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EDUCATION BEFORE DEMOBILIZATION

AMONG the limited number of benefits conferred on us by the War is the growth of the educational services in the Armed Forces. The work carried out has already been referred to in some detail in these columns[1]. The schemes have developed along different lines in the three Services, but in each case the amount and quality of work that is being done has reached proportions which would undoubtedly astonish those who were familiar with Service conditions in the War of 1914–18. In the Army, for example, a compulsory form of education has now been conducted for four years, and has grown into what must be one of the most searching and wide-ranging experiments in adult education that has yet been attempted. Soldiers and auxiliaries have been given opportunities of voluntarily studying subjects as far apart as chiropody and Chinese, music and metallurgy; the element of compulsion has been applied to the discussion of current problems and the way in which good citizens are produced. These miscellaneous activities have not been without effect, and it is not surprising, therefore, to find that Service education departments have been preparing even more comprehensive programmes for the release period which will begin when Germany is defeated. The Army and the Royal Air Force schemes were announced at the beginning of October, and it is expected that a statement will be made on behalf of the Royal Navy in the near future.

In the R.A.F., officers, airmen and airwomen, who have not been selected for regular service in the post-war period, are to be given a pre-release preliminary training to prepare them for return to civilian life, under a scheme which will be known as the Educational and Vocational Training Scheme. This will form part of the Government plan for the re-settlement of personnel after release from the service. The training will consist of three main types, re-settlement, educational and vocational, and will be part of an obligatory programme which will take up an average of six hours training time a week. Of these six hours, one will be devoted to re-settlement training, and run mainly on discussion-group lines and designed to give both background knowledge on post-war problems and information on the fundamentals of citizenship. The series of booklets, produced by the Army and called "The British Way and Purpose", will be used to deal with particular aspects of citizenship. To supplement the discussions, additional methods of instruction such as lectures, broadcasts, films, etc., will be used.

Educational training will be provided at secondary and higher levels and will allow R.A.F. personnel to improve both their general educational standards and their qualifications for civilian employment. At the secondary level, training will be devoted mainly towards the Forces Preliminary Examination. This Examination will be introduced to meet the needs of men and women who wish to prepare themselves for subsequent entry to certain universities, the Civil Service or some of the professions. Success in the

Examination will allow the candidate to be considered for entry to a university or to be exempted from the preliminary examination of the professional body concerned. It will in no way replace existing means of qualifying for entry to universities. Higher educational training will be available for those who have reached matriculation standard, and will normally consist of individual private study under the supervision of education officers and instructors.

Vocational training will be provided for civilian occupations only when the prospects of employment are favourable enough to merit training. Frequently, this training will consist of the conversion of a skilled R.A.F. tradesman into a tradesman fitted for a job in civilian life. In other cases, the aim will either be to improve existing civilian occupational qualifications or to give a man or woman with no qualifications the groundwork on which more specialized vocational training may be built outside the service. Since there is almost certain to be a great demand for training for jobs, it will scarcely be possible to provide resident specialist instructors at each station. Instead, pools of specialist instructors in technical and professional subjects will be maintained at some central station and will visit units to meet current requirements.

The training for vocations will be worked out in the following way: (1) There will be practical instruction and exercises on stations supervised by visiting instructors. (2) There will be courses in the basic theoretical subjects necessary for groups of civilian occupations. (3) Conversion courses will be arranged in station workshops. (4) When other facilities are not available, study syllabuses and textbooks will be provided. (5) Close liaison will be maintained with civilian authorities, and attendance at classes in local technical colleges and schools will be encouraged.

The scheme announced by the War Office is less ambitious than that for the R.A.F. In a pamphlet called "Brush-up for Civvy St.", which has been issued by the Army Bureau of Current Affairs, the plan is modestly described as a means "for making up, so far as possible, those arrears of education and training which are a part of the debit side of war service", and the hope is entertained that the scheme will make an important contribution to the morale and community spirit of the Army during a difficult period.

The scheme itself is described in general terms in the pamphlet; the latter will be used immediately by regimental officers to acquaint their men with the main features. But these officers are categorically told that they must make it quite clear to the men that the educational scheme to be introduced in the release period is not intended to prepare them for a gilt-edged, guaranteed job. The business of getting soldiers into jobs, or getting them trained for jobs, will be mainly the duty of the Ministry of Labour. The Army itself can do no more than provide the men and women who are awaiting release with some kind of preliminary training which will be useful to them when they are demobilized. For those who need it, "it will teach the A.B.C. of industry and commerce, so that they can go out and learn the language". For the soldiers who do not require any preliminary vocational training, opportunities will be given to pursue hobbies and interests which will broaden their cultural horizon. Individuals whose professional studies have been interrupted by the War will be given a new chance to take up the threads by means of correspondence and other courses.

The varied principles of the scheme are described under eight headings. It will be compulsory, that is, it will be an obligatory part of the working timetable. This is merely an extension of the present system, but under the new regulations, educational training will be given more emphasis and more time. Variety will be introduced into the scheme in that the troops will have a reasonably wide choice in what they want to study. The third principle—that participation in the scheme as instructor or as one of the instructed will in no way affect the individual's chances of demobilization—will be one that will wreck the scheme at the outset unless it is said loudly and often. To fit in with military organization the new scheme will dovetail into the existing pattern of Army administration and procedure. Fifthly, the scheme will be co-educational and will apply equally to men and women whenever possible. For obvious reasons, it will not be possible to put the scheme into operation at any predetermined, fixed time; according to the pamphlet, "formations will 'lay on' the scheme at different times, depending on what part of the world they are in and what their other circumstances are (e.g. static, operational)". The close collaboration with the civilian educational bodies which already exists will be continued, partly for its direct and intrinsic value to Army education, and partly because, having had experience of what the civilian system can provide, soldiers may be more stimulated to use it after the War. Lastly, it is emphasized that the new scheme will be merely a growth of something that already exists; it will be the wider and better equipped development of educational schemes which have been operating in the Army since the winter of 1940.

Although the Army cannot provide a curriculum so diverse and selective as that of a polytechnic, the War Office has attempted to provide a broad classification of subjects of study within which all soldiers will find something near their requirements and interests. These have been grouped into six wide categories: (1) technology; (2) general science; (3) home, health and hobbies; (4) man and society; (5) commerce and the professions; and (6) arts and crafts.

Under the heading of technology, courses will be organized in electrical and mechanical engineering, building construction, and similar occupations. In general science, men and women will be given the opportunity to study essential scientific principles as applied to manufacture and the professions or the problems of industry and society. The third category is intended to meet many different needs; it is not meant to teach a wage-earning job, but will provide a background knowledge for the soldier who is interested in, say, gardening or poultry-keeping, or the auxiliary who wishes to know more about domestic

subjects. "Man and society" covers sociology in its wider sense while, under "commerce and the professions", courses will be arranged for men and women who wish to make a serious study of business organization or prepare to enter the Civil Service, local government or the professions. The sixth broad field, "arts and crafts", is intended for those who want to familiarize themselves with drawing or painting or musical appreciation. "Men and women who hope to go in for printing or design or architecture or teaching will all find something in this category to provide the first principles of their special need or interest."

The organization of the scheme shows how education in the 'Interim Army' will function in a way which has not previously been possible. Instead of the present system of two compulsory hours—Army Bureau of Current Affairs (A.B.C.A.) and British Way and Purpose (B.W.P.)—there will be six to eight hours a week of education. A.B.C.A. and B.W.P. will be retained as part of these and will be organized on a communal basis as at present, that is, on a platoon or squad or troop basis. For the other four to six hours, men and women will be treated individually and will join with like-minded individuals from any part of their unit to study the subjects they select.

