities of the Armed Services. This is a concept that commends itself to our attention ; it is one on which the U.S. War

Department is most anxious to hear the views and criticisms of industry.

I cannot leave these points without mentioning again the matter of science in education which I referred to before. The future does not belong to us. It belongs to our children and to their children. We must look to them for the future of science. Unless we give them the training, the opportunities, the facilities for turning their talents and their genius into a powerful and disciplined machine, we cannot envisage a bright future for science in America.

It is a heavy assignment of responsibility to say that the future of the United States in peace and in war is to a great extent in the hands of American men of science in industry, in schools, in universities and in government. But I believe the responsibility is properly assigned, and I have confidence it will be met. Vice-President Wallace once stated that science and technology, like good will, have no natural boundaries. The opportunities, the freedom, the security which science can give to our people can be extended to the corners of the earth. By so extending them industry will make its greatest contribution to national security. The perils of war give the precepts of peace. With the help of science and the men and women who make it we shall maintain that peace.

NATIONAL FLOUR (82½ PER CENT EXTRACTION) AND BREAD

Sixth Report from the Scientific Adviser's Division, Ministry of Food

ON October 1 last the extraction of National flour in Great Britain was reduced to 82½ per cent. This lowering of the extraction followed work which showed that the bulk of the vitamins and minerals in the wheat grain are located in the germ, particularly the scutellum fraction, and in the outer endosperm adjoining the bran. Provided these two fractions are included in the flour, there will be no appreciable difference in the nutritive value of 82½ per cent as compared with 85 per cent extraction flour. At the same time, the fall in the extraction makes it possible to exclude about 1·6 per cent of bran (on the average, 85 per cent flour contains 4 per cent bran) and so give a whiter flour and bread. Details of the milling technique necessary to produce a satisfactory 82½ per cent flour have been circulated to all millers[1].

Quality of Flour

Mills were allowed about a fortnight to settle down, after which each mill was instructed to send a 6-lb. sample once a week to the Cereals Research Station, St. Albans, for analyses. These covered colour, fibre, ash, added calcium, iron, vitamin B_1, riboflavin and nicotinic acid; in addition, the flours were examined for baking quality.

It was impossible to examine every sample in every respect each week. Thus, the 'colour' of every sample was judged each week; vitamin B_1 was determined on samples from all the larger mills every week, and on the remainder once in four weeks, thus covering more than 80 per cent of the total national flour production—on a capacity basis—every week; calcium (as added creta præparata) was determined fortnightly on all samples; fibre and ash were determined on all samples sent by Ministry of Food inspectors, while the remainder of the mills were covered in about eight weeks; about forty flours were baked every week, thus covering all the mills in six or seven weeks. All mills included in the survey were grouped according to their capacity (five groups: up to 5, 6–10, 11–20, 21–50, and more than 50 sacks/hr.) and their port area (London, Bristol, Liverpool, Hull, Leith, Glasgow, and Northern Ireland). Aliquots of samples from all mills in the same capacity-group in each port area were bulked together to form a total of thirty compound samples upon which riboflavin, nicotinic acid and iron were determined fortnightly.

The production of a whitish flour of high nutritive value is a new development, and so the analytical results are given in some detail.

Colour Index. Colour (bran speck contamination) was judged on a scale of 0 to 100, where 0 represented a white flour free from visible bran specks, and 100 represented the national average 85 per cent flour (capacity basis) as manufactured during July–September, 1944.

The percentage of all samples examined that fell within the various colour index classes week by week is shown below. The average colour indexes on a mill basis and on a capacity basis are also shown.

Colour Index not exceeding	Week commencing	*A* Oct. 16	*B* 23	*C* 30	*D* Nov. 6	*E* 13	*F* 20	*G* 27
10		3	5	4	5	3	2	2
20		5	8	12	19	15	11	15
30		15	21	29	36	29	30	30
40		27	34	42	49	50	48	50
50		46	49	54	66	54	61	62
60		59	65	69	75	68	77	79
70		76	80	79	87	80	85	89
80		85	87	88	91	92	91	94
90		89	92	92	92	93	94	96
100		91	94	94	96	96	97	98
Average Colour Index	Mill basis	59	55	53	47	49	49	47
	Capacity basis	51	45	43	36	38	38	37
No. of samples		226	226	237	246	248	247	254

Vitamin B_1. The percentage distribution of vitamin B_1 values and the weekly average vitamin B_1 value (mill basis) were as follows:

B_1 (I.U./gm.)	Week commencing	*A* Oct. 16	*B* 23	*C* 30	*D* Nov. 6	*E* 13	*F* 20	*G* 27
1·10 or more		2	0	0	0	0	1	0
1·05 ,, ,,		6	0	0	0	1	2	0
1·00 ,, ,,		18	3	4	4	4	4	3
0·95 ,, ,,		38	17	20	11	20	13	11
0·90 ,, ,,		59	38	43	38	45	38	35
0·85 ,, ,,		79	65	62	58	68	65	53
0·80 ,, ,,		91	88	78	84	89	85	78
0·75 ,, ,,		97	96	90	94	97	95	86
0·70 ,, ,,		99	97	97	98	99	97	93
0·65 ,, ,,		100	98	99	100	99	98	96
0·60 ,, ,,			98	99		100	99	98
0·55 ,, ,,			100	100			100	99
No. of samples		99	118	112	117	112	119	130
Mean vitamin B_1 value		0·92	0·87	0·87	0·86	0·88	0·87	0·85
Per cent of the total milling capacity analysed		82	84	81	83	81	81	83

The average value for vitamin B_1 over weeks *A* to *D* (during which all mills were covered), on a capacity basis, was 0·88 I.U./gm.

Riboflavin, nicotinic acid and iron. The average values for these constituents (mill basis) are given in the following table:

	Fortnight commencing Oct. 16	Oct. 30	Nov. 13	Average for six weeks
Riboflavin (μgm./gm.)	1·0	1·0	1·0	1·0
Nicotinic acid (μgm./gm.)	18	18	19	18
Iron (mgm./100 gm.)	1·99	1·99	1·84	1·94

Ash and fibre. The average ash and fibre determinations (mill basis) on samples sent by mill inspectors were as follows:

Week commencing	*A* Oct. 16	*B* 23	*C* 30	*D* Nov. 6	*E* and *F* 13 and 20	*G* Nov. 27	All samples *A* to *G*
Av. ash (per cent)	0·92	0·87	0·93	0·85	0·90	0·82	0·88*
Av. fibre (per cent)	0·27	0·29	0·28	0·32	0·27	0·30	0·29
Av. fibre (per cent) (corrected for added white flour)	0·29	0·31	0·30	0·35	0·30	0·33	0·31
No. of samples	14	8	11	5	7	11	56

* Includes 0·12% due to added creta.

Creta Præparata. The average value found for the amount of added creta præparata over the last complete month (commencing October 30) was 6·5 oz./sack. The distribution of the figures was as follows:

Creta (oz./sack)	% of all samples
10 or more	4·5
9 ,, ,,	10·2
8 ,, ,,	18·6
7 ,, ,,	36·5
6 ,, ,,	61·3
5 ,, ,,	79·4
4 ,, ,,	90·6
3 ,, ,,	94·7
2 ,, ,,	96·5
1 ,, ,,	98·5

Hence, 60·8 per cent of all the samples had a value lying between 5·0 and 7·9 oz./sack. This table summarizes the results of analyses on 491 samples of flour.

Breadmaking quality. A number of flours were taken at random each week, the object being to cover all mills in due course. These flours were baked in the laboratories under ideal conditions, and the resulting loaves judged for volume, colour and quality of the crumb. The numbers of loaves described as good, fair-good, fair and poor were as follows:

Quality of loaves	Weeks commencing Oct. 16	Oct. 23	Oct. 30	Nov. 6	Nov. 13	Nov. 20	Nov. 27	Total for 7 weeks No. of loaves	% of total
Good	18	25	29	16	26	31	8	153	62
Fair-good	12	5	8	4	5	4	2	40	16
Fair	8	2	6	3	7	6	3	35	14
Poor	7	2	3	1	4	2	1	20	8

Out of the 248 samples of flour examined, 60 (= 24 per cent) showed signs of high maltose due to the inclusion in the grist of sprouted English wheat.

With the fall in extraction from 85 to 82½ per cent, the water absorption of the flour has decreased by ½ gallon per sack. Actually, as shown later, the percentage of Manitoba wheat in the grist has increased from about 40 per cent in the first six months of 1944 to about 57 per cent in October and November. Had the percentage of Manitoba remained at 40 per cent, the water absorption would have decreased by about 1 gallon per sack.

The conversion factor of 82½ per cent flour to bread is approximately 1·33.

Colour of bread crumb and colour index of flour. There was a reasonably good relation between colour of bread and colour index of flour as shown in the following table:

Colour of bread crumb	Mean Colour Index of flours used for baking Oct. 16	Oct. 23	Oct. 30	Nov. 6	Nov. 13	Nov. 20	Nov. 27	Average for seven weeks	
Very pale	34	41	31	35	36	35	32	35	(43)*
Pale	57	52	53	37	49	49	64	52	(33)
Fairly pale	97	80	63	65	55	72	73	71	(18)
Brownish†			95		95	90		92	(4)
Dark brown					100+	100+		100+	

* Figures in brackets are percentages of total number of loaves examined.

† 'Brownish' corresponds to loaf made from average 85 per cent extraction flour.

Correlation Between Flour Colour and Fibre, and Between Flour Colour and Vitamin B_1 Content

Flour colour and fibre. All samples analysed for fibre were arranged in groups according to the colour index, and the average fibre content for each group was calculated. There is a close relationship between colour index and fibre content, indicating that the colour index can be used to give a fair estimate of the fibre content.

Flour colour and vitamin B_1 content. All samples analysed for vitamin B_1 during the last complete month (commencing October 30) were similarly arranged in colour-index groups, and the average vitamin B_1 content of each group was calculated. Since samples from the large mills (more than 20 sacks/hr.) were analysed each week, the monthly averages for vitamin B_1 and colour index were calculated for each mill and these values were used instead of individual determinations. The complete lack of correlation between colour and vitamin B_1 indicates that, in general, millers who are getting good colour in their flour are *not* doing so to the detriment of its B_1 content. This is to be expected since bran, as such, contributes little to the vitamin B_1 content of flour.

Colour Index	Average fibre content (per cent)	Average vitamin B_1 content (I.U./gm.)
10	0·23 (25)*	0·88 (9)*
20	0·24 (15)	0·86 (29)
30	0·24 (19)	0·87 (47)
40	0·27 (14)	0·86 (41)
50	0·28 (20)	0·88 (34)
60	0·31 (26)	0·86 (35)
70	0·33 (27)	0·85 (29)
80	0·34 (28)	0·88 (16)
90	0·36 (8)	0·89 (7)
100	0·38 (13)	0·89 (5)
100+	0·48 (34)	0·89 (9)

* The number of determinations is shown in parentheses.

Comparison of 82½ Per Cent Flour with 85 Per Cent Flour

Average figures for 82½ per cent extraction flour as given above are set against figures for 85 per cent flour as given in the 5th Report[2] (covering 85 per cent flour samples received during January–June, 1944).

		82½% flour		85% flour	
Vitamin B_1 (I.U./gm.)	(Sample basis)	0·88	(807)*	0·975	(346)*
Riboflavin (μgm./gm.)	,,	1·0	(723)	1·3	(346)
Nicotinic acid (μgm./gm.)	,,	18	(723)	17	(346)
Iron (mgm./100 gm.)	,,	1·94	(723)	2·07	(346)
Protein (per cent)	,,	11·6	(245)	10·7	(346)
Fibre (per cent)	,,	0·31	(56)	0·50	(346)
Ash (per cent)	,,	0·88	(56)	0·98	(346)
Colour Index	,,	51	(1684)	—	—
Colour Index	(capacity basis)	41	(1684)	100	(200)

* The values represent averages for the number of samples given in parentheses.

In the report on High Vitamin Flour[1] it was predicted that the lowering of extraction by 2½ per cent would entail a reduction of the bran content of the flour from 4 per cent to 2·4 per cent, and that the 82½ per cent flour would have an average fibre content not exceeding 0·3 per cent. This prediction has been justified in the average figure of 0·29 per cent of fibre (0·31 per cent when corrected for added white flour). This lowering of fibre content is reflected in the lighter colour of the flour. The ash content has also decreased slightly. The vitamin B_1 content has dropped rather more than the theoretical prediction of 0·02 I.U./gm., and this, taken in conjunction with the drop in riboflavin content, suggests that some scutellum and embryo are being lost to the offals.

The iron content has shown roughly the forecast decrease of 0·16 mgm./100 gm. On the other hand, the nicotinic acid content, instead of decreasing, has actually increased slightly. The explanation of this anomaly is probably to be found in the composition of the grists used in milling the 85 per cent flour analysed during the first six months of 1944 and those being used for the 82½ per cent flour in October and November. The following table gives details of the grists.

	Average composition of grist in samples analysed			
	Manitoba wheat	Home-grown wheat	Other wheat	Barley and rye
85 per cent extraction survey:				
January	37·4	59·5	0·5	2·6
February	39·7	57·3	0·5	2·5
March	35·3	61·1	2·1	1·5
April	38·3	58·4	2·8	0·5
May	42·7	53·2	3·6	0·5
June	42·6	54·2	3·0	0·2
82½ per cent extraction survey:				
October 16–30	57·0	38·1	3·8	1·1
October 30–November 13	57·1	38·1	3·8	1·0
November 13–27	57·7	37·7	3·7	0·9

The higher Manitoba content of the grist used in making 82½ per cent flour is reflected in the higher protein content of this flour compared with 85 per cent flour.

Further, Manitoba wheat is richer in nicotinic acid than English wheat. An average figure for Manitoba wheat is 60μgm./gm. against 45μgm./gm. for English wheat.

The amount of added white flour during 1944 has varied between 5 and 12½ per cent. The bulk of this flour is Canadian G.R. (fortified with vitamin B_1 to a level of approximately 1 I.U./gm.), but small quantities of Plate and, just recently, American fortified flour have also been added. Average figures for this last flour are vitamin B_1 1·5 I.U./gm.; riboflavin 2·7 μgm./gm.; nicotinic acid 36 μgm./gm.; and iron 2·9 mgm./100 gm. It is understood that during the period when the 82½ per cent flour samples were analysed, the overall addition of American enriched flour was well below 2 per cent. Even at 2 per cent level, however, the American flour would only increase the values for 82½ per cent flour by the following amounts: vitamin B_1, 0·01 I.U./gm.; riboflavin, 0·03 μgm./gm.; nicotinic acid, 0·4 μgm./gm.; and iron, 0·02 mgm./100 gm. Plate flour and Canadian G.R. flour (except as regards vitamin B_1, where it has no effect) would act in the opposite direction.