The Army Educational Corps is to be considerably increased in numbers and will be responsible for the general direction of the scheme. But since the programme will be organized on a unit basis, the key men will undoubtedly be the unit education officers, "the 'amateurs', whose duty it will be to publicise the alternatives in the curriculum and to organise the facilities which unit resources can provide". They will be specially trained and equipped with manuals of guidance which should help them over some of their difficulties. The instructors will be selected from unit personnel and will be drawn from officers and other ranks. (The scheme as a whole will apply equally to all ranks.) A start has already been made in training instructors in a wide range of subjects at an Army school specially created for the purpose. Moreover, although the educational scheme for the release period cannot train men for jobs or find jobs for men, unit education officers will be supplied with a steady stream of information which will allow them to give "details of the various trades and professions and the qualifications required for them to those individuals who are in doubt about their careers".

Some of the educational activities will naturally be devoted to the passing of examinations; the Forces Preliminary Examination will apply to the Army in the same way as to the R.A.F. No doubt some unit education officers will be tempted to assess their achievement merely by the number of certificates their units can collect, but they will be strongly urged to keep this 'pot-hunting' in its proper place and concentrate their energies in giving a little to the lot rather than a lot to the few. No scheme of the above magnitude could be attempted without suitable accommodation and a considerable amount of equipment. It is heartening to know that already the premises in which educational work can best be conducted are being earmarked and scheduled for adaptation. Books by the million are also being negotiated for, as are the tools, the raw materials, the films, and other educational accessories.

In assessing the merits of the above scheme, it may be illuminating to recall a little of what happened when a former British Army was sent back to civilian life after a long war. As is well known, a comprehensive educational scheme for the Armistice period after the War of 1914–18 was drawn up by Lord Gorell and his staff. But since there had been no official recognition of education in the Army until September 1918, it can be understood that the scheme for the demobilization period had to be hastily devised and implemented. To the end of the scheme attendance remained voluntary. Further, the accommodation provided for the educational scheme was far from satisfactory in many cases, and often educational activities would have been impossible if the Young Men's Christian Association and the Church Army had not come forward to place their huts at the disposal of the service authorities. Much more unfortunate, the demobilization of men on a profession basis meant that all serving schoolmasters and students were demobilized almost simultaneously early in 1919, leaving the Army without a group of instructors that it could ill afford to lose.

In turning to the scheme proposed for the coming release period, one can see that it starts with many points in its favour. There is now a well-established Army Educational Corps the ranks of which have been considerably increased during the War. The war-time scheme has been in existence for four years already on an official basis, and had been in unofficial operation for some time before that. A measure of compulsion was introduced so far back as 1941. The early problems of accommodation were energetically tackled and in the interim period should present no difficulties incapable of solution. Above all, the way in which demobilization is to take place suggests that instructors and potential instructors will be demobilized in stages rather than as one group, leaving at least some behind who will close their ranks and carry on to the end.

Yet although there are many reasons why the present schemes announced by the Army and the R.A.F. should work, the fact remains that paper schemes, however brilliantly conceived, often fail to go beyond the infant phase. When the schemes are translated into practice, many obstacles will have to be overcome. Men and women who have become used to a life of movement and sometimes excitement will find it difficult to submit to the discipline of the class-room. If this is true of individuals who were previously accustomed to study, it will be ten times more applicable to those for whom regular study was hitherto unknown. The number of competent instructors is not likely to be nearly adequate. These, and other reasons, will present formidable problems. It will, indeed, be interesting to see whether the bolder scheme announced by the R.A.F. achieves more in the long run than the more cautious programme which the Army proposes adopting.

Nevertheless, although the Services are scarcely the ideal places for arranging educational programmes, these schemes should work—and must. The difficulties may be many; frustration and disillusionment will be inevitable. But Service educationists who have developed vast programmes during the War should not find the problem of expanding these schemes during the demobilization period beyond their skill and resource. If they need encouragement, they should be constantly reminded that their individual efforts will together make up one of the greatest contributions to democratic thinking yet attempted.

[1] *Nature*, **151**, 440 (1943).

PROBLEMS OF DEMOBILIZATION

The Journey Home

A Report prepared by Mass-Observation for the Advertising Service Guild. ('Change' Wartime Surveys, No. 5.) Pp. 123. (London: John Murray, 1944.) 6*s*.

ALTHOUGH the Government has only just declared its demobilization plans, the question of demobilization has been ably discussed in reports from the political parties as well as in one of the usual admirable broadsheets from Political and Economic Planning. These, however, have been concerned essentially with proposals or principles for demobilization and to some extent this is true of Sir Ronald Davison's somewhat broader survey "Remobilization for Peace" in the "Target for To-morrow" series. Mass Observation, in its fifth major social survey since the War began, makes an attempt to chronicle what people are actually thinking about demobilization and to provide a sample of public opinion on this question for the guidance of those who have to plan "The Journey Home".

The report is admittedly qualitative in nature. Its main statistics are based on 570 interviews, half in London, and half in other parts of the country—in Manchester, Bolton, Newark, Bishop Auckland, and a cluster of Hampshire villages. This material was supplemented by reports from Mass Observation's National Panel of Voluntary Observers, while a series of smaller investigations were made to amplify and clarify trends emerging from the analysis of this material; and although the gross numbers are necessarily small, every effort was made to obtain a justly weighted cross-section.

The first point of interest that emerges from this survey is the soundness of the point made both in the *Planning* broadsheet and in the report of the Conservative Sub-Committee that the Government, having announced the general principles which it proposes to adopt, must see that they are strictly observed. Full publicity and strict observance appear to be even more important than the general details of the scheme, provided it is one which wins the approval and confidence of the members of the armed forces. Mass Observation drives home the point in reference to the points scheme outlined by the Conservative Sub-Committee itself, which, while embodying the type of principle which people appeared to consider a just and fair basis for priority in demobilization, made very little impression on the minds of the civilian population because propaganda was not continuous.

It must, of course, be remembered that sampling opinion by a series of questions in this way has the admitted defect of psychological laboratory tests that the test itself mostly creates an artificial situation which has somehow to be discounted. The questions are liable to start the questioned on an unaccustomed train of thought, at the end of which he finds his opinions are really not at all what he supposed them to be. For all that, a study of the report suggests that the summary does give a composite picture of the hopes and fears of the Englishman or Englishwoman at the time of the inquiry, even if the spontaneity or representative character of particular sets of answers is to be discounted.

The picture, it is true, is largely one that might have been expected. Nevertheless, it throws some light on the conflict in the public mind between ideas of liberty and fairness, between conceptions of democracy and efficiency, and in this respect "The Journey Home" is of interest in relation to the question of other post-war controls than those involved in demobilization. The conclusion that no executive action will be a success unless the hopes, fears, moods and expectations of the masses who will be affected are taken into consideration has a wide bearing on post-war planning. To the extent that tension between expectation, hope and realization leads to a sense of frustration becoming prominent, the possibility of a harmonious solution of demobilization or other social problems recedes.

Clarification of ideas on demobilization is the first step, it is urged by Mass Observation, though "The Journey Home" cannot be regarded as a contribution to that end comparable with Sir Ronald Davison's little book. "People need to know more than how and when they are coming out. They need to know where they are going then. They need to know where everyone is going, what is going to happen to mankind." There is a task, or rather a duty, of exposition or interpretation which is primarily the responsibility of the Government, whether through the Ministry of Information or in some other way, and a popular booklet at a much lower price than "Remobilization for Peace" would be valuable.

But beyond this it might be added that the success of demobilization and of post-war reconstruction depends on people minding enough about the future of mankind to accept responsibility for concrete action themselves. There is nothing in this survey that indicates more clearly the weakness of democracy than the tendency of those interviewed to dissociate themselves from their democratic responsibility by saying 'they' instead of 'we' when they mean the powers that be. The report is a timely reminder of how much yet remains to be done in this direction and how much a democratic system depends on an educated electorate. To the sociologist it is of interest as an example of technique in the analysis of public opinion on any subject, and incidentally raises the fundamental question of what we understand by public opinion. It has, however, a wider appeal to all who are concerned with the prospects and possibilities of post-war planning as indicating not merely some of the dangers and difficulties to be faced, the immensity of the task of education, but also practical problems for each individual, of adapting and fitting his own hopes and aspirations into those of the community as a whole if demobilization is to prove what it is intended to be—the first step towards remobilization for peace, for building up the future of man.