Quality of Bread

971 commercial loaves from different parts of Great Britain have been examined during the period October 1–November 30. These were graded for quality (commercial standards) with the following results:

Good	=	98 loaves	=	10·1	per cent
Fair-Good	=	427 ,,	=	44·0	,, ,,
Fair	=	266 ,,	=	27·4	,, ,,
Poor	=	180 ,,	=	18·5	,, ,,

Unfortunately, this harvest was a particularly wet one, and much British home-grown wheat sprouted in the stack. Such wheat has a high maltose content and tends to give a loaf with a doughy crumb. The results, described earlier in this report, showed that some 24 per cent of the flours received from mills gave loaves showing high maltose damage. Of the commercial loaves 298 (= 31 per cent) showed the same defect, and as a result the total percentage of 'Good' and 'Fair-Good' loaves (54 per cent in all) was lower than would otherwise have been the case. There was, however, a marked improvement in the colour of the loaves compared with those made from 85 per cent flour.

This work was carried out at the Cereals Research Station, Ministry of Food, St. Albans.

[1] "High Vitamin Flour" (Ministry of Food, October 1944). cf. also *Milling*, Nov. 4, 1944.
[2] *Nature*, 154, 582 (1944).

OBITUARIES

Prof. C. G. Barkla, F.R.S.

CHARLES GLOVER BARKLA, Nobel Prizeman in Physics for the year 1917, died at his home, Braidwood, Edinburgh, on October 23. The news came as a shock to his friends, for his death occurred rather suddenly. He had been in poor health for some months and had undergone an operation in June. He had, however, recovered from that and was back at work, looking well and seemingly his bright, happy self again, when suddenly he collapsed, was ill for a week and died.

Barkla was the son of John Martin Barkla, a former secretary of the Atlas Chemical Company of Widnes, in which town Charles was born on June 7, 1877. He was educated at the Liverpool Institute, from which he proceeded to University College, Liverpool, where he read for an honours degree in physics. He graduated in 1898 and obtained the master's degree in the following year. In 1899, on the nomination of his College, he was awarded a research scholarship by the Royal Commissioners for the Exhibition of 1851, and went to Cambridge in the autumn of that year, being admitted to Trinity College as an 'advanced student'. He began research work at the Cavendish Laboratory by investigating the velocity of electric waves along wires of various materials and of different thickness. He studied also the absorption of electric waves by dielectrics. The scholarship was in the first instance for two years, but Barkla's tenure was exceptionally renewed for a third year. It was during this additional year that he commenced his investigations of secondary X-radiation, and so entered the field of research work with which his name will always be associated.

After one year at Trinity, Barkla migrated to King's College. He possessed a powerful baritone voice and during his first year at Cambridge had contemplated the delight of singing in the choir of a chapel of the size and magnificence of King's. Dr. Mann, the organist of King's, encouraged the migration, and Barkla became a member of King's College choir and a regular attendant both at practices and services. His magnificent singing added to the reputation of the College chapel in that respect, and, in his last year at Cambridge, if it became known that Mr. Barkla was to sing the solo part in an anthem, the great chapel of King's was crowded for the occasion.

On leaving Cambridge in 1902, Barkla was elected to the Oliver Lodge fellowship of the University of Liverpool, which he held for three years, continuing his researches on X-rays. During the period 1905–9 he was successively demonstrator, assistant lecturer in physics and special lecturer in advanced electricity at the University. He was then appointed to the Wheatstone chair of physics in the University of London (King's College) in succession to H. A. Wilson, who was leaving to succeed Rutherford at Montreal.

The Royal Society elected Barkla to its fellowship in 1912, and in the following year he accepted the professorship of natural philosophy in the University of Edinburgh, which he held until his death.

During the most active period of his life, Barkla's investigations dealt mainly with X-rays and their absorption by matter, and with the emission of secondary radiation. He was the first to show that the secondary emission is of two kinds, one consisting of X-rays scattered unchanged in quality, and the other a 'fluorescent radiation', characteristic of the scattering substance and accompanied by selective absorption of the primary beam. The secondary radiation of the first kind Barkla showed to be polarized, an experimental result of fundamental importance, for it indicated that X-radiation was to be regarded as similar to ordinary light, a point which, up to that time, was thought to be doubtful.

For the discovery of the characteristic radiation and for the explanation of its origin Barkla was most deservedly awarded the Nobel Prize for Physics in the year 1917. His outstanding achievements were also recognized by the Royal Society, which appointed him Bakerian Lecturer for 1916 and awarded him the Hughes Medal in the following year.

Barkla was a successful teacher who inspired many of his pupils with an enthusiasm for research. He was in great request as an examiner in physics, and few excelled him at this work. His long experience of students in three universities, the wide range of his knowledge of physics, his judgment and common sense made him an eminently fair and discriminating examiner. He would re-read with extreme patience (not always shared by his co-examiner) any script of a 'border-line' candidate which he found difficult to assess, and his verdict, when finally delivered, could be accepted with confidence.

While a lecturer at Liverpool, Barkla married Mary Esther, eldest daughter of the late John T. Cowell, receiver-general of the Isle of Man. He leaves two sons and a daughter. Only in the last year was his life clouded by indifferent health; but the family had previously suffered a grievous loss by the death at Carthage in August 1943 of the youngest son, Flight-Lieutenant Michael Barkla, whose achievements at school and at the university had given promise of a career no less brilliant than that of his distinguished father.

Those who were privileged to know Barkla well will treasure the memory of his open-hearted friendliness and personal charm, of the delights of the Hermitage of Braid—his earlier home in Edinburgh—and of the almost idyllic happiness of his domestic life there. Frank Horton.

Prof. G. D. Birkhoff

The many friends of Prof. G. D. Birkhoff on the eastern side of the Atlantic are deeply grieved to hear of his death on November 12. For a whole generation he had been a commanding figure among mathematicians and a link between American men of science and their colleagues in both western and eastern Europe.

George David Birkhoff was born at Overisel, Michigan, on March 21, 1884; as the name would indicate, his family was originally Dutch, but it has long been settled in the United States. He studied first at Chicago and then at Harvard, returning to Chicago for his doctorate; and, after a short period as instructor in the University of Wisconsin, was appointed assistant professor of mathematics at Princeton in 1909. It was here that he wrote the memoir on the "General Theory of Linear Difference Equations" (*Trans. Amer. Math. Soc.*, 1911) which first brought him into prominence; the "Jahrbuch über die Fortschritte der Mathematik" devoted more than two pages to a notice of it, a rare honour for a young and unknown author. Fundamental solutions of linear difference equations with rational coefficients were obtained for the entire plane of the complex variable by direct matrix methods, and their nature was studied from the functional point of view. Birkhoff showed that there exists a purely Riemannian theory of the equations, and found quantities which play a part like that of the monodromic group constants of an ordinary linear differential equation. His methods were of wide generality, and the paper constituted a striking advance in the subject, to which he made further contributions from time to time, notably in a memoir in *Acta Math.*, **54** (1930).

A closely related branch of mathematics which also owes much to Birkhoff is the theory of linear differential equations, on which he published many memoirs from 1910 onwards (*Proc. Amer. Acad.* and *Trans. Amer. Math. Soc.*); the earlier ones were particularly concerned with the problem of constructing systems of linear differential equations with prescribed singular points of given character and with a given monodromic group.

Birkhoff's interests were shared between pure and applied mathematics, and his work in dynamics was of great value. In an extensive memoir—almost a complete treatise—on "Dynamical Systems with Two Degrees of Freedom" (*Trans. Amer. Math. Soc.*, **18**; 1917), he reduced all problems relating to such systems, even in the 'irreversible' case, to the problem of determining the orbits of a particle constrained to move on a smooth surface which rotates about a fixed axis with uniform angular velocity and which carries with it a conservative field of force; and he showed how the existence of periodic solutions may be directly inferred, and their form determined. This investigation was followed by others, especially on periodic orbits and the problem of three bodies (*Acta Math.*, *Amer. J. Math.* and elsewhere); a connected account of much of his dynamical work appeared in 1927 as one of the American Mathematical Society's Colloquium volumes, under the title "Dynamical Systems".

His two books on relativity, "Relativity and Modern Physics" (1923) and "The Origin, Nature, and Influence of Relativity" (1925) were useful and widely read, and characteristically original in treatment.

In later life, Birkhoff became much occupied with the discovery of mathematical relations in æsthetics. As is well known, more than two thousand years ago Pythagoras founded the scientific theory of music by showing that simple numerical ratios exist between the lengths of the strings the notes of which yield agreeable melodic progressions. Birkhoff's aim was to create a theory of similar character for the fine arts: the results obtained were described in his book "Aesthetic Measure", published in 1933.

Birkhoff was professor of mathematics in Harvard University from 1919 onwards, president of the American Mathematical Society during 1924–26, president of the American Association for the Advancement of Science during 1936–37; an honorary doctor of many American universities and of St. Andrews, Poitiers, Paris, Athens and Sofia;

a foreign member of many European academies (including the Institut de France, the Lincei and the Pontifical Academy) and mathematical societies, and an Officier de la Legion d'honneur. His last years were gladdened by the knowledge that his brilliant son Garrett was steadily advancing towards a position in the world of mathematics not inferior to his own.

E. T. WHITTAKER.

Dr. O. F. Bloch

OLAF BLOCH was a man of remarkable energy largely applied to the progress of photographic science and in furthering the application of photography as a tool in many branches of science and technology. He received his earliest scientific training at the Finsbury Technical Institute under Prof. H. E. Armstrong, and having spent some years in the Davy Faraday Laboratory and in chemical manufacture, he joined the staff of Ilford, Ltd., in 1910. Little can be written of his very successful work over many years to produce improved light-sensitive materials, for much of it was made known only to his closest associates and publication in this field is rare; but mention may be made of important work with F. F. Renwick on the optical properties of photographic layers, and early attempts, with Miss F. M. Hamer, to relate the chemical structure of cyanine dyes with their sensitizing properties.

As secretary of the Scientific and Technical Group of the Royal Photographic Society in the years following the War of 1914–18, Bloch took a leading part in organizing an attack on the problem of the sensitometric testing of photographic materials, leading to recommendations to the Sixth International Congress of Photography in Paris in 1925.

Bloch became chief chemist of Ilford, Ltd., in 1930, and his devoted work for the Royal Photographic Society was recognized by his election to the presidency in the following year. His ready wit and wide knowledge made him a most popular lecturer, and he addressed many of the learned societies in Great Britain. He will be particularly remembered for his accounts of the many applications of infra-red photography, just then made really practicable by the discovery and application of thiatricarbocyanines. Later he turned to demonstrating the importance of photography as an indispensable tool in many branches of science and industry, and in these lectures Bloch referred always to his conviction that photography is grossly neglected by British universities as a subject for teaching and research. The foundation of a chair of photographic science at a university in Britain was a cause very dear to him, so that he found particular pleasure in helping academic scientific workers in their photographic problems. Thus by collaboration with Dr. F. W. Aston he produced plates especially designed for recording atomic particles of low penetration, and these were used in the classical investigation of isotopes. A range of materials of special characteristics and spectral sensitivities was prepared for use in astronomy and related sciences. More recently, Bloch eagerly accepted opportunities to collaborate with atomic physicists to evolve photographic emulsion layers of value in recording tracks produced by penetrating atomic particles.

These and other services to scientific investigation were recognized by the University of Aberdeen by the award of the honorary degree of LL.D. He received the Progress Medal of the Royal Photographic Society, and, appropriately, was chosen to preside at the commemoration of the centenary of photography at the Royal Society of Arts in 1939.

Away from his work, Bloch had a remarkable range of interests; he was deeply appreciative of literature and the arts, and was a keen gardener with an encyclopædic knowledge of garden plants. Taking up alpine mountaineering with characteristic enthusiasm when more than fifty years old, he qualified for membership of the Alpine Club. He died on October 19 at the age of seventy-two years.

C. WALLER.

WE regret to announce the following deaths:

Sir John Fox, C.B., O.B.E., F.R.S., Government chemist, on November 28, aged seventy.

Sir Percy Nunn, first director of the Institute of Education, University of London, on December 12, aged seventy-four.

NEWS and VIEWS

Ethics of Scientific Investigation

IN his address "Human Nature in Science" to the Section on Geology and Geography of the American Association for the Advancement of Science, delivered at Cleveland on September 13, 1944 (*Science*, **100**, 299; 1944), Dr. J. K. Wright gave a highly stimulating discussion of some relations between human nature and science as they might be set forth in such a manual for science as Macchiavelli wrote for princes. Analysing first the personal qualities that influence scientific research, especially originality, open-mindedness, precision and scientific consciousness or the ability to discriminate between motives, Dr. Wright indicates the dangers which may attend excess of any one of these qualities. He surveyed next the motives for scientific research; these are first classified as pro-scientific, anti-scientific or non-scientific, according to whether they promote, retard or have no effect on the advancement of science; and again as personal, group or disinterested motives, depending on whether they spring from a desire to serve individual, group or no particular interests. In this analysis, Dr. Wright has wise and stimulating words about opinions or judgments of the relative worth of scientific investigations. Qualitative judgments are fairer than formal judgments, for they take account of the degree of good sense, originality, accuracy and open-mindedness to which the study bears witness, as well as of the suitability of the form and substance to the solution of the problem in hand. The preliminary work required before scientific laws can be formulated may be quite as scientific as the subsequent processes of interpretation to which it leads; and an economic law may be fully as scientific as the law of eclipses, provided all available evidence is used in developing the economic law—and used with the same degree of rationality as that attained in developing the astronomical law.

The vacancies advertised in these columns are available only to applicants to whom the Employment of Women (Control of Engagement) Orders, 1942-3, do not apply.

MURDOCH TRUST

For the BENEFIT of INDIGENT BACHELORS and WIDOWERS of good character, over 55 years of age, who have done "something" in the way of promoting or helping some branch of Science.

Donations or Pensions may be granted to persons who comply with these conditions.

For particulars apply to MESSRS. SHEPHERD & WEDDERBURN, W.S., 16 Charlotte Square, Edinburgh, 2.

THE POLYTECHNIC

REGENT STREET, LONDON, W.1.

A Course of Ten Lectures on "SOME INDUSTRIAL APPLICATIONS OF STATISTICAL METHODS" will be given on Tuesday evenings from 7 to 8.30, beginning on January 16, 1945. Fee—One Guinea.

Applications to attend the Course should be made to the Head of the Department of Mathematics and Physics as soon as possible.

VACANCY FOR SENIOR FIELD ASSISTANT

AT THE SUGAR RESEARCH OFFICE OF THE SUGAR MANUFACTURERS' ASSOCIATION (JAMAICA), LTD.

The Sugar Research Department of the Sugar Manufacturers' Association (of Jamaica), Ltd., require the services of a Senior Field Assistant for sugar cane experimental work.

The candidate should have a degree or diploma in Agriculture from a recognized University or College. Experience in tropical agriculture and knowledge of agricultural statistics will be an advantage.

Salary scale £650—£25—£750 per annum, with travelling and subsistence allowances. Free passages provided. It is intended to introduce a contributory provident fund scheme.

Appointment will be made initially on an agreement for three years, subject to a specified period of notice on either side.

In view of the development of Sugar Research in Jamaica, prospects of advancement are good.

Application, with references and copies of testimonials, should be sent, by February 28, 1945, to The Sugar Research Officer, Sugar Research Office, 162, Hope Road, Liguanea P.O., Jamaica, B.W.I.

MANCHESTER MUNICIPAL COLLEGE OF TECHNOLOGY

(Faculty of Technology in the University of Manchester)

The Governing Body invites applications for:

(a) An Assistant Lectureship in Mechanical Engineering; (b) an Assistant Lectureship in Electrical Engineering; with the title and status of Assistant Lecturer in the University of Manchester.

Importance is attached to practical experience and ability to undertake research, for which wide facilities are available. In the case of (b) practical works experience in heavy electrical engineering is desirable.

Salary, £300 per annum, rising by annual increments of £25 to £400 per annum, plus war bonus (which, at the present time, is £52 per annum). Commencing salary according to qualifications.

Conditions of appointment and form of application may be obtained from the Registrar, College of Technology, Manchester, 1. The last day for the receipt of applications is Friday, Jan. 12, 1945.

Canvassing, either directly or indirectly, will disqualify a candidate for appointment.

J. E. MYERS,
Principal of the College.

DERBY TECHNICAL COLLEGE

NORMANTON ROAD, DERBY

Applications are invited for the post of full-time Lecturer in the Department of Chemistry, to commence after the Easter vacation. Candidates must have a good honours degree in Chemistry of a British University, and industrial and/or research experience would be an advantage.

Salary according to Burnham Scale, plus bonus. —Application forms and further particulars may be obtained from the undersigned and should be returned by Jan. 10, 1945.

W. ALFRED RICHARDSON,
Principal.

EMSLIE HORNIMAN ANTHROPOLOGICAL SCHOLARSHIP FUND

The Trustees invite applications from British subjects for Emslie Horniman Anthropological studentships. The studentships are open to University Graduates and to others able to show that they are likely to profit by the study of anthropology; they will normally be tenable for a maximum period of two years at any recognised University and may include a period of fieldwork. The studentship grants will be determined according to the course of study pursued and the circumstances of each case. Cost of living, University dues, travelling, and fieldwork expenses will be taken into consideration.—Applications must be received not later than March 1, 1945. Full particulars may be obtained from the Secretary, Emslie Horniman Anthropological Scholarship Fund, 21 Bedford Square, W.C.1.

THE WEST OF SCOTLAND AGRICULTURAL COLLEGE

The Governors invite applications for the post of Assistant to the Advisory Officer in Animal Husbandry. Applicants must have a Degree in Pure Science or in Agriculture and have experience of animal husbandry.

Salary ranges, according to age, qualifications, and experience (plus appropriate war bonus) are: Men, £300 to £400; Women, £240 to £320.

Particulars of the terms and conditions of appointment may be had from the undersigned with whom applications are to be lodged not later than Jan. 10, 1945.

A. J. WILSON,
6 Blythswood Square, Glasgow. Secretary.

UNIVERSITY OF LEEDS

DEPARTMENT OF BOTANY

Applications are invited for temporary appointment as Demonstrator or Assistant Lecturer in Botany. Duties to begin in January, if possible. Commencing salary (according to qualifications and experience): Demonstrator £275: Assistant Lecturer £300/£350. Applications, stating age, qualifications and experience, and accompanied by testimonials and/or the names of referees, should reach the Acting Registrar, The University, Leeds, 2, on or before Dec. 30.

UNIVERSITY OF BRISTOL

ENTRANCE SCHOLARSHIPS

The University will proceed to award Scholarships (value £100) for the Session 1945-6 for the Faculties of Arts, Science, Medicine, Engineering, and Law, after an examination to be held in the spring of 1945.—Details of the examination and application forms may be obtained from the Registrar, The University, Bristol, 8.

UNIVERSITY OF BRISTOL

The University invites applications for the post of LABORATORY STEWARD in the DEPARTMENT OF PATHOLOGY. Salary according to qualifications and experience from £200 p.a. Applications, with copies of two recent testimonials, should reach the undersigned as soon as possible.

WINIFRED SHAPLAND,
Secretary and Registrar.

THE ROYAL CANCER HOSPITAL (FREE)

FULHAM ROAD, LONDON, S.W.3

An Assistant Cytologist required to take part in routine and research investigations on cancer. Commencing salary not less than £400 per annum, according to experience.—Applications should be made before Feb. 1, 1945, to the Secretary of the Hospital, from whom further information may be obtained.

UNIVERSITY OF LEEDS

DEPARTMENT OF AGRICULTURE

Applications are invited for the position of temporary Assistant to the Advisory Chemist. Candidates should possess a degree, or equivalent qualification, in Chemistry or Agricultural Chemistry. Salary scale £200 to £300, plus bonus. Further particulars from the Registrar.

RADIUM CUSTODIAN

A Deputy Assistant Radium Custodian (female) is required in the Radium Department of St. Bartholomew's Hospital, E.C.1, to begin duty in January. Salary £175 to £200 per annum. —Applications from suitably qualified persons should be sent to the undersigned, from whom further particulars can be obtained.

C. C. CARUS-WILSON,
Clerk to the Governors.

UNIVERSITY COLLEGE OF NORTH WALES, BANGOR

A Temporary Assistant Lecturer is required immediately in the Department of Botany. Specialized knowledge of plant physiology is desirable. Appointment for the current session in the first instance. Salary at rate of £350 p.a.

F. P. G. HUNTER,
Bursar and Acting Registrar.

Scientific Apparatus Manufacturers and LABORATORY FURNISHERS in London area have the following staff vacancies with good future prospects: TECHNICAL REPRESENTATIVE of University standard in science or with extensive trade experience, with personality and initiative. Applicant should be prepared to undergo 6—12 months' training in our internal organization. ASSISTANT BUYER for section of Buying Department purchasing electrical components and light engineering parts for assembly. Applicant should have sound electrical knowledge, business experience, and be capable of carrying out instructions from Production and Designs Departments. May be required to undergo preliminary training in workshops. ASSISTANT ESTIMATING CLERK with secondary education, matriculation standard in science, or with laboratory experience giving a broad knowledge of scientific apparatus. A person previously employed as a laboratory assistant or technician would be suitable. Good handwriting essential. ASSISTANT STOCKKEEPERS (two), of good education, preferably with scientific knowledge. Persons previously employed as laboratory assistants or technicians would be suitable.—Write, giving full particulars, including age and salary required, to Staff Manager, Box No. 283, T. G. SCOTT & SON, LTD., 9, Arundel Street, London, W.C.2.

Sudan Government. Applications are invited for the post of INSPECTOR OF AGRICULTURE, on a short-term contract of five years. Candidates must have had a thorough practical training and experience in agriculture, and should preferably be holders of a University Degree in Agriculture. Tropical experience will also be useful. Age 35 to 45. Slight physical disability would not necessarily debar candidates. Commencing salary £E.800 to £E.1,000 per annum (£E.1=£1 0s. 6d.). Free passage on appointment. At the present time there is no Income Tax in the Sudan. Applicants should write, quoting F.8285A, to the Ministry of Labour and National Service, Central (T. & S.) Register, Room 5/17 Sardinia Street, Kingsway, London, W.C.2, for the necessary forms, which should be returned completed on or before Jan. 2, 1945.

University of London. The Senate invite applications for the University Chair of Concrete Technology tenable at Imperial College of Science and Technology. Salary £1,250 a year.—Applications must be received not later than first post on Feb. 26, 1945, by the Academic Registrar, University of London, Richmond College, Richmond, Surrey, from whom further particulars should be obtained.

Applications are invited from Metallurgists, Physical Chemists, Physicists, and Engineers for appointments to the Research and Development staff of a Company in the London area. Appointments will be made to Junior and Senior posts. Applicants should have had a sound scientific education, and considerable importance is attached to character and personality.—Applicants should give details of training, experience, and references to Box 286, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Young Lady wanted for Secretarial work in Research Department of a well-known Industrial Undertaking near London Bridge. Shorthand and typing required. Ability to abstract scientific journals an advantage. State salary required.—Box 284, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

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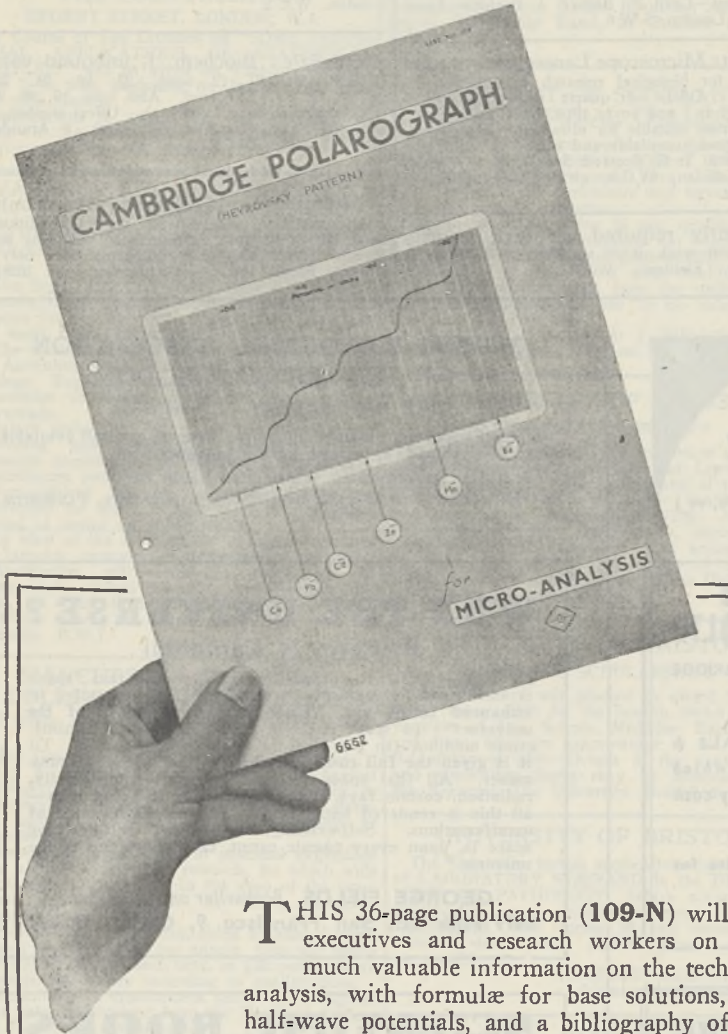
CERAMICS
WATER PURIFICATION



(*v.* J. E. Page, NATURE, 1944, **154**, 199–12th August.)

THIS 36-page publication (**109-N**) will be sent to responsible executives and research workers on request. It contains much valuable information on the technique of polarographic analysis, with formulæ for base solutions, tables and charts of half-wave potentials, and a bibliography of 168 important references. A special feature is the reproduction of actual records obtained in original experiments in our own laboratory. A supplement describes the new Cambridge Voltamoscope, for routine determinations, which performs the same functions, but is non-recording.

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With regard to pragmatic opinions which rate scientific researches in terms of their effects, incomplete and even earlier studies of little understood but important phenomena may have more far-reaching and beneficial effects than studies of higher quality that deal either with inconsequential matters or with matters already well understood in their essentials. Great works of compilation may be rated very high from the pragmatic point of view, because of the many practical purposes they serve and the stimulus they furnish for the development of scientific theories. Pragmatic opinions also largely fashion the response of the scientific worker to group motives, and here Dr. Wright stresses obstacles which anti-scientific practices arising from such motives offer to the advancement of science. Three types are indicated: the wilful distortion of truth to mislead rival groups; suppression of the results of scientific research to prevent rivals benefiting by them; and use, as in war, of the results of scientific research to injure rival groups. Ethics and science, he holds, are inextricably linked, and unethical practices are not only anti-social but also anti-scientific. Again, he urges that the advancement of science demands the continuous discovery of new truths and the continuous development of new hypotheses, for which the fullest and freest possible interchange of knowledge is prerequisite. Dealing briefly in conclusion with the effects of war on science and with the reconstruction of scientific endeavour after the War, Dr. Wright admits that war may lead to rapid advances along certain specific lines of research, but suggests that the transition problems may be even more difficult than those in waging war itself. He urges concentrated effort to forestall the loss or destruction of the masses of information accumulated for war-time purposes.

Incentives in Industry

IN an address to the Leicester Centre of the Institute of Industrial Administration on "Incentives for Indirect Workers" (*J. Inst. Indust. Admin.*, **5**, 14; 1944), Mr. Harold White gives an interesting analysis of the incentives affecting workers not directly engaged in manufacturing processes or the assembly or finishing of products. After discussing the characteristic features of the indirect worker's job, he indicates seven types of incentive—particular interest in the type of work, personal pride in the apparent importance of the position held, increase in rate of pay, opportunities for promotion, bonuses based on earnings of direct workers, *ex gratia* bonuses, and permanency of position—the effectiveness of which depends largely on the intelligence and ambition of the individual and the general nature of his job. Factors on which actual bonus schemes have been based are next considered, and Mr. Whitehead's review of these schemes leads him to six conclusions, as follow. The big majority had proved sufficiently satisfactory to be considered a permanent feature of the company's policy. The more direct the bonus to the indirect worker, the better the response. Confidence in the management is essential to the success of a scheme. 'Ready-made' schemes are dangerous; no standard programme of incentives can be laid down for adoption without studying and evaluating internal circumstances. An incentive plan for indirect workers cannot be established by intuition: it demands thorough and careful forethought. The probable results, in cash, to the indirect workers must be fully considered, so that the probable amount is a real incentive, and not merely a financial liability to the company.

Science in Post-Primary Education

AN interim report has recently been compiled by the Association of Women Science Teachers with the view of submitting a scheme for the teaching of science in the post-primary schools of the future (An Interim Report of a Sub-Committee of the Association of Women Science Teachers. Pp. vi+22. London: John Murray, 1944. 1*s*. 3*d*. net). The sub-committee which submitted this report considers the needs of all types of children within the secondary school range, dealing fully with the ideals that should permeate the science teaching and with the need for a change of outlook. Although the present publication outlines full syllabuses for children of eleven to sixteen years only, a subsequent publication, already in preparation, will also contain chapters on sixth form science, part-time education in science, the training of teachers and administrative problems. A useful chapter on laboratories and equipment, the museum, first aid, organization of department and other matters will be appended.

The five-year course of general science suggested is based on the fundamental principles of social relationships; selection from the syllabuses, by the teacher, will be necessary, as these syllabuses are thought to contain the maximum for children of the highest intelligence, given the best opportunity. For the first two years, the topics considered are the universe and its attributes of light, heat and gravitation, water, air, land and people; for the last three years those of energy, matter and life. Methods of presentation are discussed and time allowances for science recommended. A progressive outlook has produced syllabuses that are less academic than usual, although the experimental and objective attitude to problems is regarded throughout as of paramount importance.

Royal Institution

DR. L. R. G. TRELOAR delivered a discourse at the Royal Institution on December 15, speaking on "Rubbers and their Characteristics: Real and Ideal". He pointed out that although rubbers are diverse in chemical constitution, they all conform to a general type of molecular structure, and it is in this structure that the origin of the remarkable physical properties of rubbers is to be found. All rubbers are built up of enormously long chain-like molecules which are linked together so as to form a loose three-dimensional network. The atoms of the molecular chain are in a state of continuous motion, due to their thermal energy; hence the molecule tends to take up a randomly-kinked, continuously fluctuating form, in which its effective length is only a small fraction of the full chain-length. As a result, the molecule exhibits elasticity. The elasticity of rubbers, like that of gases, is thus kinetic in origin. Rubber-like elasticity is always limited to a certain range of temperature, varying with the chemical constitution of the molecule. At low temperature, rubbers are transformed to a glass-hard condition, whereas at high temperatures they tend to lose strength and to approach the condition of a highly viscous liquid. In some rubbers, also, a crystalline state is possible. Crystallization develops slowly in natural rubber at low temperatures, but it may be produced almost instantaneously by stretching at normal temperatures. Crystallization profoundly affects the physical properties of rubber, and its study has had an important bearing on the elucidation of its molecular structure.