R. BRIGHTMAN.

DIAGNOSIS AND TREATMENT OF VENEREAL DISEASES

The Venereal Diseases

A Manual for Practitioners and Students. By Major James Marshall. Pp. xi+348. (London: Macmillan and Co., Ltd., 1944.) 21*s*. net.

IT is both unfortunate and remarkable that the average general practitioner knows so little about venereal disease; unfortunate because it seems not unlikely that he will have to treat much of it in the near future, and remarkable because ignorance of it is all too common. Marshall's "Venereal Diseases" contains just that practical information which the student and the practitioner require, set out clearly and succinctly. No one within the compass of 340 pages can say all there is to be said about venereal disease, but this book does contain the salient facts; almost everything that is excluded is essentially a matter for the expert. Gonorrhœa—the commonest venereal disease—is allotted some ninety-odd pages, into which is crammed a vast amount of information. The anatomy of the urogenital system, without a knowledge of which treatment must be largely empirical, is clearly explained, the importance of pathological examinations in diagnosis rightly stressed, and treatment, especially with sulphonamides, skilfully handled. Case-records indicate how different types of cases should be treated, and any problems not covered by this section should be referred to a specialist. A word of warning concerning the use of sulphonamides in patients previously treated with these drugs, and the possibility of sensitization, might have been included with advantage.

Syphilis is condensed into less than 280 pages—an impossible task if the whole subject is to be covered in detail; for this reason the rarer conditions have been excluded or only touched on briefly, most attention being given to the commoner aspects. The coloured plates, of which there are eight, are for the most part beautifully produced, and represent the nearest approach to real life which the photographer's art can provide. Numerous figures show clearly a variety of morbid conditions, and should prove most helpful to the reader. Stress is, very rightly, laid on the importance of pathological aids to diagnosis; to diagnose early syphilis without these is nothing short of criminal. Treatment of late syphilis must be individualized, and most cases should be referred to experts; that of early syphilis can, however, be more or less stereotyped. That recommended is the 'continuous' with overlapping arsenic and bismuth; many will think the dosage rather heavy in the early phases; but there can be no shadow of doubt that over-treatment is far preferable to under-treatment, and the latter is all too common. The therapist is given the choice of neo-arsphenamine, 'Mapharside' and 'Neohalarsine'; the first-named is the most popular in Great Britain; 'Mapharside' is being used more and more; 'Neohalarsine' is still on trial. The routine bismuth preparation recommended is the aqueous suspension of the metal.

The section on the side effects of arsenicals is particularly good and very important; that of post-arsphenamine jaundice is outstanding, the author being an acknowledged authority on the subject. Arsenical drugs are notoriously dangerous, and everyone who undertakes the treatment of syphilis should know how to handle them. The section on "Other Venereal and Allied Diseases" contains a short account of those conditions likely to be met with in general practice which are venereal or associated with venereal disease. Not everyone realizes the ubiquity of *Trichomonas vaginalis*, nor the fact that scabies is often acquired during sexual intercourse. Warts or condylomata acuminata are often difficult to eradicate, and frequently considerable ingenuity is required to cure a non-specific urethritis; if the directions given are followed, few failures will be recorded.

Practical instructions in irrigation, urethroscopy, dark-ground examination, the giving of intravenous and intramuscular injections, lumbar puncture, fever therapy and prophylaxis, add very considerably to the value of the book, while the appendix on the "Sociology of Venereal Diseases" should be very carefully studied by all who are interested in these diseases as a public health problem; simply to treat the patient with drugs is not the only duty of the practitioner; for every patient with venereal disease who consults a doctor there is always another—often several—who may not even know they have the disease.

It would seem almost churlish to criticize such an excellent book, but criticism may be permissible if it is constructive and perhaps helpful in the preparation of future editions. While the meaning almost everywhere is clear, the English is sometimes loose and the grammar frequently bad; there are plural nouns followed by singular verbs; a vaginal discharge is not a symptom but a sign. "A course of 10 injections is given every other day" will not stand analysis; bi-weekly is a term to be avoided since it can mean twice a week or once in two weeks; instrument is usually a substantive, not a verb; such expressions as "results as good, if not better, than", "Fibrosis which replaces the elastic tissue", "being satisfied that there is no evidence of syphilis . . . a detailed examination of the genitals is made" are not good English and offend the reader.

Some reference to the use of alkalis in combination with the sulphonamides, more use of oil-soluble bismuth, a description of the Dattner lumbar puncture needle, and more information concerning the treatment of non-specific urethritis, would be valuable additions. Nevertheless, there can be no doubt that this book will have a wide circulation, and deservedly so.

FLOOD CALCULATIONS

Flood Estimation and Control

By B. D. Richards. Pp. vii+152. (London: Chapman and Hall, Ltd., 1944.) 16*s*. net.

IN this book the author deals with the problem of estimating the maximum flow which may be run off a catchment area during a period of exceptional rainfall. Provision to deal with such maximum flows has to be made in many civil engineering works. In the construction of a reservoir, for example, means must be provided to ensure that when the reservoir is full, all surplus water will be carried off in such a way that the stability of the embankment or dam is in no way affected. Bridges over rivers or streams must have large enough waterways to allow the maximum flood water to flow under the bridge without injuring the structure. Culverts carrying watercourses under roadways or railways must be so

designed that the greatest flow likely to happen may be conveyed without damage to the constructed works. The problem of the engineer is to estimate the probable amount of flood water and to make provision accordingly.

The subject of flood prediction is not new. The author himself points out that it has long been one of the perennial problems of civil engineering. The estimation of such floods is difficult. While, as the author states, floods follow natural laws, the number and complexity of the factors and the interplay between them make precise estimation impossible.

In his foreword, Mr. Binnie regrets that the records of floods which have occurred in the past in the British Isles are limited, and that we are so far behind other countries in taking steps to ensure that such information is available. According to the author, however, a flood of exceptional severity may possibly be met with once only in a hundred years. Complete security can only be obtained, he adds, by ascertaining the maximum possible flood and making due provision accordingly. In connexion with this it may not be out of place to point out that, however meagre the information has been in the past, the civil engineering structures in Britain likely to have been affected by floods seem to have been remarkably well designed to meet such emergencies. The number of reservoir dam disasters in the country in the past century can be counted almost on the digits of one hand. There are bridges over rivers and streams which are centuries old and which have stood the test of time and flood. On the other hand, the number of dam disasters alone, in the United States, run into hundreds. But in America, as on the continents of Europe and Asia, catastrophic floods occur far exceeding anything ever experienced in Great Britain. In whatever country floods occur, the engineer must take into account their possible magnitude, and his designs must be such that they are safe in any circumstances.

The author begins by discussing generally the factors affecting the intensity, duration and discharge of floods. These factors depend upon the rainfall and size and characteristics of the area on which the rain falls. The number of formulæ which have been deduced by previous investigators is impressive. There are no fewer than ten of these given and they do not include all. One of those omitted is the Iszkowski formula so widely accepted in Germany and Austria. The ten given are sufficient, however, to show widely divergent results obtained by the different formulæ when applied to a single rainfall on a given catchment. Most of these do not take into account the shape and contour of the ground. It is the purpose of this book to show how a more accurate estimate of the flood discharge may be made.

Very properly the first point dealt with is rainfall intensity. Rainfall both as a function of time and as a function of area is discussed. Examples of curves as well as actual recordings of intense rainfalls are given, not only for the British Isles but also for Central India, the eastern United States, Southern Rhodesia and Western Australia. Then follows a discussion on the period of concentration intensity and run-off of the flood. There are some interesting graphs showing how coefficients vary on larger and smaller areas when compared with a standard catchment of 25 square miles. The coefficients for flood estimation, taking all the factors—including the size and slope of the catchment—into account, are next dealt with, and then follows the determination of maximum flood discharges by the construction of flood hydrographs. The chapter dealing with the effect of intensity and distribution of the rainfall on the flood hydrograph will be found rather difficult reading by most engineers; but an excellent summary of all that has been written follows. A chapter on flood control as applied to reservoirs deals with open weirs, siphon spillways and under-sluices combined with overflow weirs. The chapter dealing with soil erosion should be of special interest to irrigation engineers Finally, there are some useful examples of flood calculations.