White Rainbow at Malvern

An account of a white rainbow has been received from Mr. R. H. Stevens of "Rockland", Cowleigh Road, Malvern. The bow was seen at about 10.30 a.m. on November 8 after a short snowstorm, but no snow could be seen to be falling at the time of the observation. The white rainbow, also known as the 'fog-bow' or 'Ulloas Ring', is a rare phenomenon due, as in the case of the ordinary coloured rainbow, to refraction and reflexion of sunlight in falling drops of rain, but the raindrops composing the cloud must be very small—0·1 mm. or less in diameter. When this is the case, the first maxima of intensity for the different colours of the spectrum are spread out over a wider angle than with the larger drops, and are nearly coincident, the result being approximately to restore the original colour of the sunlight. The bow is only bright enough to be visible in exceptionally favourable circumstances and when the observer is near the cloud which contains the small drops. In this instance the previous occurrence of snow must be assumed to have been fortuitous, the snow probably having originated from clouds at a higher level than that of the cloud which carried the water drops.

Recent Earthquakes

During August 1944, five strong earthquakes were registered by the seismographs at the Dominion Observatory, Wellington, New Zealand. The first of these, on August 8, from an estimated epicentral distance from Wellington of a little more than 48°, had a depth of focus near 80 km. Those of August 15, 25 and 30 all had a depth of focus near 100 km. In addition, thirteen earthquakes and tremors originated in or near New Zealand during the month and were felt by people in the Dominion. The strongest of these, on August 16, was felt with intensity 5 on the modified Mercalli scale in the region of Kahurangi Point. Others with intensity 4 were in the southern part of North Island on August 14 ; on the west coast of the North Island—Wanganui—Wellington, on August 17 ; and in the Wairarapa and north Wellington region on August 26.

The United States Coast and Geodetic Survey in co-operation with Science Service and the Jesuit Seismological Association has determined the provisional epicentres of three earthquakes on September 23, October 2 and 6. The earthquake of September 23, which took place about 12h. 13·3m. G.M.T., had its epicentre near lat. 53·5° N., long. 160·7° E., which is in the Kamchatka Peninsula. It was reported as registered by fourteen seismological stations. The earthquake of October 2 at 17h. 21·9m. G.M.T. had its epicentre near lat. 14·5° N., long. 90·1° W., which is in Guatemala. The shock of October 6 at 2h. 34·7m. G.M.T. occurred at lat. 39° N., long. 27° E., which is in Turkey. The earthquakes of September 23 and October 6 were registered by Mr. E. W. Pollard at his observatory at Binstead, Isle of Wight. Between August 2 and October 31, Mr. Pollard's home-made apparatus registered twenty-three earthquakes and tremors, mostly from large distances.

Recordings for the period October, November and December 1943 have just been received from Suva, Fiji. Altogether thirty-seven earthquakes were registered during the period. These registrations are most useful when taken in conjunction with those of New Zealand, Australia and America.

Scientific Literature for Liberated Europe

An appeal, signed by Sir William Beveridge, Prof. P. M. S. Blackett, Mr. E. Carter, Mr. J. G. Crowther, Dr. C. D. Darlington and Sir Richard Gregory, has been issued for literature dealing with advances made in Allied Countries during the War for dispatch to liberated Europe. In particular, French men of science need this material as quickly as possible. In Paris, there is gas and electricity for only one or two hours in the evenings, so that experimental work is scarcely possible. All material sent to France would be fully used. Literature would go to the Centre National de Recherche Scientifique in Paris, which is in touch with the whole body of French scientific workers. Single copies would be microfilmed, and films and abstracts distributed. Thus the greatest possible use could be made immediately of any periodicals that can be sent to them. Sets of journals and single copies should be sent to the Association of Scientific Workers, Hanover House, 73 High Holborn, London, W.C.1.

Conference on the Place of Science in Industry

The Division for Social and International Relations of Science of the British Association is arranging a conference on "The Place of Science in Industry" to be held on January 12 and 13 at the Royal Institution, Albemarle Street, London, W.1. The conference will be opened by Sir Richard Gregory, president of the Association, and there will be four sessions, at which the chair will be taken respectively by Mr. Ernest Bevin, Lord McGowan, Sir John Greenly and Lord Woolton. The subjects of the sessions will be : what industry owes to science, fundamental research in relation to industry, industrial research and development, and the future—what science might accomplish. A limited number of tickets will be available for the public other than members of the Association, and may be applied for at the office of the British Association, Burlington House, London, W.1.

Announcements

Dr. Sidney E. Smith, who recently resigned from the presidency of the University of Manitoba to take up the appointment of principal of University College, Toronto, and executive assistant to the president of the University of Toronto, the Rev. H. J. Cody, will succeed Dr. Cody as president on July 1, 1945.

The Langley Memorial Prize, value £21, is open to competition among officers of the Colonial Medical Service who are serving, or who have served, in West Africa. The prize will be awarded for a paper on (a) tropical medicine or surgery ; (b) tropical hygiene and sanitation ; or (c) tropical entomology and parasitology. Papers, which may consist of either published or unpublished work, should be delivered to the Secretary, London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1, not later than October 1, 1945.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. No notice is taken of anonymous communications.

Penicillin in Yaws and Tropical Ulcer

PENICILLIN has not, up to the present, been extensively employed in tropical medicine. There is, however, evidence that, among other conditions, penicillin has an action in syphilis[1-2], on *Spirochæta recurrentis* infections in mice and on *Spirillum minus*[3] as well as possibly on *Leptospira icterohæmorrhagiæ*[4]. Evidence which is here presented shows that penicillin is of value in yaws and tropical ulcers, which form two of the greatest problems in tropical medicine. Ulcers during the present year, 1944, have, for example, been responsible for the loss of 30,000 men-days among West African troops.

A total of twenty-four cases of yaws in children has now been treated; two were primary, the remainder secondary. 50,000–100,000 Oxford Units have been injected intramuscularly over 12–24 hours. The results are dramatic, and nineteen cases were clinically cured in an average time of 6½ days.

In the two cases of primary yaws, complete cure with reversal of the Kahn test was effected within 7 days. In the secondary cases, the 'snuffles' disappeared, the papules desquamated and the typical yaw dried up and lost its yellow colour within 24 hours. Afterwards, within 2 to 10 days scabs had fallen off and the only stigmata of secondary infection were white or grey-brown scarred areas.

In one case where a severe bismuth stomatitis had developed in a child following 1·5 grains of 'Sobita', penicillin produced a rapid cure both of the yaws and the stomatitis within 48 hours.

Typical cases are as follows:

Case 11. *Akusa*. Female. Aged 9 months. Achimota Village. A case of large primary yaw involving almost the whole of the sole of the left foot. Kahn and Ide tests both positive. 100,000 units of sodium penicillin given over 24 hours, and penicillin ointment applied to sole. After 2 days the primary had decreased in size and was drying up. After 6 days the foot was healed. Kahn and Ide negative. The foot was re-examined after 15 days and was found to be perfectly healed; no secondary rash.

Case 17. *Fahti*. Female. Aged 12 years. Fulani Zongo Village. Primary lesion on left knee six months ago, which was still present: has had generalized papular rash for 4 months. Kahn and Ide tests both positive. 100,000 units of sodium penicillin given over 12 hours. Within 24 hours, distinct flattening of some of the papules, and in others early desquamation. After 10 days, site of papules denoted only by areas of hyperpigmentation and the primary site by a grey-brown scar. Kahn and Ide positive.

Case 16. *Owudu*. Male. Aged 2½ years. Fulani Zongo Village. Primary lesion on inner border of right thigh, 8 months ago. This was still present. Multiple secondary lesions for the last six months, the main sites being chin and neck, abdomen, perineum and occiput. Also had a running nose. Ide test positive. Spirochætes demonstrated from the yaw in large numbers. 100,000 units of sodium penicillin over 12 hours intramuscularly. Within 24 hours the primary lesion had dried up, and presented a pink glazed appearance and the snuffles had ceased. Within 48 hours, all yaws showed thinning and shrinking of their crusts, darkening and complete disappearance of the typical yellow colour, the whole giving an appearance as if the scab had been desiccated. Some lesions already showed separation at the periphery. By 5 days, all yaws had disappeared, leaving either a pale fairly sound skin at the site of the lesion, or a grey brown leathery surface. By 10 days there was no evidence of active yaws, and the only stigmata left were areas of scarring denoting the site of the original lesions. Ide test still positive after 21 days.

The serology has been followed up in all cases, though complete results are not yet to hand. In the two cases of primary yaws treated, healing, with complete reversal of Kahn, has been accomplished within seven days. In two cases of secondary yaws observed over six weeks, the Kahn and Ide tests have not been reversed.

The reversal of the Kahn test is in fact an academic point, for the main object of any mass treatment of yaws is to cause cessation of the active infection. The indications are, however, in the light of the work of Wise and Pillsbury on syphilis, that larger doses of from half to one million units would effect the reversal of the serological tests. With larger supplies of penicillin available it is hoped to employ bigger dosage. Even with the small doses at present used, the disappearance of lesions is far more rapid than with 'Sobita'. There have been no toxic results even in quite young and very under-nourished children or in the nine cases where calcium penicillin was used intramuscularly.

Thus since *Spirochæta pertenue* is apparently also among the organisms susceptible to penicillin, it was decided to employ penicillin in phagædenic tropical ulcers, in which spirochætes and fusiform bacilli are present together with other organisms.

Many of the ulcers had been in existence for periods up to one year. A total of 35 cases has been treated, and six have healed completely within 7–35 days, while the rest, still under surveillance, are in process of healing. Here again, 100,000 Oxford Units were injected in twenty-four hours and penicillin ointment (250 units per gram) was applied, or penicillin ointment alone locally was used. Within forty-eight hours, there is a marked reduction in the pus, with disappearance of smell and rapid formation of granulation tissue in the base of the ulcer and a blue line of commencing epithelization at the edge. The œdema subsides; the surrounding hyperpigmentation of the skin also tends to disappear. The subsequent course of events is a rapid surface epithelization of the edges with filling up of the base of the ulcer with granulations. Within a few days the ulcer becomes sterile or shows only scanty organisms (occasionally spirochætes only), though in five cases *Ps. pyocyanea* has been found to be present but with no apparent inhibition of healing. Better results are obtained by a combination of local treatment and parenteral injection than local treatment alone.

Typical cases:

Case 2. *Adisah*. Female. Aged 30 years. Fulani Zongo Village. Large ulcer 5 cm. × 2 cm. and 1 cm. deep, with a chronic rolled edge of one year's duration. Spirochætes, fusiform, vibrios, staphylococci and anaerobic streptococci in the pus. Calcium penicillin ointment applied daily through the treatment. Within 48 hours, the edge was sodden and white coloured. In 3 days, the white detritus at the edge had been replaced by a blue line of epithelium, while the base was filling up with granulation tissue. By 7 days the cavity was nearly filled with a clean red granulation tissue and *Ps. pyocyanea* was cultured. At 21 days there was a central core of granulation 3 cm. × 1 cm. surrounded by a zone of soft white scar tissue. 24 days, almost healed, central area covered by a pink shiny epithelium.

Case 14. *Gharley*. Male. Aged 10 years. Winneba. Ulcer on left internal malleolus 0·5 cm. in diameter, of one month duration. Smear and culture, fusiform bacilli and spirochætes, virios and anaerobic streptococci. Calcium penicillin was applied for 3 days only. After 7 days a blue line of epithelium had extended 0·5 cm. from the edge. Smear showed no organisms. Examined at 28 days—had been away from hospital with original dressing for three weeks. Despite this, only small central granulations were present about 2 mm. in diameter. Smear showed fusiforms and spirochætes. Penicillin ointment re-applied and within another 7 days the ulcer healed.

Case 15. *Kwasi Bentum*. Female. Aged 5 years. Winneba. Foul-smelling saucer-shaped ulcer of the right arm, 10 cm. × 5 cm., of 9 days duration; showed grey-green membrane with hæmorrhages. Smear and culture yielded fusiforms, spirochætes, vibrios and anaerobic streptococci. 100,000 units of sodium penicillin were given over 12 hours intramuscularly. After 24 hours the smell had gone, the edges flattened and the base of the ulcer cleaner though still unhealthy-looking; after 5 days, ulcer closing rapidly due to advancing epithelization from the edges. 15 days healed; 22 days, sound scar.

Two severe cases of cancrum oris in children have been treated; in both cases the lesions rapidly cleared both clinically and bacteriologically; one small boy suffering from extreme marasmus and vitamin B complex deficiency unfortunately died a fortnight after the local condition had healed; the other patient recovered.

The impression has been gained that penicillin treatment gives the initial impetus to healing of phagædenic ulcers of several months duration; once healing has started, the subsequent course of events is controlled by the nutrition of the patient. It is to be noted that all our cases were ambulatory and all were under-nourished.

G. M. FINDLAY.
K. R. HILL.
A. MACPHERSON.

General Headquarters,
West Africa Force,
Accra, Gold Coast.

[1] Mahoney, J. F., Arnold, R. C., and Harris, A., *Amer. J. Pub. Hlth.*, 33, 1387 (1943).
[2] Wise, E. R., and Pillsbury, D. M., *Proc. Roy. Soc. Med.*, Section of Medicine, 30, 11 (1944).
[3] Lourie, E. M., and Collier, H. O. J., *Ann. Trop. Med. and Parasitol.*, 37, 200 (1943).
[4] Herrell, W. E., Nichols, D. R., and Heilman, D. H., *J. Amer. Med. Assoc.*, 125, 1003 (1944).

Bacteriostatic Action of Sulphonamide Derivatives

WE have confirmed and extended the observations of L. K. Wolff and H. W. Julius (1939) that sulphanilamide acts on bacteria only when they are multiplying, that is, in the logarithmic phase of their growth. Taking into consideration the physicochemical changes which are apparent in the environment of bacteria rapidly subdividing, more especially the rapid fall in potential which accompanies multiplication, we have looked for a reducing agent and have found that about the time when the sulphonamides begin to act *in vitro* a substance is produced which gives the *o*-dinitrobenzene test applied by Fearon and Kawerau (1943) to the recognition of dienol compounds. This substance is of the nature of, and may be identical with, reductone.

Reductone readily condenses with *p*-aminobenzoic acid, sulphanilamide, sulphapyridine and sulphathiazole to form coloured compounds. We have isolated these compounds in crystalline form by adding the appropriate aminobenzene derivative to solutions of glucose which have been heated with alkali and then made acid according to the method used by H. von Euler and co-workers (1933) for the preparation of reductone. On account of its solubility, the sulphanilamide - reductone compound has not yet been obtained pure; but the other derivatives have been separated completely from the added aminobenzene compound.

From a study of the properties of these reductone derivatives, we have arrived at certain conclusions as to the role of *p*-aminobenzoic acid in bacterial metabolism and the way in which it is supplanted by the sulphonamides. The *p*-aminobenzoic acid-reductone compound goes into solution readily at a *p*H of 7·5–8·0, giving a yellow solution in which it undergoes rapid hydrolysis, even at room temperature, setting free *p*-aminobenzoic acid and reductone. When completely hydrolysed the solution is colourless. The sulphapyridine and sulphathiazole compounds are much less soluble than the *p*-aminobenzoic acid compound, and hydrolyse slowly and incompletely. From these and other observations it is concluded that the function of *p*-aminobenzoic acid in bacterial metabolism is to condense with, stabilize and temporarily immobilize prior to utilization, reductone or compounds of the reductone type which play an essential part in the chain of metabolic reactions and which, without such stabilization, would, by reason of their reactivity, be either lost to the bacterial cell or toxic to it. If compounds of the sulphonamide type be presented to the cell, they compete with *p*-aminobenzoic acid for the reductone produced during metabolism, and form with it compounds which are not available for use by the micro-organism.

In support of this view the following are some of the experimental results which we have obtained:

(1) Growth of streptococci has been observed on supplying the *p*-aminobenzoic acid - reductone compound to a medium, deficient in energy sources, which otherwise failed to give growth.

(2) No growth has been observed when the sulphapyridine - and sulphathiazole - reductone compounds have been substituted in the above experiment.

(3) Bacteria can be shown to assimilate added *p*-aminobenzoic acid from their environment, especially during the most active phase of growth. At a later stage of growth they return it once more to the surrounding medium.

(4) Bacteria also assimilate and later liberate added sulphanilamide, sulphapyridine and sulphathiazole, but not so rapidly.

Full details of this work will be published elsewhere later.

R. A. Q. O'MEARA.
P. A. MCNALLY.
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School of Pathology,
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Dublin.
Nov. 4.

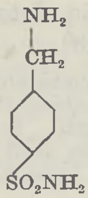
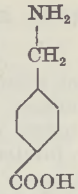
Mode of Action of Benzylamine Sulphonamide ('Marfanil')

THE antibacterial agent benzylamine-4-sulphonamide (I), which under the name of 'Marfanil' was supplied in quantity to Rommel's forces in North Africa, has given interesting results in Allied hands (cf. Mitchell, Rees and Robinson[1]). Organisms made resistant to sulphanilamide by growing them in contact with the drug were resistant to all other sulphonamides except 'Marfanil'[2]. Schreuss found that the antibacterial action of 'Marfanil' was not antagonized by *p*-aminobenzoic acid[3]. A possible reason for these differences from the sulphanilamide-like drugs is revealed by the determination of the basic strength.

Benzylamine sulphonamide, having the amino-group insulated from the benzene nucleus by a methylene group, should be a much stronger base than sulphanilamide and *p*-aminobenzoic acid, which were found to be very weak bases[4]. Following the procedure outlined in the previous communication[4], the negative log of the acidity constant (pKa) expressing the position of the equilibrium of the reaction

$$BH \rightleftharpoons B + H^+$$

(where B represents the base) was determined by potentiometric titration with the glass electrode in water at 20° C. (see table). Benzylamine-4-carboxylic acid (II), which stands in the same structural relationship to benzylamine sulphonamide as *p*-aminobenzoic acid does to sulphanilamide, was investigated also.

(I)  (II) 

If the forces between enzyme and metabolite or drug are electrical in nature, then similarly charged ions are overwhelmingly best fitted to compete with one another for the enzyme. However, the fact that substances with both acid and basic groups exist in solution as an equilibrium mixture of the four different electrical forms, in the proportion determined by the *p*H and the *p*K*a*, would render all substances in the accompanying table capable of competing with one another to some extent; but when a substance intended to displace an essential metabolite from an enzyme is mainly in a different electrical form from the metabolite, then the concentration required for its action may be so high as to exclude its use as a drug.

Substance	*p*K*a* (basic group)	*p*K*a* (acid group)	Principal ionic form at *p*H 7·3
Benzylamine-4-sulphonamide (I)	8·18	10·23	cationic
Benzylamine-4-carboxylic acid (II)	9·64	3·59	zwitterionic
Sulphanilamide (for comparison)	2·1	10·3	unionized
p-Aminobenzoic acid (for comparison)	2·2	4·9	anionic

Applying the Mass-Law equation

$$pH - pKa = \log \frac{[B]}{[BH+]},$$

one deduces that, at the physiological *p*H value (7·3), benzylamine sulphonamide exists mainly in the form of positive ions, whereas sulphanilamide exists as uncharged molecules plus a small proportion (0·1 per cent) of negative ions (this proportion increasing as the potency of sulphanilamide is increased by substitution, as in sulphathiazole and sulphadiazine[5]). Similarly, *p*-aminobenzoic acid exists mainly as negatively charged ions. Thus it is unlikely that benzylamine sulphonamide can compete effectively for the same position on the enzyme surface as the oppositely charged *p*-aminobenzoic acid.

Accordingly, it is postulated that benzylamine sulphonamide acts on a different enzyme from that involving *p*-aminobenzoic acid. Whether benzylamine-4-carboxylic acid can antagonize the antibacterial action of benzylamine sulphonamide remains to be determined. This possibility is not excluded by the above results, but it will depend, of course, on whether benzylamine-4-carboxylic acid is an essential metabolite, as demanded by the Woods-Fildes theory.

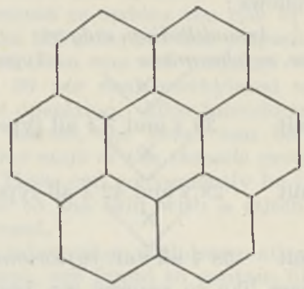
The benzylamine-4-sulphonamide was prepared by Prof. A. K. Macbeth, University of Adelaide, and the benzylamine-4-carboxylic acid (new synthesis)[6] by Dr. A. Albert, University of Sydney, who are hereby thanked.

R. J. GOLDACRE.
Council of Scientific and Industrial Research,
Melbourne.

[1] Mitchell, G., Rees, W., and Robinson, C., *Lancet*, 627 (1944).
[2] Selbie, F., and McIntosh, J., *Brit. J. Exper. Path.*, **24**, 246 (1943).
[3] Schreuss, H., *Klin. Wochsch.*, **21**, 671 (1942).
[4] Albert, A., and Goldacre, R., *Nature*, **149**, 245 (1942).
[5] Bell, P., and Roblin, R., *J. Amer. Chem. Soc.*, **64**, 2905 (1942).
[6] Albert, A., and Magrath, D., *J. Chem. Soc.*, in the Press.

Structure of Coronene

IN a recent communication[1], Robertson and White have reported provisional crystal structure determinations for coronene, $C_{24}H_{12}$. The molecule has great symmetry, as is shown by the figure. In view of the importance of this molecule in coal formation, some purely theoretical calculations I have made may be worth mentioning. Using the methods developed in an earlier paper[2], the energies of the mobile electrons have been computed in terms of the fundamental resonance integral β. From this it is easy to calculate the bond-orders and -lengths. The table below shows (i) the mean energy of the mobile



Coronene, $C_{24}H_{12}$

electrons; (ii) the mean order of the C–C bonds; (iii) the order of the six central C–C bonds; (iv) the mean length of the C–C bonds; and (v) the length of the central bonds. Similar values are given for benzene and graphite. The last decimal place in the lengths is valid on a relative scale, but not on an absolute one. It may be added that the only experimental data used in this table are the lengths of the C–C, C=C and C≡C bonds in ethane, ethylene and acetylene.

PROPERTIES OF THE CORONENE MOLECULE.

	Coronene	Graphite	Benzene
Mean energy per mobile electron	1·440β	1·576β	1·333β
Mean order of C-C bonds	1·576	1·525	1·667
Order of central C-C bonds	1·522	1·525	1·667
Mean length of C-C bonds (A.)	1·406	1·417	1·389
Length of central bonds (A.)	1·418	1·417	1·389

It is evident from the table that coronene lies between benzene and graphite, being nearer to the latter. The central bonds are very similar to the bonds of graphite, though the mean bond-length is about 0·01 A. shorter. This confirms the provisional conclusions of Robertson and White.

Further details will be published elsewhere.

C. A. COULSON.
University College,
Dundee. Nov. 15.

[1] *Nature*, **154**, 605 (1944).
[2] Coulson, C. A., *Proc. Roy. Soc.*, A, **169**, 413 (1939).

Genetics of Woodlice

THE work of Howard and Vandel on the genetics of the terrestrial Isopoda are well known, and their erudite memoirs have opened up a new chapter in genetics. As illustrating the profound difficulties of the geneticist, the following facts are of interest. Unfortunately, I do not possess that knowledge of genetics to explain the following phenomena, but would gladly welcome some enlightenment.

Briefly the facts are as follows: I crossed a female specimen of *Armadillidium vulgare* Latr. var. *rufobrunneus* Cllge. with a male specimen of Howard's type *D*, with the ultimate result that I obtained a brood of 39 females and 7 males all referable to the type *D*. A female of this brood was crossed with the male parent and in due course I obtained a brood consisting of 28 females and 42 males, all referable to Howard's type *D*. A male and female of this brood were crossed, with the result that a brood was liberated consisting of 58 females all referable to the variety *rufobrunneus* Cllge., most of which died within two days of liberation from the brood pouch.

The above-mentioned facts may be briefly summarized as follows:

Armadillidium vulgare

♀ var. *rufobrunneus* × ♂ type *D*

Result 39 ♀ and 7 ♂ all type *D*

×

Result 28 ♀ and 42 ♂ all type *D*

×

Result 58 ♀ all var. *rufobrunneus*.

I should here like to express my best thanks to Dr. H. W. Howard and Dr. Hamilton E. Quick for their kindness in supplying me with material.

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Heredity, Development and Infection

PROF. J. B. S. HALDANE's[1] letter on Dr. Darlington's[2] interesting and provocative article calls for two comments. First there is, I think, no published evidence to show that reversion from climber to bush type in roses is due to an agent transmitted from the stock (incidentally it may be noticed that Crane and Lawrence's[3] account of their experiment on p. 178 of their book does not mention the type of stock on which the buds were grafted). Even assuming that the difference between the climber and bush type is due to a change in a plasmagene, the reversion of a percentage of the buds might be due to the somatic sorting out of two different types of plasmagenes such as sometimes happens with plastids.

Secondly, at least a few British geneticists have been interested enough in the work of Lysenko and his colleagues in the U.S.S.R. for them to try experiments similar to those of the Russian workers. As no results have been published, one can only conclude they were negative. Thus I personally have experimented with the narrow-leafed rogue of peas[4,5] which Darlington[6] suggests is due to a plasmagene (seeds of type and rogue were kindly given to me by Miss C. Pellew for this work). Grafts of type on type, type on rogue, rogue on rogue and rogue on type were made in the seedling stages, and the length and breadth of stipules at flowering time measured. No effect of stock on scion was found.

H. W. HOWARD.

Plant Breeding Institute, School of Agriculture, Cambridge. Oct. 17.

[1] *Nature*, 154, 429 (1944).

[2] *Nature*, 154, 164 (1944).

[3] "Genetics of Garden Plants", 2nd ed. (London, 1937).

[4] *J. Genet.*, 5, 13 (1915).

[5] *Proc. Roy. Soc.*, B, 91, 186 (1920).

[6] "The Evolution of Genetic Systems" (Cambridge, 1939).

Inheritance of the Keel in *Potamopyrgus Jenkinsi* (Smith)

THE keel, when present in the aquatic and parthenogenetic mollusc, *Potamopyrgus Jenkinsi* (Smith), can exist in many degrees of strength. It may vary from the faintest of lines on the shell to a well-marked spinous keel, this latter being the aculeate variety of Overton.

Robson[1] found that colonies may be all smooth, all keeled, or the two forms may co-exist. The keeled forms may persist for years in the same locality, though the proportion keeled may vary from year to year, sometimes dwindling to zero. Boycott[2], who also worked on this character, found strongly keeled (aculeate) colonies rather rare. Juvenile keeled snails from the field, grown to adult size in the laboratory, were indistinguishable from wild-born adults. He also found many grades of development in the keel, and the occasional occurrence in Nature of the discontinuous development of the character when the keel fades off to give a smooth body whorl.

Both Robson and Boycott bred keeled snails in the laboratory. Robson, using keeled snails and fresh water of different chemical compositions and brackish water, obtained only perfectly smooth offspring. Boycott, using aculeate snails from a freshwater colony near Criccieth, obtained some keeled snails (mostly faintly keeled). However, conditions did not permit any definite conclusions to be drawn about possible causative conditions, except that keeled offspring more often appeared in the 'bad' conditions of open-air aquaria or in cultures kept in rusty tins. In recent years, similar experiments have been repeated, and in fresh water the few positive results have, like Boycott's, been inconclusive.

In 1943 a locality was found near Christchurch, Hants, where smooth snails live in a small fresh-water stream and aculeate snails in the brackish water stretch of the same stream. These aculeate snails, bred in jars with brackish water of salinity 0·175 per cent and algal-covered pebbles from their native brackish stream (called keel-inducing conditions below), yielded 100 per cent aculeate offspring. Under similar conditions keeled and smooth snails, kept together in the same jar, yielded both keeled and smooth offspring. These experiments have been successfully repeated and amplified this year, and some of the main results are summarized, pending opportunities for carrying out more precise work.

A glass jar was immersed in the brackish stream at Christchurch for the second half of April 1944. This jar, filled with stream water and using keeled snails as parents, yielded both smooth and keeled offspring. A precisely similar experiment, using a jar immersed for part of May, gave only smooth *F*1. A jar set up with keel-inducing conditions and three snails—one perfectly smooth and the other two with barely perceptible keels—yielded an *F*1 of smooth snails and snails with a well-developed keel. Under similar conditions, ten smooth snails from a hundred per cent smooth colony yielded only smooth offspring. Experiments were also made by keeping snails, offspring of keeled parents, under keel-inducing conditions for varying periods of the first part of their lives and then transferring them to smooth-inducing conditions. A batch thus kept for the first 28–35 days of their lives before transference yielded seven individuals, only one of which was keeled. Similarly, of twelve snails kept 35–42 days before transference to smooth-inducing conditions (and which were smooth at transference), eleven developed keels of varying strengths, one remaining smooth. The keel-inducing influence thus seems to act during the first few weeks of life. Snails first showed the keel at the age of about seven weeks. Though the discontinuous development of the keel has not yet been produced in the laboratory, its natural occurrence, on one occasion at least, seems to be due to accidental change of conditions from keel-inducing to smooth-inducing.

From the above experiments it appears that *P. Jenkinsi* exists as both keeled and smooth genotypes. Further, since brackish water *per se* does not induce a keel, it seems that the environmental factor responsible for the appearance of the keel is Algal. Moreover, this agency needs only to act in early life to induce a keel for the rest of the life of the snail. The Alga probably acts partly in a quantitative manner to produce keels of strengths varying from a scarcely perceptible ridge to the fully aculeate form.