The book will be found of great value to all engineers who have flood problems to deal with Hitherto the designer of structures which have to withstand the effects of floods has had to rely on empirical formulæ giving widely varying results. He may now, by applying the principles set forth in this volume, arrive at a much more reliable result in determining the maximum flood discharge.

The task of writing such a book as this is obviously an enormous one, and the author is to be commended very strongly on the results which he has achieved.

JOHN BOWMAN.

SYNTHETIC RUBBER

Modern Synthetic Rubbers

By Dr. Harry Barron. Second edition, revised and enlarged. Pp. xii+355+20 plates. (London: Chapman and Hall, Ltd., 1943.) 28*s*. net.

IN view of the large amount of material published, especially in the American technical Press, in the last two years on synthetic rubbers, we should expect the second edition of Dr. Barron's book to be a big improvement on the first edition, and such is the case. The general lay-out remains excellent and the contents make interesting reading from cover to cover. It is written in a most readable form and the plates are excellently reproduced. The scope of the second edition is roughly the same as that of the first—economics, chemical and physical background, and technology—but it has been considerably amplified in detail. The first edition has been carefully revised, but a few mistakes such as (p. 29) *GR–N* instead of *GR–M* for Government neoprene have crept into the new edition.

From the point of view of the general reader, there are only two criticisms to offer against this new edition; and they are that the author sets out so obviously to be the champion of synthetic rubber that his views cannot be accepted as unbiased on this important controversy of natural versus synthetic rubber. On p. 177 the statement is made that "the largest and most critical users of rubber, the major American tyre companies, have investigated Buna *S* [it is assumed that Buna *S* is here meant to be *GR–S*] in tyre treads and the general conclusion is in favour of Buna *S* against natural rubber". It is doubtful, in the opinion of the reviewer, whether any tyre manufacturer could be found who would use Buna *S* (or *GR–S*) if alternative supplies of natural rubber were freely available. Other examples of this same attitude could be quoted; for example, on p. 25 the variation (variability) of natural rubber is discussed and the suggestion is made that it does not or *should not* occur in synthetic rubber in the following words: "in fact, the latter [the synthetic

rubber interests] are perhaps more favourably placed since, working from pure materials, they can produce a material of definite properties and characteristics. Synthetic rubbers can virtually be made to specification". Unfortunately, the synthetic rubber interests do not work with pure material—it would be impracticable—and do not produce invariable material; in fact, the variations in synthetic rubbers are as big, if not bigger, than those in natural rubber. In further elaboration of the purity question, the author states on p. 84 that the butadiene for *GR–S* must be 98·5 per cent pure, but it is probable that much *GR–S* has been made from butadiene of as low purity as 95 per cent. When it is kept in view that different processes for butadiene will give different impurities and these impurities may enter into or direct molecular structure in different ways, it is not surprising that the resulting products have been variable to some extent. Experience has shown that chemical control, however detailed, in the shaping of large molecules is a poor substitute for the vital control of Nature.

The second criticism is one which also applied to the first edition, namely, that the author, in spite of his anxiety to see more work carried out on this side of the Atlantic, does not appear to realize how much fundamental work has been carried out in the last few years in Great Britain; for example, on p. 80 no mention is made of the fact that the pioneer work on the production of butadiene from 2·3 butylene glycol diacetate was carried out in Manchester, or on p. 221 that the first copolymers of butadiene and substituted acrylic acids were prepared and evaluated in the same city. Many other British contributions have also been overlooked.

From the point of view of the technical reader, there is a further criticism. The phraseology is sometimes rather unorthodox; for example, on p. 220 there appears the sentence: "While butadiene is the main constituent, there are various synthetic resins, other than styrene and acrylic nitrile which have been successfully developed as copolymer". Synthetic resins are not monomers and styrene and acrylic nitrile are not synthetic resins. The sentence is, in fact, a sort of technical double negative.

In spite of its defects the book is to be recommended to those who wish to acquire a general knowledge of the field of synthetic rubber. W. J. S. NAUNTON.

ENZYME CHEMISTRY

Chemistry and Methods of Enzymes

By Prof. James B. Sumner and G. Fred Somers. Pp. xi+365. (New York: Academic Press, Inc., 1943.) 5 dollars.

A BOOK on enzymes by the hand of Dr. Sumner might well be expected to present an authoritative review of that phase of enzyme work with which his name is intimately associated, namely, the preparation and properties of crystalline enzymes. In this we are not disappointed. The accounts of the preparations of urease and catalase, of the work of Northrop and Kunitz on the preparation of crystalline trypsin and chymotrypsin, of Anson on crystalline carboxypeptidase, leave little to be desired in an introductory book of this nature. When we turn, however, to the consideration of the larger aspects of enzyme chemistry, Sumner and Somers' book can only be regarded as consisting for the most part of descriptions of the preparations and characteristic properties of a fairly extensive list of enzymes. The distinguishing feature of this compilation is the treatment of each enzyme by short statements under a number of headings such as history, occurrence, action, specificity, etc. The statements tend to be very brief, with a consequent curtailment of any critical discussion of the properties of enzymes and of recent work bearing upon their mechanism of action. The authors state, however, that they have attempted to give the research worker and advanced student a general survey of enzyme chemistry without presenting too much detail on any subject, and in this objective they may be said to have succeeded—perhaps only too well.

The book commences with a chapter on the general properties of enzymes. This deals mostly with the physical chemistry of enzymes. The treatment, in common with that of the rest of the book, is sketchy and terse, lacking the details and explanatory data necessary to make the somewhat complicated subject of enzyme kinetics clearly intelligible to the student. The chapter deals briefly with most matters proper to a physicochemical description of enzymes and includes short statements concerning activators, protective substances, poisons, coenzymes and anti-enzymes.

The remaining seventeen chapters of the book are concerned with a fairly comprehensive survey of enzyme systems. These are classified into the hydrolytic group comprising the esterases, carbohydrases, phosphorylases, nucleases, amidases, and proteolytic enzymes; the oxidizing group comprising those enzymes possessing iron-containing constituents, and those depending for their activities on the presence of copper, the various dehydrogenases and flavin-containing enzymes, and a batch of oxidizing enzymes which apparently defy adequate classification; and finally the desmolases.

The final part of the book consists of two chapters, the first of which is devoted to a brief description of hydrases and mutases, and the second to a description of some mechanisms involved in carbohydrate metabolism as illustrative of the manner in which enzyme reactions in the living cell are brought together.

Omissions of greater or lesser importance must obviously be characteristic of a book which aims at curtailment of detail. Sumner and Somers' book suffers from the omission of many facts concerning enzyme chemistry of equal interest to those actually presented. Thus, to give a few examples, nothing is said of the ability of lactic dehydrogenase to reduce alloxan in the absence of a coenzyme, a fact pertinent to any discussion of the mechanism of action of the coenzyme-linked dehydrogenases. Nothing is said of the inhibitive action of oxalacetic acid on the activity of succinic dehydrogenase and of the importance of thiol groupings in the make-up of this enzyme. There is but little mention of the reversible poisoning of enzymes by dyestuffs, of the effects of narcotics on respiratory enzyme systems, or of the general principles of competitive inhibition of enzymes so important to-day in the interpretation of many facts of therapeutic and pharmacological significance.

In spite of these shortcomings, Sumner and Somers' book will undoubtedly prove to be of much interest to the student of enzyme chemistry, and it is a welcome addition to the steadily increasing number of text-books on the subject. J. H. QUASTEL.

COLONIES OF *PENICILLIUM NOTATUM* AND OTHER MOULDS AS MODELS FOR THE STUDY OF POPULATION GENETICS

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EXPOSURE of mould colonies to X-rays has long been known to give rise to 'sectorial' mutants. Mutant 'sectors', of course, also arise 'spontaneously' in Fungi as well as in Bacteria. The frequency varies between strains, but is always much smaller than the maximum obtainable by irradiation. *Penicillium notatum* is no exception, as we have obtained mutant 'sectors' in abundance following irradiation, and occasionally without irradiation. All 'sectors' isolated gave rise to mutant strains, differing from the original in morphological or metabolic properties.

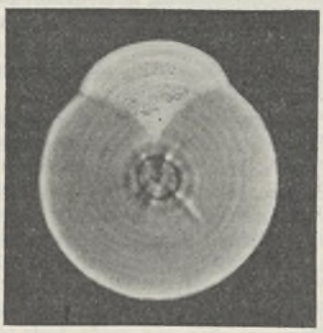

Fig. 1. 'SPONTANEOUS SECTOR' OF *Penicillium notatum*.

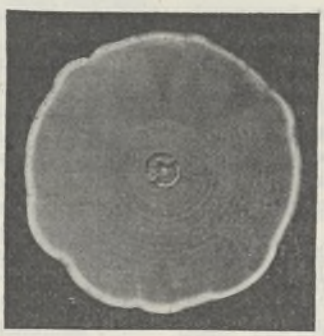

Fig. 2. IRRADIATED COLONY SHOWING MUTANT 'SECTORS' OF DIFFERENT SHAPES.

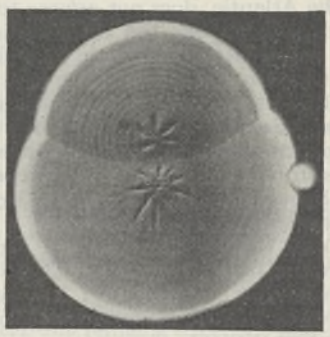

Fig. 8. TWO SEPARATE COLONIES WITH DIFFERENT GROWTH-RATES MEET AND COMPETE FOR THE SAME TERRITORY.

The analogy between 'sectoring' in Fungi and somatic mutation, or segregation, in Metazoa and Metaphyta is evident. But the two-dimensional type of growth of mould colonies makes them an unparalleled material for following the fate of a single mutated cell in a growing population of cells. Natural selection and chance can be seen here at work, under measurable conditions, and leave, as it were, a graphical record of their effects.

It is surprising indeed that so little attention has been paid to the strikingly regular shapes of sectors, both 'spontaneous' (Fig. 1) and induced (Fig. 2), and to the significance of these shapes. Even though the term 'sector' is a geometrical misnomer, since the majority have curved borders or open out at too great an angle, most 'sectors' lend themselves to description in very simple geometrical terms. They may be classified into three elementary types and combinations of them. Fig. 3, *a*, *b*, *c* show diagrammatically these three simple types, and Fig. 3, *d*, one of the complex types, a combination of *c* and *a*. Whereas 'sectors' induced by irradiation may show any one of the three elementary shapes and of their possible combinations, 'spontaneous sectors' in Fungi and Bacteria are almost exclusively of type *a*. It will be noticed (Fig. 3) that X-ray induced sectors have their origin where the edge of the colony was at the time of irradiation. This is simply because the increase in diameter of a colony takes place by multiplication of cells in or near the hyphal tips that form its edge. A nucleus has, thus, a chance to give rise to a patch of mutated mycelium only if it was situated on the growing fringe of the colony at the moment it underwent mutation. But it will also be noticed that whereas 'sectors' of type *a* taper towards the irradiated edge from which they originate, types *b* and *c* originate in a sort of blunt apex. We shall see why later.

Before discussing the geometry of 'sectors', let us consider the mode of growth of a mould colony under certain conditions (hard agar and others) which are essential for obtaining regular shapes. Under these conditions, growth of colonies is, as a first approximation, two-dimensional. A hyphal tip or a germinating spore free from competition branches in all directions in a plane so rapidly that it soon forms a circular microcolony; from this moment the colony grows as a circle, expanding in diameter at a uniform rate so long as there is further medium to occupy. The hyphæ elongate radially, with little intertwining, and branch to fill the increasing space available. The circular expansion of a colony made up of homogeneous mycelium is the resultant of the potentially circular expansion of each one of its myriads of hyphal tips, limited by the fact that the territory occupied by one hypha cannot be occupied by another. Hence (1) if a hyphal tip in a large colony were set free from the competition of its neighbours, it would soon produce a roughly semi-circular microcolony bulging out from, and with centre upon, the edge of the larger colony; (2) competition between hyphæ is extremely severe, and consequently natural selection has plenty of scope for operating.

Let us now suppose that in such a homogeneous colony a hyphal tip suddenly changes its growth-rate. If the new growth-rate is lower, usually the mutated hypha will soon be surrounded by branches of its neighbours and prevented from further growth. No trace of the event will be visible. If the new growth-rate is higher, on the other hand, usually the result will be a 'sector' of type *a* (Fig. 3, *a*), the boundaries of which are parts of equiangular spirals, with characteristics depending on the ratio of the two growth-rates and the diameter of the mother colony when the changed system arises. A verification of this geometrical explanation can be made by deliberately imitating natural sectors. If a small inoculum is made with a suspension of spores of two strains having different growth-rates, and the spores of slower growth form a big majority, the results are indistinguishable from 'sectors' of type *a*

(Fig. 4). It seems that a mutation endowing a hyphal tip with a higher growth-rate is all that is needed to explain the shape of 'spontaneous' and X-ray induced 'sectors' of this type.

The shape of 'sectors' of type *b* seems, at first, rather mysterious. The straight sides proclaim them to have a growth-rate equal to that of the mother colony. But with an equal growth-rate a hyphal tip should not be able to produce a 'sector' other than one with vertex at the centre. 'Sectors' of this kind do occur after irradiation, but not frequently. Most type *b* 'sectors' have vertex away from the centre. Again, the imitation of 'sectors' by mixed inocula has given a clue to a possible mechanism. If a small inoculum is made with a thick suspension of spores of two strains with equal growth-rates, the result is a colony made up of nearly radial sectors of one strain alternating with similar sectors of the other, a sort of rising sun figure (Fig. 5). If, however, the inoculum is large, irregular in shape and contains few spores, some of the sectors open out at great angles. Obviously some initial positional advantage plays a part. The next step is to control this positional advantage by starting two colonies, one of each strain, at different times and near each other (Fig. 6). The results are as those given by the intersection of two systems of concentric circles, expanding at the same rate, but differing in diameter when they first meet. The intersections are hyperbolæ and the angle between the asymptotes depends only on the ratio of the two diameters when the systems first meet (Fig. 3, *e*). The smaller the diameter of the small colony (or system) in relation to that of the larger one, the smaller becomes this angle and the more nearly do the sides of the resulting 'sector' coincide with the asymptotes and look like straight lines forming a blunt vertex. To explain 'sectors' of type *b*, to which many of those produced by irradiation belong, we have thus only to assume that the mutated hypha either had, immediately after irradiation, a positional advantage over neighbouring hyphæ, or that it enjoyed for a short time a much higher growth-rate. Plausible mechanisms of either type are easily imagined. For example, irradiation may kill a high proportion of hyphal tips and the surviving ones have a greater *Lebensraum*. Alternatively, differences in metabolism between mutated and non-mutated hyphæ may give one of the former a temporary advantage depending on conditions of the medium temporarily altered by irradiation.

'Sectors' of type *c* are nothing more than a modification of the preceding case; that is, the mutant has an initial temporary advantage, but a growth-rate lower than that of the mother colony. The experimental imitation of 'sectors' of this type needs no comment (Fig. 7).