As already stated, the offspring obtained from jars immersed during April and May at Christchurch were a mixture of keeled and smooth and smooth respectively. These results may throw some light on the many negative results previously obtained in experiments on the inheritance of the keel. It appears likely that, especially in freshwater, the keel-inducing species of Alga may have a relatively short life under the laboratory conditions tried hitherto. Jars with a healthy growth of brackish water Algæ from Christchurch on pebbles yielded 100 per cent keeled offspring from keeled parents. In the above two jars, however, the Algæ only remained healthy for a short time, later forming a flocculent precipitate. The keeled snails in the April jar were older (larger) than the smooth snails. This may be significant as suggesting that the older snails were in the labile condition for keel production at a time when the keel-inducing Alga was still alive in sufficient quantity in the culture. It is to be expected that some smooth colonies will prove on breeding analysis to contain a proportion of genotypically keeled specimens.

I am indebted to Miss C. H. Popham, of Christchurch, for helping in the collection of field material and to Mr. Moffatt, of Hambleden, for facilities in housing experiments.

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[1] Robson, G. C., *Brit. J. Exp. Biol.*, 3, 149 (1926).
[2] Boycott, A. E., *Proc. Mal. Soc.*, 18, 230 (1929).

A Method of Obtaining Tissue Cultures of Adult Fibroblasts

IN recent years we have made several attempts to infect tissue cultures of fibroblasts from chicks and fowls of various ages with the virus of Rous sarcoma No. 1. Although we were not satisfied that such infection can take place *in vitro*, we gained some experience in methods of obtaining tissue cultures of adult fibroblasts, which may be of interest to others.

Resting adult connective tissues did not give satisfactory cultures, and it was necessary to devise a method of setting up local connective tissue proliferation, and afterwards removing cells at various intervals of time. Methods involving open operations were avoided, because of the risk of airborne bacterial contamination. In our first experiments, we implanted various kinds of threads into the breast muscles of fowls and withdrew them after different time-intervals, together with proliferating cells that had become entangled in them. This method, though satisfactory up to a point, had the disadvantage of introducing foreign matter into the culture medium and was sometimes accompanied by infection. The most satisfactory method was as follows. Small glass capillary tubes, 1·5 cm. long and 2·0 mm. outside diameter, were implanted into the breast muscle of fowls by means of a trocar and canula. The tubes were open at both ends, but a constriction at one end allowed a knotted thread to be retained by the tube and served to withdraw it at the desired time. A small skin incision can be made before inserting the trocar and canula to reduce the risk of introducing organisms from the skin; but this was not found to be necessary if the skin was well prepared with 1 : 1,000 acriflavin in 50 per cent methylated spirit immediately before operation. After introducing the tubes through the canula, the latter can be withdrawn, leaving the free ends of the threads protruding from the wound. These can conveniently be tied together and anchored to the skin with a stitch which also closes the wound.

Such small tubes, when withdrawn after intervals of one to ten days, are found to contain fibrin clot invaded by fibroblasts and macrophages ; they are, in fact, miniature tissue cultures. By breaking the thin capillary tube, the contents can easily be liberated for implantation into suitable culture medium in roller tubes or other type of tissue culture apparatus. The method has the advantage of simplicity, and reduces handling with consequent risks of infection by airborne organisms. Cultures obtained in this way were maintained for about two weeks on fowl plasma desiccated embryo extract medium without the addition of any living cells.

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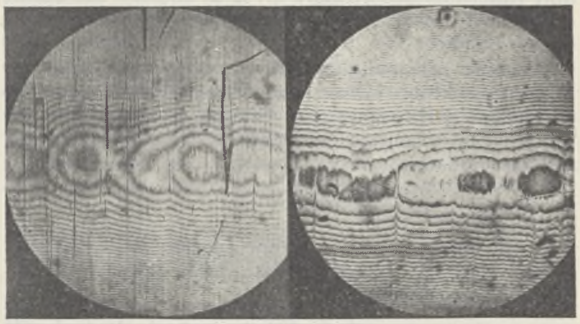
Silvered Mirrors for Interferometric Measurement

THE simple interferometric devices used in Great Britain[1] and on the Continent for testing the surface quality of workpieces of less than 20 micro-in. surface roughness have recently been improved by applying a partly reflecting mirror as suggested by L. Leinert[2]. This method has been compared with



PHOTOGRAPHS OF A LAPPED RING, USING SODIUM LIGHT. (*a*) PHOTOGRAPHED THROUGH AN ORDINARY GLASS COVER SLIT ; (*b*) PHOTOGRAPHED THROUGH SILVER SPUTTERED MIRROR. MIRROR BY COURTESY OF MESSRS. C. J. WHILEMS, LTD., ILFORD OPTICAL WORKS, FORREST ROAD, BARKINGSIDE, ESSEX.

the usual practice of using non-silvered glass[1] and the results are quite interesting. Whereas with non-silvered glass the interference bands are relatively weak and the underlying surface with its imperfections is easy to recognize, the silvered glass of the same surface shows the outlines of the interference bands very clearly (see accompanying reproductions). This is due to the fact that in this case the scattered light from the workpiece cannot penetrate the silver layer. A much better topographic picture of the surface is thus obtained; but it is open to question whether for practical inspection purposes a combined picture of surface and interferences would not be more desirable.

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[1] Kayser, J. F., *Industrial Diamond Review*, 4, 2 and 72 (1944).
[2] Leinert, L., *Werkstattstechnik Der Betrieb*, 37/22, 279 (July, 1943), extracted in *Engineers Digest*, 5, 247 (August, 1944).

Significant Figures of Numbers in Statistical Tables

IT is a well-known fact that most numbers in statistical tables start with a small digit. For example, in population tables almost one third of the entries begin with the digit 1. The same holds true for most tables of the type occurring in the World's Almanac.

A rough qualitative explanation of this fact can easily be given. If we consider tables in which the entries become rarer the larger they are, we can draw the obvious conclusion that in any interval, say, between 10 and 99, or 10,000 and 99,999, there are more entries on the small side than on the large side.

The quantitative aspect of this phenomenon requires a more detailed discussion. The study of a large number of tables shows that of all entries the fraction which begins with the digit 1 is given by $\log_{10} 2/1 = 0{\cdot}301$, beginning with 2 it is $\log_{10} 3/2 = 0{\cdot}176$, and, in general, the fraction with p as its first digit is $\log_{10}(p+1)/p$. This quantitative behaviour has been studied in detail by Benford[1]. In spite of his investigation, Benford appears to arrive at the conclusion that this logarithmic distribution of the first digits is some natural phenomenon which he calls the "Law of Anomalous Numbers". In reality there is nothing profound about this 'law' and it is certainly not connected with the observation that "Nature counts e^0, e^x, e^{2x}, . . . and builds and functions accordingly". It is merely the result of our way of writing numbers, as we shall demonstrate below.

Consider an arbitrary table with a large number of entries which either are all positive or else are considered without regard to sign. Let $f(x)dx$ be the fraction of entries in the interval between x and $x + dx$; then

$$\int_0^x f(x)dx = 1. \quad . \quad . \quad . \quad . \quad . \quad (1)$$

If the basis of our number system is A, for example $A = 10$, we shall write each entry x of the table in the form

$$x = pA^m, \quad . \quad . \quad . \quad . \quad . \quad . \quad (2)$$

where we take

$1 \leq p < A$; m = integer: positive, negative or zero. (3)

In this way p is a continuous variable which can be used to indicate the first digit of the number x; for example, if p is between 3 and 4, the first digit of x is a 3. More generally, p gives the significant figures, m the order of magnitude. We want to know what fraction of the entries has the value of p lying in a small interval between p and $p + dp$. For a fixed value of the exponent m this is given by

$$f(x)dx = f(pA^m)\,A^m dp. \quad . \quad . \quad . \quad . \quad (4)$$

We must next sum this over all values of m, and the required fraction becomes

$$F(p)dp = \sum_{m=-\infty}^{m=+\infty} f(pA^m)A^m dp \quad . \quad . \quad . \quad (5)$$

This equation represents the mathematical formulation of the process of 'counting the first digits' of the entries in the table. If we integrate Equation (5) over p, between 3 and 4 say, we get the fraction of entries starting with the digit 3.

We next estimate the sum in Equation (5) by approximating it by an integral

$$F(p) = \sum_m f(pA^m)A^m \cong \int_{-\infty}^{+\infty} f(pA^m)A^m dm. \quad . \quad (6)$$

This integral is easily evaluated, for by substituting again the expression for x,

$$x = pA^m,\ dx = pA^m \ln A\ dm, \quad . \quad . \quad . \quad (7)$$

we find using Equation (1):

$$F(p) \cong \int_0^\infty f(x)dx/p \ln A = 1/p \ln A \quad . \quad . \quad . \quad (8)$$

The fraction of entries which have p in an interval from a to b is

$$\int_a^b F(p)dp = (\ln b - \ln a)/\ln A = \log_A \frac{b}{a} \quad . \quad (9)$$

By taking $A = 10$ and a and b two consecutive integers, we have the required distribution law. The main point in this derivation is that the integral in Equations (6) and (8) is independent of the function $f(x)$, that is, independent of the distribution of the magnitudes of the entries in the table. The logarithmic distribution of the first digits has nothing to do with the nature of the entries in the table or with their distribution.

One important question has still to be considered, namely, how accurately the integral in Equation (6) approximates the sum. The answer to this question does depend upon the properties of $f(x)$. It is thus easy to find examples of tables for which the logarithmic distribution of the first digits is not true, by choosing $f(x)$ in such a manner that the sum differs widely from the integral; this is so, for example, for a table of populations of places with five thousand or more people, in which almost as many entries occur with first digit 5 as with first digit 1. Moreover, the range of most tables is not very large, and therefore the sum over m for any one table contains only a few terms. The observed agreement is probably improved by the fact that we integrate between two integers p and $p + 1$, which presumably has a smoothing out effect.

$A = 10$

First digit	1	2	3	4	5	6	7	8	9
Actual	636	341	256	211	168	154	130	111	102
Expected	635	371	263	205	167	141	122	108	97

$A = 100$

Number of digits	odd			even		
First digits	1	2, 3	4-9	1	2, 3	4-9
Actual	359	309	396	277	288	480
Expected	317	317	420	317	317	420

Some of the questions connected with the approximation of the sum by the integral are discussed in another communication by Furry and Hurwitz[2]. It is obvious that the approximation will be good for sufficiently small A and poorer for larger A. This is illustrated by counts of a group of population tables using first $A = 10$ and then $A = 100$, as shown in the tables. The expected numbers are calculated from Equation (9). In this case $A = 10$ is small enough for the agreement to be good ($P(>\chi^2) \simeq 0 \cdot 77$ on Pearson's test of goodness of fit), but $A = 100$ is not ($P(>\chi^2) = 0 \cdot 0003$).

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Aug. 30.

[1] Benford, Frank, *Proc. Amer. Phil. Soc.*, **78**, 551 (1938).
[2] *Nature*, in the press.

Observations on Bird Behaviour

DR. K. G. BRITTON has recently described the behaviour of "a deluded sparrow"[1]. I can quote an almost identical case which happened some years ago. Early one summer morning I was awakened by a cock house-sparrow pecking violently at my bedroom window, which faced nearly due east. This was repeated the next morning. Between onslaughts at the window glass the sparrow clung to ivy which covered the deeply recessed sides of the window. This continued for a week, after which time the sparrow disappeared.

Dr. Britton draws interesting implications from the experiments and observations he made, namely, (*a*) mental maladjustment of the sparrow, (*b*) the possibility of intelligence well above the instinctive level. I should like to add collaborative examples of both postulates.

(*a*) *Mental maladjustment.* A hen blackbird nested in our garden and successfully reared two young ones. When these no longer required feeding, she continued for two or three weeks to offer food to any bird, adult or fledgling, that came near her. A young thrush accepted food, and once, when the blackbird offered a worm to an adult robin, it accepted this, whether from surprise or intention one cannot tell.

(*b*) *Intelligence.* The parents of a family of fledgling house-sparrows brought their young to feed on a supply of crumbs which we placed regularly on our verandah. When the parents ceased their care of the young sparrows, the latter continued to come by themselves. It was soon possible for us to recognize two individuals among them. One held its head on one side and the foot and leg of the other side were partly paralysed. The bird was timid, stupid and at a disadvantage. The second was a hen bird: in time we learnt to recognize her by slight individualities of proportion and colouring; but before this her behaviour distinguished her clearly. She took charge of the cripple, led it to food, and encouraged it by chirp and by suitable feeding movements. One day, as we sat very still in the lounge, with the door leading on to the verandah open, the young hen led her 'afflicted brother' through the door and across the floor to crumbs fallen under the table. She watched him feed and escorted him back to safety again.

It is usually stated that all bird behaviour is instinctive. Much of it can, of course, be adequately described by this term. It seems inadequate, however, to speak as though the whole of animal behaviour, vehicled through such diverse types of nervous systems, can be classified under one of two terms—instinct or intelligence. Such stultified and obsolete terminology has long since been advanced upon by the psychologist dealing with human behaviour. Human psychology has developed terms for all the grades of specific psychic* phenomena. In our opinion biologists are hampered by this paucity of psychological terms, a condition which tends to mask instead of to clarify the ideas at issue. No doubt fuller terminology has been developed by specialist workers, but nothing of the kind is used by biology or natural history at large.

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CHAS. STEWART.
(lately of) University College of the South West,
Exeter. Oct. 12.

* Using the word in its legitimate sense.
[1] *Nature*, **153**, 559 (1944).

WITH regard to the cock house-sparrow reported in *Nature* of May 6, 1944, as continually attacking its own reflexion in a glass window, a peacock of mine was a great nuisance because he would fight himself, in windows and the bright parts of cars. I have seen a cock house-sparrow attacking a window, and cases have been reported to me of a male blackbird, chaffinch, robin, dipper (at a house near a stream) and a grey wagtail doing the same. In all these cases the bird appeared to mistake its reflexion for a rival male trespassing on its territory and strove long and steadfastly to expel the intruder.

FRANCES PITT.
The Albynes, Bridgnorth. Dec. 3.

Wharton's Jelly Considered as a Conducting Path

IN connexion with the interesting discovery by Barcroft *et al.*[1] of the passage of molecules as large as serum albumin along the Wharton's jelly of the umbilical cord of the sheep, I beg to offer the following comments.

So far as the supply of nutriment (other than water) to the fœtus is concerned, in the late stage of development of the experimental specimens employed, namely, after the establishment of a fœtal vascular system and of its relation to the maternal endometrium, the transmission of large-sized molecules at a relatively slow rate along the Wharton's jelly may be considered to be only a minor method of nutritive supply compared with the rapid transmission of substances with smaller molecules by the blood stream. But the discovery of this function of the Wharton's jelly becomes of paramount importance, if we may postulate that, in the very early stages of development before angiogenesis has commenced, the primitive mesoblast, from which the Wharton's jelly is derived, has the same power to transfer large-molecule substances from the trophoblast (and hence from the endometrium) to the embryo. In this light, the early development of the primitive mesoblast in the monkey[2], and its even more precocious development in man[3,4], becomes of considerable significance.

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Nov. 30.

[1] Barcroft, J., *et al.*, *Nature*, **154**, 667 (1944).
[2] Heuser, C. H., and Streeter, G. L., *Contrib. Embryol. Carneg. Inst. Wash.*, **29**, No. 180, 15 (1941).
[3] Davies, F., *Trans. Roy. Soc. Edin.*, **61**, pt. II, 315 (1944).
[4] Davies, F., and Harding, H. E., *J. Obstet. Gynæcol. Brit. Emp.*, **51**, 225 (1944).