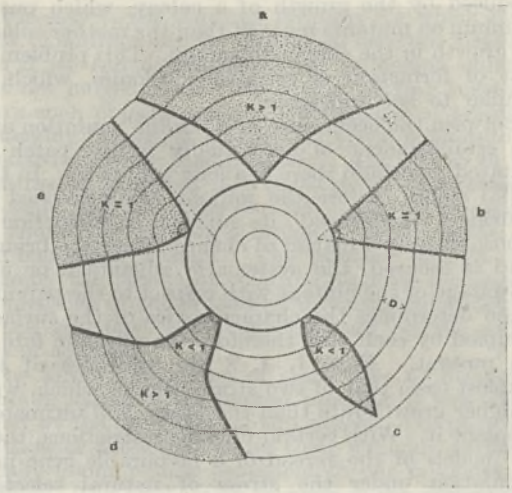

Fig. 3. GEOMETRY OF 'SECTORS': *a*, *b*, *c*, THE THREE SIMPLE TYPES, *d*, ONE OF THE COMPLEX TYPES, *e*, 'SECTOR' OF TYPE *b* IMITATED BY STARTING TWO COLONIES WITH EQUAL GROWTH-RATES AT DIFFERENT TIMES. HEAVY CIRCLE INDICATES EDGE OF COLONY WHEN IRRADIATED. *K*, RATIO OF GROWTH-RATES OF SECTOR AND COLONY; *D*, INCREASE IN RADIUS PER UNIT TIME.

The types of 'sectors' so far discussed are those in which mother colony and mutant have growth-rates bearing a fixed ratio to each other over a long period. A number of sectors with shapes interpretable as combinations of those so far described, however, are obviously not of this type. The ratio changes as the colony grows old. This may be due to a special growth habit of the mutant, that is, something detectable even if the mutant is grown by itself, or it may be due to an interaction between mutant and mother colony. Among the mutants we have isolated both types are represented. A simple example of non-reciprocal interaction is that of a mutant which grows more slowly than the normal strain on acid medium and more quickly on alkaline medium. As the *p*H of the medium changes (from acid to alkaline) with the growth of a colony, so also does the intersection curve between normal and mutant colonies grown side by side; its final form depends on the time of inoculation of the mutant after the establishment of the normal colony. If very soon (acid medium), the mutant will form a type *c* 'sector'; if somewhat later (acid medium changing to alkaline), the mutant will form a type *d* 'sector'; if still later, the mutant will expand at the expense of the normal.

Cases of reciprocal interaction, namely, antagonism or collaboration, between two or more strains are identifiable and analysable by some such methods. Another problem, in addition, can be investigated along these lines: that of changes in the medium,

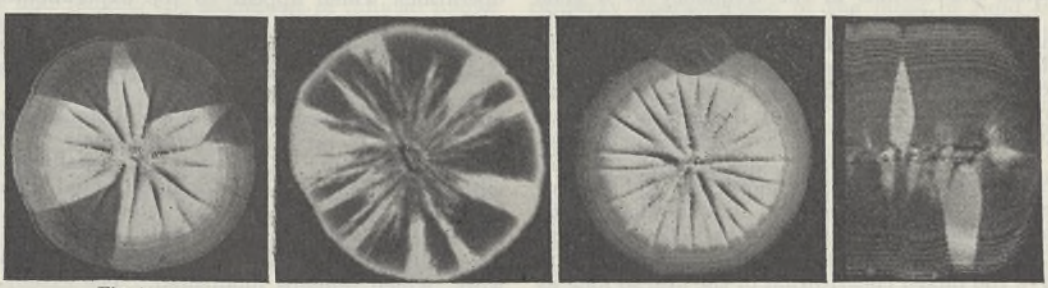

Fig. 4. Fig. 5. Fig. 6. Fig. 7.

Figs. 4–7. IMITATION OF VARIOUS TYPES OF 'SECTORS' BY INOCULA OF TWO STRAINS WITH EQUAL (FIGS. 5, 6) AND DIFFERENT (FIGS. 4, 7) GROWTH-RATES. FIG. 5 GIVES A GRAPHIC MODEL OF THE SEWALL WRIGHT EFFECT.

produced by the growth of a colony, which put a premium on mutants more fit than the mother colony for growth in the changed medium. This problem is that of formation of secondary colonies, which is familiar to bacteriologists.

Between the occurrence of a 'visible' mutation and the establishment of an actually visible patch of mutated mycelium there is a long way to go. In the initial stages, before the mutant has succeeded in securing a 'bridgehead', its survival or extinction is almost entirely a matter of chance. Once the bridgehead is secured, the systematic advantage or disadvantage of the mutant with respect to the parental strain determines the characteristics of the surfaces occupied by each, and therefore the ultimate fate of the mutant. Figs. 1, 4, 8 are examples of the simplest case, that of two strains one of which, with a higher growth-rate than the other, will ultimately supplant it. With certain obvious restrictions, these are models of the spread of a favourable gene in a population under the stress of natural selection alone. In Fig. 1 the mutant starts as a single individual in a large population; in Fig. 4 the mutant starts as 10 per cent of the initial population; in Fig. 8 two separate populations with different growth-rates start at the same time and compete for the same territory: the boundary between them is a circle.

It is, however, as models of the accidental multiplication or elimination of genes, and its dependence on the size of the population, that mutants of moulds can be most useful. Mixed colonies of strains with equal growth-rates are especially instructive, since in them the effect of natural selection between strains is nil, and that of chance alone stands out. A colony of this type, begun with great numbers of spores of each of two strains, shows (Fig. 5) in its early stages an apparently thorough mixture of both. Later on, the colony becomes made up of clearly distinct sectors each of either one or the other strain. As, with appropriate magnification, the early apparent mixture is seen to result from an alternation of very thin radial strips of each strain, the difference between earlier and later structure is simply a substitution of fewer sectors of great width for an initial very large number of sectors of very small width. Clearly a process of sorting out takes place: sectors which are too small in width either increase in width or disappear. The result is that any small apparently mixed arc in the young colony gives rise, after sufficient growth, to an arc in which one strain only is established to the exclusion of the other.

Here is an evident analogy with the Sewall Wright effect of the small size of populations upon the accidental fixation or extinction of genes. In the case of sexually reproducing species, the effect is due to the sampling nature of the reproductive process: accidental fluctuations in the frequency of a gene may, in a small population, reach the irreversible alternatives of either fixation or loss. In mould colonies a similar sampling operates. A hyphal tip in a colony of radius r gives rise, *on the average*, to r'/r hyphal tips when the colony has grown to radius r'. Accidents of growth, however, allow for fluctuations around this average: one hyphal tip will contribute more to the next 'generation', and another one less and leave no 'progeny'. In a small arc, with a small number of hyphal tips of two strains alternating, these fluctuations will be reversible and preserve the mixed constitution of the arc, so long as they do not happen to reach the irreversible state of all hyphæ being of one or the other strain. This will ultimately bring about the segregation of the two strains into 'sectors' of substantial size. To grasp fully the analogy between the Sewall Wright effect in sexually reproducing organisms and our example, one has to substitute a hyphal tip for a gene, and a small arc of the colony for a small population.

There are several possible ways of measuring the intensity of the sampling effects in moulds: unlike the sampling effect of sexual reproduction, its variance may be expected to depend on external conditions.

In conclusion, the remarkable diagrams that mould colonies may be made to produce offer a range of opportunities for the experimental approach to problems as apparently unrelated as morphogenesis and genetics of populations.

We wish to thank Miss A. H. Waddell for advice on the mathematical side, and Dr. W. M'Farlane, who carried out the irradiations at the Western Infirmary, Glasgow, for his most helpful contribution to our discussions. A research grant from the Carnegie Trust for the Universities of Scotland has covered part of the cost of materials.

FOUNDATIONS OF ELECTRICAL MEASUREMENT*

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THE last two or three years have seen the publication of a surprising number of papers on the fundamental magnitudes of classical physics. Even more surprising is the divergence of opinion expressed on such well-worn themes as the precise significance of the magnitudes of everyday electricity and magnetism. Well-known expounders of these subjects at our universities have found one another unintelligible, and practising engineers and physicists have frequently been heard to ask if these concepts are really as doubtful as all that after half a century of experience and discussion.

There seems to be fairly general agreement that the working concepts should be defined by reference to the processes by means of which they are measured, but there is no sort of agreement as to what these processes are. It appears that there are many possible processes for each quantity and no agreement as to their relative status. One of the troubles is that the processes described are usually idealized. They have been described as 'theoretical experiments'. It is agreed that they have not actually been performed, but it is asserted that they could be performed in principle; for example, you take two point charges and measure certain distances and forces and so on, operations which appear to the experimentalist of to-day as practically impossible, and in the results of which he would have no confidence whatever.