St. Jerome and Vitamin A

THE following passage, taken from St. Jerome's "Life of St. Hilarion", which was written about A.D. 392, appears to be the earliest account of the etiology, symptoms and cure of severe vitamin A deficiency. "From his thirty-first to his thirty-fifth year he had for food six ounces of barley bread, and vegetables slightly cooked without oil. But finding that his eyes were growing dim, and that his whole body was shrivelled with an eruption and a sort of stony roughness (*impetigine et pumicea quadam scabredine*) he added oil to his former food, and up to the sixty-third year of his life followed this temperate course, tasting neither fruit nor pulse, nor anything whatsoever besides."

This combination of an eye-affection, night-blindness or perhaps xerophthalmia, with a severe hyperkeratosis precisely resembles the condition described by Frazier and Hu[1] as occurring in Chinese patients who had received a diet not unlike that of St. Hilarion, namely, a cereal other than wheat, white cabbage and salted vegetables. These patients were speedily cured by cod-liver oil or carotene; and it seems probable that a crude and unpurified olive oil, such as St. Hilarion would have permitted himself, would contain enough of the fairly high vitamin A content of the olive to relieve his symptoms and maintain good health. The evident accuracy of St. Jerome in this particular may induce further study of this interesting biography.

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[1] Frazier, C. N., and Hu, C. K., *Arch. Dermat. and Syph.*, 33, 825 (1936).

West Cumberland and its Utilization

As one who has had contacts, through geology, with industry, mining and agriculture in Cumberland during a quarter of a century, may I be permitted to comment upon Dr. Stamp's article on "West Cumberland and its Utilization" in *Nature* of November 18.

The basic causes of the depression in West Cumberland during the 'thirties are only too fully recognized, and lack of transport facilities cannot be regarded as one of them. Indeed, as the raw materials for the iron and steel industry are found within the district, the transport from mine to furnace and furnace to factory is almost eliminated.

Although West Cumberland does not lie on the western main route from England to Scotland, it is misleading to describe it as lying at the end of a branch line from Carlisle. It is connected with the main railway route at three places, Carlisle, Penrith and Carnforth. Admittedly the south route needs improving. The urgent need here is for a railway and road, across the Duddon Estuary, so quartering the road and rail distance between Askam and Millom.

The intense depression in the heavy iron and steel industries in the 'thirties was national, but in West Cumberland its effects were felt not only in the rolling mills, the blast furnaces and the coke ovens, but also in the local iron-ore mines, limestone quarries and coal mines, which supplied the raw materials for the heavy industries. The presence of coal, hæmatite and limestone in the same area are natural advantages enjoyed by West Cumberland, and to them we may add two more. Adequate water supplies are, or can be made, readily available. The district is served by ports, so that foreign hæmatite, when needed, comes into the district by the cheapest means of transport—transport by sea—and exports flow from the ports.

These natural advantages are beneficial during times of trade prosperity; but because the industries are so largely interrelated and interdependent, the whole district is especially susceptible to trade depressions. The need for new industries is self-evident.

Dr. Stamp's statement that under certain contingencies "the enormously important influx of wealth from holiday makers will cease" is difficult to understand. Alas, no such wealth has ever flowed into West Cumberland. West Cumberland should not be confused with the Lake District, from which it is quite distinct, both topographically and geologically. The present industrialization of the former district in no way affects the amenities of the latter, and the position would not be changed by bringing new industries into West Cumberland.

Whether the Lake District becomes a national park or not, the holiday resorts for this lovely district will continue to be largely centred on Keswick, Ambleside and Penrith, all far removed from the industrial West Cumberland. As regards the seaside villages on the West Cumbrian coast, these are primarily the holiday resorts of local people. Their prosperity will reflect the prosperity of the industrial area.

Everybody will agree that regional "planning is essentially the right allocation of land". In Cumberland the allocation would appear to be: land for industries in the industrial zone of West Cumberland, the minimum inroad by industry into the rich agricultural land surrounding Carlisle, and the reservation of the Lake District as a national park.

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Manchester.

I HAVE no quarrel with most that Dr. Trotter says, but his letter strikes just that note of false optimism which it was my concern to avoid. Apart from the steady deflexion of the hæmatite reserves, the heavy iron and steel industry is naturally well sited, but to say the "need for new industries is self-evident" is a long way from suggesting how they can be attracted. It is in this regard that a manufacturer seeking a location for, say, a textile factory, would look seriously at the time taken to reach an area off the main line by which his goods would be distributed. It is $1\frac{1}{2}$ hours by rail to Whitehaven from Carlisle, $2\frac{1}{4}$–3 hours from Penrith and $2\frac{3}{4}$–$3\frac{3}{4}$ hours from Carnforth. I was not, of course, confusing West Cumberland with the Lake District; but it is important to realize that the war-time extension of the industrial area has introduced an alien element in the once purely rural views from the high ground of the western Lakes. To say that the charming West Cumbrian coast from St. Bee's Head to Millom is primarily the resort of local people is to deny its immense potentialities as a natural seaside extension to the Lakes, which increased facilities of access and accommodation should render very popular and a consequent source of wealth to the area—but not if it is spoiled by sporadic industrialization.

L. D. STAMP.

RAT PLAGUES IN WESTERN QUEENSLAND

By A. C. CROMBIE
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PLAGUES of native species of rodent recur from time to time in the dry inland plains of Australia[1,2,3,4]. Palmer[3] describes an outbreak of rats (apparently the long-haired rat, *Rattus villosissimus* Waite[4]) which occurred after continuous rains during 1869–70, and moved northwards across the Gulf Country plains from the head of the Flinders River (Fig. 1). There was a corresponding increase in native dogs, snakes, hawks and owls which, together with the exhaustion of the food supply, the drying of the grass at the end of the season and their own cannibalism, brought the plague to an end. Evidence of previous plagues was found in "hollow trees, in which owls had lived for years, [which] were filled with the bones and skulls of millions of rats". Troughton[4] (p. 286) observed another outbreak of *R. villosissimus* on the Barkly Tableland in 1934. I have been unable to obtain records of plagues on the plains of Central Western Queensland further back than the beginning of this century; but since then *R. villosissimus* has erupted here at intervals of approximately eleven years, in 1907, 1918, 1930–31 and 1940–42. Each time the rats travelled in a roughly south-easterly direction. During April–June 1907 they moved at night on a 150-mile front south and south-east from the Flinders River, and were followed by large numbers of wild domestic cats and dingoes[1]. In this year, and in 1918, it was observed that practically all those trapped were males[1].

Several correspondents have kindly described to me the latest plague of *R. villosissimus* (identified by the Queensland Museum), which has recently subsided. Migration was not continuous. The rats took about two years to go from Boulia to the Thompson River at Longreach, a distance of about 200 miles. They were present in large numbers at Quilpie in March 1941. At a point *X* (Fig. 1), the course of the plague was as follows. They had arrived at a place 60 miles north-west of *X* about two months before they reached *X* itself in fair numbers in December 1940. In January 1941, their numbers greatly increased and persisted at this level until about October of the same year. It is difficult to estimate the actual population density. Between 8 and 53 were caught per night in traps consisting of a tip-board which dropped the vermin into a large tub of water, a number of which were set round the verandahs of the house. The population decreased suddenly in December 1941, rose again in February 1942, and fell once more in April. The rats finally disappeared after the heavy, soaking rains of May 26, 1942, and very few were seen after that. They fed mainly on vegetable matter, destroying all the fruit and vegetables in gardens except, according to one correspondent, parsnips and members of the onion family. They would also eat meat, leather, etc., when they found it. Cannibalism was widespread. An observer at Boulia "was informed from reliable sources that 95% of the rats trapped were males". In plagues of *Mus musculus*[1] there was a preponderance of females before, and of males after, they began to migrate. The reason for the preponderance of males was apparently that they led the migrations and left no food behind them for females and young, which then resorted to cannibalism. All the above observations on *R. villosissimus* were made on migrating swarms.

All four rat plagues were followed by plagues of feral cats, which later died of disease and starvation. In 1931, the rats reached their maximum at *X* in May, and the cats were dying in large numbers by September. On one occasion 73 cats were shot in a day about the house and garden at *X*. The number

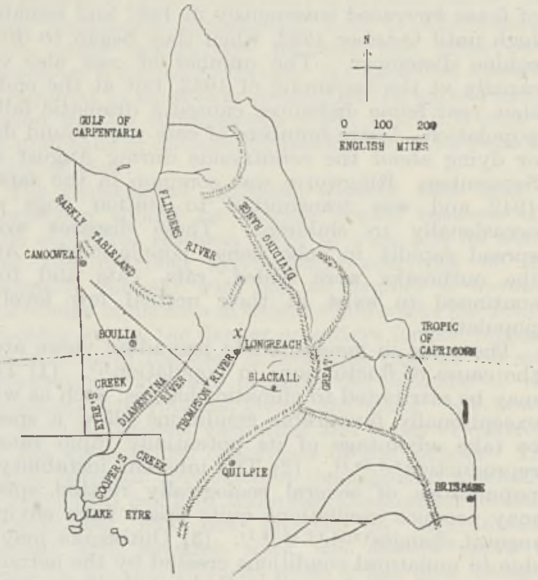

Fig. 1. Map of Queensland. The arrow shows the general direction of the plague of *Rattus villosissimus* in 1940–42.

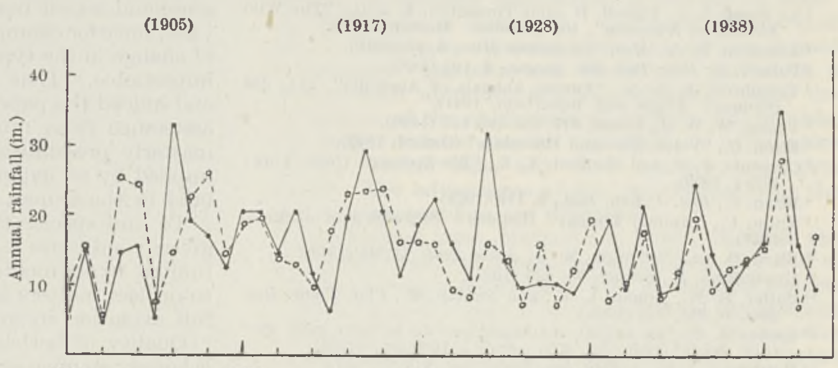

Fig. 2. Annual rainfall at Longreach (●) and Camooweal (○) from 1900–43. In general the annual rainfall of the whole of Western Queensland follows the same course, but decreases from north-east to south-west. Plague years are shown in italics. Years in which sunspot maxima occurred are given in brackets above the chart.

of foxes increased enormously in 1941 and remained high until October 1942, when they began to die of canine distemper. The number of cats also rose rapidly at the beginning of 1942, but at the end of that year feline distemper caused a dramatic fall in population. Large numbers of cats were found dead or dying about the countryside during August and September. Ringworm was common in the cats in 1942 and was transmitted to station dogs and occasionally to children. These diseases would spread rapidly in such dense populations[5]. After the outbreaks were ended, rats, cats and foxes continued to exist at their normal low level of population.

There are in general three prevailing views about the cause of fluctuations in population[6,7]. (1) They may be attributed to climatic changes, such as when exceptionally favourable conditions allow a species to take advantage of its potentially rapid rate of reproduction[8,9,10,11]. (2) The inherent instability of populations of several ecologically related species may produce oscillations quite apart from environmental changes[12,13,14,15,16,17]. (3) Outbreaks may be due to unnatural conditions created by the activities of man. Fig. 2 shows that three of the four plagues described above were associated with exceptionally rainy seasons[18]. On the other hand, the plague years 1930–31 were not especially wet, while other wet years did not have plagues. It is possible that in 1930–31 temperature or other conditions may have favoured increase. MacLagan[19] has shown that over the last hundred years the frequency of outbreaks of several British insects is correlated with the periodicity of sunspots. The connecting link between sunspots and outbreaks is climatic. Each of the four plagues described above began within two years of the sunspot maximum immediately preceding it. It is possible that there may be some connexion between them; but the number of records is too few to establish either this or the contrary.

I wish to thank Mr. G. W. Moule, Government veterinary surgeon, Central West, for his kindness in sending some of the information quoted above; Mr. H. A. Longman, director of the Queensland Museum, for other information; and Mr. J. H. Pike, Agent-General for Queensland, for the loan of "Tables of Rainfalls in Queensland" (1933). My other correspondents will be nameless, but not unthanked.

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TROPICAL PASTURES

THE best grassland has depended for its existence upon a moderately cool and humid climate. Only a relative few of those familiar with the almost perpetual verdancy of English meadows and pastures realize the intensity of longing expressed in Psalm xxiii for *green* pastures and running waters seldom seen in a semi-arid land. In the tropics a high rainfall promotes the formation of acid soils, and a high temperature makes it difficult for most turfy grasses to form what inhabitants of temperate climates regard as a sward. Choice of tropical fodder plants is so limited that some varieties of sugar-cane are impressed into the class of forage grasses; and most of the tropical grasses are either tall and erect, or trail to make a tangled cover, neither type of growth being so amenable as that of the grasslands of Great Britain or of the temperate lands colonized by European pasture-species.

The difficulties of establishing a pasture in the tropics are added to by an apparent lack of suitable leguminous companion plants: no legume having properties corresponding to wild white or subterranean clover has been found.

Two recent Bulletins (Nos. 31 and 32) of the Imperial Bureau of Pastures and Forage Crops at Aberystwyth deal with pasture problems. No. 31 is entirely, and No. 32 partly, devoted to problems of management in the warmer countries. No. 32 ("Advances in Grassland Husbandry and Fodder Production: a Symposium") is a miscellany, ranging from an appreciation (with bibliography) of the scientific work of R. D. Williams to a review of field experiments at Potchefstroom and a note on the fixed oil of the seeds of *Trifolium subterraneum*. The articles are mainly reviews or abstracts, the 'symposium' thus being a gathering of varied information which might not otherwise have been published, or, if published, might escape the attention which the compilers seem to think it deserves. There is no common thread of interest.

Under the title "The Provision of Animal Fodder in Tropical and Subtropical Countries: Part One", Bulletin No. 31 gives a succinct account of experience and hopes in the West Indies, Hawaii, Fiji, the Gold Coast, Nigeria, the Anglo-Egyptian Sudan, Zanzibar and Pemba, and Southern Rhodesia. The information it gives will be valuable not only from the purely grassland aspect but also from sociological points of view, since for example in West Africa the potentialities of change in the type of husbandry are of high social importance. That is also true of the West Indies, and indeed the paper written by D. D. Paterson with assistance from other West Indian authorities is a masterly presentation in brief of the whole problem implied by an extensive establishment of good grassland in the tropics.

To find species that would grow at all under the given conditions has been the first thing, and with limited experimental resources it has been natural to neglect matters like those which have not received full attention in more highly developed areas.

Quality of herbage, and its effect upon livestock, is largely an open question in the tropics, few chemical analyses being available. Paterson remarks: "There can be no doubt that under tropical conditions the chances that the herbage may be lacking in some essential minor constituents are not less than in temperate countries. . . . After a spell in some of the other islands, racehorses reared in Tobago do not stand up to the strain of the racecourse as well as they do in their home island". Pressure of research in other directions is given as the reason for deferment of intensive study of the role of minor elements; but it seems fair to ask why the question of nutritional quality should be taken so fatalistically. The salary of a chemist or two would surely not be too much to add to an ordinary budget of chemical or veterinary investigation, and in conjunction with a rational policy of land use and nutrition would probably yield a high dividend.

The bulletin contains a large number of suggestive facts. Fiji has no native grass, the so-called 'native' grasses being importations which have run wild. In view of the decline of the natural indigo industry, it is interesting to learn that the cultivation of a trailing species of indigo for fodder and for purposes of soil protection is actually on the increase. What is a pest in one part of the world may be a useful grass in other parts of the world—or, as in Hawaii, in another part of one island. HUGH NICOL.

ECOLOGICAL PRINCIPLES AND FORESTRY

ON July 2, 1943, members of the forestry associations of Great Britain met at the invitation of the British Ecological Society to discuss problems arising from a paper by Sir Roy Robinson in *Forestry*, the journal of the Society of Foresters of Great Britain (see *Nature*, 152, 196; 1943). A fuller account of the meeting is now available (*Forestry*, 17; 1943).

Prof. A. G. Tansley, in opening the meeting, said he welcomed the desire for a closer contact between ecology and forestry. He thinks foresters would, through ecology, find much to help them to a scientific rationale of their practical operations. Prof. Tansley stresses that scientific ecology is a very young subject of research, almost entirely a product of the present century and only developed energetically since the War of 1914–18. It is in this newness of the subject that may lie the danger for the young forester. As is said, it has only been really developed since the War of 1914–18, and it is in this period that the word 'ecology' has come trippingly from the lips and pens of the young trained forester, the word being often made to serve as explanation for forestry processes as yet but dimly understood or assimilated by the junior. Prof. Tansley says: "I know very little of practical forestry, and I have often wished when I was teaching forestry students their elementary botany, and always from the general point of view of ecology, that I had had a practical training both in forestry and agriculture, just as I wished I had had a practical training in medicine when I was teaching biology to medical students. For just as scientific medicine is really a branch of applied biology, so forestry and agriculture may be regarded as branches of applied ecology."

To increase our knowledge of the ecology of woodlands, Prof. Tansley suggests a "continuous opportunity for access to and study of planting experiments together with the power of suggesting different variations and forms of control which are likely to lead to increased insight into the factors at work"—in fact, research work, which all foresters would welcome. It is, however, at present, a long step from this interesting and valuable work to the ordinary practical operations of the forester based on the growth of crops to produce marketable timber. Sir Roy Robinson's explanation that in afforestation work some species are pioneers and others are successors is obviously correct. But practical research is required to show how to shorten the experimental period in new afforestation work, if such a step is economically or ecologically possible from the financial point of view.

The experienced practical forester feels that a distinction should be sharply drawn between the true ecological research point of view and its work, and the practical sylvicultural activities of the executive forester who has to acquire a working knowledge of his soils in order to undertake his duties. In other words, the danger nowadays for the younger generations of foresters is that they may be led into sylvicultural inaction pending the outcome of the ecologists' experiments, giving the latter "the power to suggest different variations and forms of control" of the sylvicultural operations of the forester. The highly efficient sylvicultural management gradually brought into being in European Continental forestry departments was not attained by such means, though such research work will always prove of value to the sylviculturist when it has been brought to the point where its practical applications will obviously lead to better results.

BIOLOGICAL STUDIES IN SOUTH AFRICA

THE *South African Journal of Medical Sciences*, published quarterly by the University of Witwatersrand and the South African Institute for Medical Research, is devoted to original work in any of the sciences represented in the medical curriculum. C. de V. Bevan contributes to the February 1944 issue (9, No. 1) an interesting article on the cultivation of the South African Rickettsiæ in developing chicks and the preparation of vaccines from the membranes of these. Dilute egg vaccines do not, he concludes, protect guinea pigs against epidemic infection, although they protect wholly against tick-borne infection and partially against endemic infection. Concentrated vaccines must be used in order to obtain complete protection against epidemic typhus produced by inoculation of guinea pigs with egg-passaged strains. A modified Machiavello technique for staining Rickettsiæ is described. The author finds that clearer staining is obtained if the smears are cleared in benzene. Bacteria and Rickettsiæ ground in a mortar with alundum are disintegrated. The development of the chick-embryo method will provide, the author thinks, smaller quantities of a far more potent vaccine than any that has yet been produced. The advantages of the egg-vaccine over the mammalian vaccines are discussed.

In the same issue, Margaret L. Creed discusses the nutritional value of a poor South African diet and of certain dietary supplements, and N. Sapeika reports on the digitalis action of a glycoside from the liliacean species *Urginea rubella*. More than twenty-five species of *Urginea* have been recorded in South Africa; many of these probably contain a toxic glycoside and a few are known to be toxic to stock. The issue concludes with a paper by O. S. Heyns and S. S. Hersch on the birth-weight of urban Bantu and the incidence among them of syphilis, still-birth and premature labour.

The Biological Supplement to this journal is published separately. The February 1944 issue includes a noteworthy article by C. J. van der Horst on further stages in the embryological development of *Elephantulus*, the affinities of which with the Insectivora and Lemuroidea relate this study to the embryology of the primates and of man.

Christine Gilbert records work on the development of the post-renal segment of the inferior vena cava in the same species. G. H. Roux gives a beautifully illustrated account of the cranial anatomy of the marine amphibian *Microhyla Carolinensis*. Protozoology is represented by a description, by A. J. Gibbs, of the life-history of the Adeleid coccidian *Chagasella* sp., found in the salivary glands of the plant-feeding Hemipteran *Cenæus carnifex*.

G. LAPAGE.

FORTHCOMING EVENTS

Thursday, December 28

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Sir Harold Spencer Jones, F.R.S.: "Astronomy in our Daily Life", 1: "The Spinning Earth" (Christmas Lectures).

Saturday, December 30

NUTRITION SOCIETY (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 11 a.m.—Conference on "The Nutritional Role of the Micro-Flora in the Alimentary Tract".

ASSOCIATION FOR SCIENTIFIC PHOTOGRAPHY (at Caxton Hall, Westminster, London, S.W.1), at 2.30 p.m.—Discussion on "The Choice of Materials for Scientific Photography" (Papers by Dr. H. Baines and Mr. F. J. Tritton).

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Sir Harold Spencer Jones, F.R.S.: "Astronomy in our Daily Life", 2: "The Revolving Earth" (Christmas Lectures).

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

ANALYTICAL CHEMIST FOR THE METALLURGY DIVISION of the National Physical Laboratory—The Ministry of Labour and National Service, Central (T. and S.) Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. F.3304.A) (December 27).

DEMONSTRATOR OF ASSISTANT LECTURER (temporary) in BOTANY—The Acting Registrar, The University, Leeds 2 (December 30).

SPEECH THERAPIST—The Director of Education, Education Offices, Woodlands Road, Middlesbrough (December 30).

TEACHER mainly for MATHEMATICS and ENGINEERING SCIENCE in the Junior Technical School and in Senior Day and Evening Classes—The Principal, County Technical College, Gainsborough, Lincs. (January 5).

ASSISTANT REGISTRAR—The Secretary, Bedford College for Women, Regent's Park, London, N.W.1 (January 6).

RADIO DEVELOPMENT ENGINEERS for the laboratory of a large electrical engineering works in the N.W.—The Ministry of Labour and National Service, Central Register, Room 5/17, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. A.736.XA) (January 11).

UNIVERSITY CHAIR OF CONCRETE TECHNOLOGY tenable at Imperial College of Science and Technology—The Academic Registrar, University of London, c/o Richmond College, Richmond, Surrey (February 26).

PROFESSOR OF MATHEMATICS, and a PROFESSOR OF CHEMISTRY—The Secretary, Queen's University, Belfast (March 31).

LECTURESHIP IN MORAL PHILOSOPHY AND THE HISTORY OF PHILOSOPHY (including Greek Philosophy)—The Secretary, Queen's University, Belfast (April 30).

SPEECH THERAPIST—The Education Officer, Town Hall, Chesterfield.

LABORATORY STEWARD IN THE DEPARTMENT OF PATHOLOGY—The Secretary and Registrar, The University, Bristol.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

City and Guilds of London Institute. Report of the Council to the Members of the Institute for the Year 1943. Pp. xlix. (London: City and Guilds of London Institute.) [211

Religious Instruction in Schools. Preliminary Statement prepared by a Committee of representatives of the Joint Conference of Anglicans and Free Churchmen, the Association of Education Committees and the National Union of Teachers. Pp. 8. (London: National Union of Teachers.) [211

Britain and the World: an Outline of Reconstruction Problems. By the Hon. H. A. Wyndham. (Looking Forward Pamphlets, No. 1.) Pp. 60. (London and New York: Royal Institute of International Affairs.) 1*s*. net. [311

Ministry of Aircraft Production. A College of Aeronautics: Report of the Interdepartmental Committee on the Establishment of a School of Aeronautical Science. Pp. ii+98. (London: H.M. Stationery Office.) 2*s*. net. [711

Science in Post-Primary Education, with reference to the Scientific Education in Schools of Pupils of 11-18, and its relation to their subsequent Training in Universities and Colleges. Interim Report of a Sub-Committee of the Association of Women Science Teachers. Pp. vi+22. (London: John Murray.) 1*s*. 3*d*. net. [911

An Annotated Bibliography of Medical Mycology, 1943. Edited by Dr. S. P. Wiltshire, in collaboration with Dr. Charles Wilcocks and J. T. Duncan. Pp. 32. (Kew: Imperial Mycological Institute.) 5*s*. net. [911

Lighting Reconstruction Pamphlet, No. 5: Public Lighting in the City and Highway. Pp. 16. (London: Illuminating Engineering Society.) 1*s*. [911

Imperial Bureau of Pastures and Forage Crops. Bulletin 31: The Provision of Animal Fodder in Tropical and Subtropical Countries, Part 1. Pp. 84. 4*s*. Bulletin 32: Advances in Grassland Husbandry and Fodder Production, First Symposium. Pp. 108. 4*s*. (Aberystwyth: Imperial Bureau of Pastures and Forage Crops.) [911

Quality Control Chart Technique when Manufacturing to a Specification: with Special Reference to Articles Machined to Dimensional Tolerances. By Dr. B. P. Dudding and W. J. Jennett. Pp. iv+74. (London: General Electric Co., Ltd.) 2*s*. 6*d*. [911

Medical Science and Physical Education. A three-part Interim Report by the Reseach Board for the Correlation of Medical Science and Physical Education. Pp. xx+119. (London: Ling Physical Education Association.) 2*s*. [911

Philosophical Transactions of the Royal Society of London. Series B: Biological Sciences. No. 583. Vol. 231: A Revision of *Williamsoniella*. By T. M. Harris. Pp. 313-328+plates 25-26. 4*s*. 6*d*. No. 584, Vol. 231: On Large-scale Sample Surveys. By P. C. Mahalanobis. Pp. 329-451. 19*s*. (London: Cambridge University Press.) [911

Proceedings of a Conference on Problems in the Utilisation of Small Coals, held at the Institution of Civil Engineers, November 10th and 11th, 1943. Pp. 294. (London: British Coal Utilisation Research Association.) [1411

Iron and Steel Institute. Special Report No. 30: Ironmaking at the Appleby-Frodingham Works of the United Steel Companies, Ltd. By G. D. Elliot and the Staffs of the Appleby-Frodingham Ironworks, Scunthorpe, and of the Central Research Department, Stocksbridge (the United Steel Companies, Ltd.). Pp. vi+280+16 plates. (London: Iron and Steel Institute.) 16*s*. [1411

Other Countries

Imperial Council of Agricultural Research. Miscellaneous Bulletin No. 58: Canning of Tomatoes in Baluchistan. By Dr. G. S. Siddappa and A. M. Mustafa. Pp. 4+2 plates. (Delhi: Manager of Publications.) 10 annas; 1*s*. [2710

Memoirs of the San Diego Society of Natural History. Vol. 2: The Geology and Paleontology of the Marine Pliocene of San Diego, California. Part 1: Geology. By Leo George Hertlein and U. S. Grant, IV. Pp. 72+18 plates. (San Diego: San Diego Society of Natural History.) 1.50 dollars. [3010

Publications of the Dominion Observatory, Ottawa. Vol. 13: Bibliography of Seismology, No. 14: Items 5564-5673, July to December 1943. By Ernest A. Hodgson. Pp. 231-252. (Ottawa: King's Printer.) 25 cents. [3010

British Honduras. Report of the Forest Department for the Year ended 31st December 1943. Pp. 10. (Belize: Forest Department.) [3010

Imperial Council of Agricultural Research. Scientific Monograph No. 15: Dry Farming in India. By N. V. Kanitkar. Pp. x+352. (Delhi: Manager of Publications.) 13.12 rupees; 21*s*. 6*d*. [211

Annals of the New York Academy of Sciences. Vol. 45, Art. 8: The Organization of the New York Academy of Sciences; its Incorporation, its Amended Charter, its Constitution and By-Laws, together with a Classified List of its Members. Revised to August 1, 1944. By Eunice Thomas Miner. Pp. 317-356. (New York: New York Academy of Sciences.) [711

Cawthron Institute, Nelson, New Zealand. Annual Report, 1943-4. Pp. 35. (Nelson: Cawthron Institute.) [711

State of California Department of Natural Resources: Division of Fish and Game, Bureau of Marine Fisheries. Fish Bulletin No. 59: The Commercial Fish Catch of California for the Years 1941 and 1942. By the Staff of the Bureau of Marine Fisheries. Pp. 68. (Sacramento: California State Printing Office.) [911

Brooklyn Botanic Garden Record. Vol. 33, No. 2: C. Stuart Gager and the Brooklyn Botanic Garden. Pp. 69-178. (Brooklyn, N.Y.: Brooklyn Institute of Arts and Sciences.) [911

Bulletin of the American Museum of Natural History. Vol. 83, Art. 5: A Preliminary Study of the Thermal Requirements of Desert Reptiles. By Prof. Raymond Bridgman Cowles and Charles Mitchill Bogert. Pp. 261-296+plates 19-29. (New York: American Museum of Natural History.) [911

Academia Brasileira de Ciências. Symposium sôbre Raios Cósmicos, Rio de Janeiro, Agosto 4-8, 1941. Pp. 180+19 plates. (Rio de Janeiro: Academia Brasileira de Ciências.) [911

University of Colorado Studies. Series B: Studies in the Humanities, Vol. 2, No. 2: Fitz-James O'Brien, a Literary Bohemian of the Eighteen-Fifties. By Prof. Francis Wolle. Pp. xi+309. (Boulder, Colo.: University of Colorado.) 2 dollars. [911

Proceedings of the United States National Museum. Vol. 95, No. 3183: New Species of Buprestid Beetles from Trinidad. By W. S. Fisher. Pp. 397-410. (Washington, D.C.: Government Printing Office.) [1011

Smithsonian Institution: United States National Museum. Bulletin 185: Checklist of the Coleopterous Insects of Mexico, Central America, the West Indies and South America, Part 2. Compiled by Richard E. Blackwelder. Pp. iii+189-342. (Washington, D.C.: Government Printing Office.) 30 cents. [1011