An outstanding fact, and one which the experimentalist finds very reassuring, is that all the doubt and discussion surrounding these theoretical experiments seem to produce no repercussions on his own real experiments. His values are usually accepted without argument, understood and acted upon with useful results. He can only conclude that these theoretical operations about which there is so much argument cannot really be the basis of the laboratory work, which remains unaffected. The extent of our

* Based on a lecture to the Measurements Section of the Institution of Electrical Engineers delivered on May 19.

agreement in practical matters shows that we must be working on some common basis. It is curious that it is so difficult to express it in terms on which we are all agreed.

Dr. Norman Campbell alone in recent years seems to have felt the necessity of maintaining a close and direct connexion between the principles and experimental laws which he enunciates as the basis of our measurements, and the methods that we actually employ in our everyday work. His work has, however, been strangely neglected in the recent discussions, and unfortunately, as he himself has pointed out, the matter is too complicated to be adequately covered by a few simple statements of the kind frequently offered. These are rightly used in introductory text-books, where it is expedient to conceal complexities until the more prominent ideas have been grasped, but when trying to find our basis the complexities must be faced. In these circumstances it would obviously be impossible to give here a precise statement of the position, but it may be of interest to indicate in broad outline some of its main features.

Measurement is essentially the derivation of numbers that are capable of representing physical properties in their relations to one another; and just as the various physical properties are defined by reference to the process adopted for their measurement, the numbers used in experimental physics are the symbols representing the results of the familiar physical or experimental operation of counting. The characteristic properties of numbers are the laws of addition, from which the other mathematical operations employed are derived, repeated addition leading to multiplication, the reverse operations providing subtraction and division, and so on. Thus the first condition to be satisfied in order that measurement may become possible is that some physical properties must obey laws that are analogous to the laws of addition for numbers. Another requirement is that operations must be devised that will enable us to judge of two objects, whether one is greater than, equal to, or less than, the other, in respect of some particular property. In short, judgments of equality and laws of physical addition form the basis of the whole problem.

It is generally agreed that in all our practical work we shall take length, mass and time as the primary properties, and probably everyone would agree with the statement that these quantities are all additive, though it is far from easy to say exactly what this statement means. Attempts to do so are apt to be tedious, but it is of interest to note that the measurement of these quantities depends only on the operations and principles mentioned above.

Length we define by reference to rigid rods. Judgments of equality are made by putting rods side by side and judging the alignment of fiducial marks or the coincidence of the planes of end-faces. Physical addition is performed with such rods by placing them end to end and in line. What justifies us in calling such a process addition? Briefly, it has characteristics similar to those laid down in the laws of addition, commutative, associative and distributive, the essential ones being as follows. First, whenever we perform the operation an increase of length is brought about, as can be established by our ability to judge equality, etc. Secondly, if we apply the process to a number of such rods, the length of the combination is always the same, however the various operations are performed and in whatever order they are carried out.

It is easy to see that any property for which such a law of addition can be established becomes measurable if we can devise means for producing objects that are judged equal. We can by adding together many such objects produce a succession of systems of steadily increasing magnitude, which constitute a standard scale for that property. Any object to be measured is compared with the systems of the standard scale, and when the two are judged to be equal, we count the number of original equal objects in the composite system. The familiar devices for reducing the labour of counting, and for increasing the precision of the process by including subdivisions in the standard scale, depend only on the same laws of addition.

The direct application of these laws to measurements of length of the highest precision is well illustrated by the use of sets of slip gauges. The physical addition of these gauges by their wringing surfaces is daily giving results consistent to one millionth of an inch. The application to mass is too obvious to need description, but time and frequency differ somewhat from the other primary magnitudes. In practical work we are solely concerned with periods of time, a concept based on recurrent phenomena. In rotating and vibrating systems, we recognize certain features which recur regularly. These recognizable features are regarded as defining instants separated by periods of time, and we can judge instinctively whether two such instants are simultaneous or whether one is 'before' or 'after' another. We choose some definite system as a standard and define its characteristic periods as equal intervals of time. Then the time between any two instants is, by definition, to be measured by counting the number of recurrences of the standard, after the first instant and before or simultaneous with the second. Clocks are standard periodic systems attached to mechanical counting devices or adding machines.

Frequency, which is perhaps more important than time in electrical work, is merely another aspect of the same phenomena: it is just the number of recurrences of the system in each standard period. A clock without its calculating machine is a frequency standard. It is well known to all wireless engineers that laws for the physical addition, subtraction, multiplication and division of frequency of certain periodic electrical systems have been experimentally established and that actual measurements of frequency are often made with the highest precision in virtue of these laws. It is a fortunate fact of Nature that these laws are consistent with our notion of time, which is additive by definition.

Angle also should be regarded as one of our primary properties. It is essentially a property denoting difference or change of direction, that is to say, a property characteristic of the faces of rigid bodies like crystals, or alternatively, one characteristic of the operation of rotation or of rotating systems. There is a common delusion that the measurement of angle is based on that of length, but both 'static' angles and angles of rotation are in practice measured fundamentally using only laws of addition, and there is close correspondence between the two. Anyone who has calibrated a divided circle will know that measurements of length play no essential part in the process, but that the essence of the matter is the continued addition of a number (n) of equal rotations until exactly one complete turn has been made. Each of the equal rotations then bears the relation $1/n$ to one complete revolution. Obviously angles

of this kind are also measured whenever we count revolutions.

A most interesting illustration of the fact that angle of the other kind is measured fundamentally, and of its relation to rotation, is provided by a new system of angle gauges recently developed at the National Physical Laboratory by Dr. G. A. Tomlinson. They consist of pieces of hardened steel with plane faces $3\frac{1}{2}$ in. $\times$ $\frac{5}{8}$ in., inclined together at various angles and so truly plane that they can be wrung together to form combinations like length gauges. This is the process of addition. Equality of angles could be tested by the parallelism of corresponding faces, and thus starting with an arbitrary unit angle, standards of 1, 2, 2, 5, etc., or 1, 2, 4, 8, etc., could be established and any desired angle produced by addition. Tomlinson has, however, greatly simplified the practical problem by making use of the fact that if two equal standards are added with their directions reversed, their external faces are parallel, that is, their sum is zero : in other words, in this case physical subtraction as well as physical addition is possible, and therefore with a given number of gauges more combinations are possible. Tomlinson uses only twelve gauges of angles 3″, 9″, 27″, 1′, 3′, 9′, 27′, and 1°, 3°, 9°, 27°, 41°, and with these he can quickly produce any angle between 0° and 81° to within $1\frac{1}{2}$″ of its nominal value, some 97,000 possible values.

Measurements of angles of rotation can obviously be made with these gauges in conjunction with an auto-collimating microscope. The appropriate gauge is placed on the rotating member with one face perpendicular to the axis of collimation. The other face is, of course, not visible through the gauge, but it becomes available for inspection by wringing any plane reflecting surface on to it and arranging this surface so that it projects beyond the edge of the gauge and is thus exposed to the collimator. The rotating member is now turned until the second face becomes perpendicular to the collimator axis, as is shown by a zero reading in the eyepiece. The angle of rotation is then equal to that of the gauge. The gauges require no accurate centring, and provide a relatively simple method of measuring angle with the highest precision. Of the first four sets of gauges constructed at the National Physical Laboratory the average error was only 0·2″, and only three gauges out of forty-eight had errors so large as 0·5″.

Measurements of this kind, based solely on laws of physical addition and judgments of equality, are called by Norman Campbell fundamental or independent measurements. Not only are they employed for the most precise measurements of the primary mechanical properties ; they are also employed for the most precise measurements of electrical properties. In the National Physical Laboratory, for example, they are employed for the basic measurements of resistance, capacitance and mutual inductance, and the laws of addition for these properties are the ones on which our electrical measurements primarily depend. Resistance is additive for conductors connected in series ; capacitance for condensers connected in parallel ; and mutual inductance for pairs of coils each consisting of a common primary coil and a secondary coil, when the secondary coils are connected in series. Standard scales for these quantities analogous to the scale of length are built up by the successive addition of resistors, condensers and inductors that are judged to be equal, the various bridges and balancing devices employed in making these judgments being detectors rather than measuring instruments, and serving only to amplify our senses.

Other electrical quantities which are additive are conductance, additive for conductors connected in parallel ; electromotive force, additive for cells in series ; and current, additive in circuits in parallel connexion. These quantities can all be measured fundamentally with high precision over a limited range. For measurements over a wider range other processes of measurement are used. For conductance we usually base our measurements on the law connecting it with resistance, which it may be noted is very similar to that connecting frequency and time.

Fundamental measurement is obviously severely limited in its scope, since each property is measured independently of any knowledge of any other property. But it is the relations between different properties that give to physical science its great scope, and modern experimental technique consists largely of measurements based on the numerical laws expressing these relations. It is important, however, to recognize that these numerical laws are entirely dependent on the laws of fundamental measurement that have previously been established for certain of the properties. It is only possible here to consider the first two or three in the sequence of derived laws which forms the basis of our experimental work. The great bulk of the electrical apparatus used in Great Britain is calibrated by instrument makers by reference to standards calibrated at the National Physical Laboratory, and therefore measurements made with this apparatus must be based on the laws adopted at the National Physical Laboratory for standardizing purposes.

The first of these laws is that connecting mutual inductance M and geometrical properties. It can be written

$$M = \mu_0 N,$$

where N denotes Neumann's integral $\int\int \frac{ds_1\, ds_2 \cos \varepsilon}{r}$.

We have seen that for certain systems M can be measured fundamentally. For many such systems N can be expressed in terms of lengths and angles, which can also be measured fundamentally. It therefore becomes possible to establish with very high precision the law that for all mutual inductors constructed of non-magnetic material, M and N are proportional to one another, the proportionality constant μ_0 depending only on the units adopted for M and N respectively. It can also be established that for inductors made of magnetic material the law becomes $M = \mu N$, where μ is constant for any one material, but varies with change of material. This law therefore provides a process for the measurement of the property μ characteristic of magnetic materials. It is the law defining magnetic permeability, and most of the usual methods of measuring permeability are directly based on it. The constant μ_0 must now be interpreted as the permeability of all non-magnetic materials. We can regard it as having the dimensions 1 in inductance, and -1 in length, if we find the practice useful, and it is convenient to write its value as 10^{-9} henry per cm. The unit of inductance, the henry, has of course been fixed by assigning this value to μ_0.

Our next law is that of the electrodynamometer, which forms the working basis of most of our measurements of current. It can be written

$$F = a\, I^2 \frac{dM}{dz},$$

where F denotes the mechanical force between two coils when each carries the same current I, M denotes the mutual inductance between the coils, and the z-axis is the direction of the force. This law has been established with the highest precision for the special case of the current balance built of non-magnetic material, the force F being determined by weighing, in terms of mass, and the quantity $\frac{dM}{dz}$ by application of the law of mutual inductance in terms of the geometrical property $\frac{dN}{dz}$. I can be measured fundamentally over a limited range, and thus the dynamometer law is established by means of the current balance in the form

$$mg = a\, I^2\, \mu_0\, \frac{dN}{dz}.$$

The proportionality constant a, unlike μ_0 in the previous law, appears to be characteristic of no important property. We therefore choose our unit of I so that a takes the value of unity and disappears from our working equation, which becomes

$$F = I^2\, \frac{dM}{dz}.$$

Next in the sequence is Ohm's Law, the law of the potentiometer, which can be established in the form

$$E = b\, I.R,$$

since both E and R can be measured fundamentally, while I can be measured both fundamentally and by means of the dynamometer law. The constant b appears to be characteristic of no important property and is therefore suppressed by a suitable choice of units for E and R.

It is impossible to pursue the subject further here, but the examples given are sufficient to show the kinds of law that form our real foundations at the present time. These foundations change to some extent with changing technique. The basic laws are those of the instruments and operations which have enabled us to correlate our experiences with the highest precision, and have therefore been used in establishing our working standards. At the present time, alternating currents are employed for precision electrical work to an increasing extent, and therefore some of the laws concerning alternating currents are of basic importance. Note that the electrodynamometer law provides us with a means of measuring alternating current as well as direct current, and then by means of the electrostatic voltmeter we can extend Ohm's Law to certain classes of conductors, namely, resistors. Thus we can define and measure alternating potential difference. Faraday's Law of Induction can then be established in the form in which it states the relation between the alternating potential difference at the secondary terminals of a mutual inductor M of which the primary carries a current I. Adopting the usual vector notation, we establish the law

$$E = kM\omega I,$$

and then choose the unit of E so that $k = 1$. The constant b which appeared in Ohm's Law is then suppressed by a suitable choice of the unit of resistance.

It is unfortunate that this system of laws, upon which our experimental work is based, does not readily link up to form a simple logical development of the theory of the subject; but once we have recognized the great difference between the basic experimental laws and the theoretical relations which have been devised as the simplest easily workable system consistent with these laws, we are prepared to find differences of opinion as to which theoretical scheme can be used with the least risk of confusion.

PSYCHOLOGICAL ASPECTS OF MORAL PROGRESS

A WIDESPREAD readiness to re-examine human values makes it particularly appropriate at the present time to ask whether recent scientific work can add to our understanding of moral advance. This was the question taken up in a discussion on "Psychological Aspects of Moral and Social Progress" at a meeting of the British Psychological Society on September 23, in which the chief speakers were Prof. J. C. Flugel, Prof. Karl Mannheim and Dr. R. H. Thouless.

In opening the discussion, Prof. Flugel suggested that, as a first approximation, we may identify eight mental tendencies exhibited in what we regard as moral progress. Once recognized, they can be illustrated in three fields of comparison: they differentiate the mind of the infant and child from the more mature mind, the abnormal (pathological) mind from the healthy mind, and the primitive from the civilized culture. These eight tendencies may be briefly stated.

(1) There is a trend away from ego-centricity and towards sociality, an increasing readiness to subordinate one's own immediate requirements to the needs of one's fellows, and to find satisfaction in the well-being of groups ever more broadly conceived, so that what starts as a concern for a few family associates may develop into loyalty to a nation, a church, or the whole human race. Among the psychological mechanisms involved in this process, an important part is played by vicarious satisfaction; our interest goes out to people very different from ourselves because they represent some of what William James called the 'potential selves' which we all give up in becoming our own one self.

(2) Progress towards greater consciousness, away from the control of conduct and feeling by unconscious urges, also appears in the advance towards individual maturity and civilized social organization. Progress along this line is pre-eminently the aim of psycho-analysis. At the same time, it must be recognized that, conscious scrutiny having thoroughly performed its task, much behaviour has to be relegated to the habitual and the automatic. Individual conscious life is supported by a mass of habits, reflexes, and other non-conscious determining tendencies. In social life, traditions and conventions have a similar role. Their value lies in the economy they effect, their danger in that they may grow antiquated and ill-adapted; but they must always be necessary in mental and social organization, simply because the span of consciousness at any one time is strictly limited.

(3) The trend towards realistic thinking, away from dreaming and 'wishful thinking' in individual life, and away from magic in social life, is a third mark of advance. Science, Freud has suggested, is essen-

tially an endeavour to think according to the 'reality principle'.

(4) Social and individual progress shows a gradual replacement of aggression by tolerance. Primitive and infantile mortality is marked by a sweeping aggressiveness which gives place in later development, to finer discriminations and broader tolerance. The mature mind can better tolerate unwelcome stimuli, including new points of view, and has less need to react in aggressive defence of things as they are. In one respect this appears as the toleration of criticism which is vital to science; in another as that capacity for 'collaboration in opposition' which Madariaga has noted particularly in the British national character.

(5) A trend is to be seen in individual and social advance towards spontaneity in doing what is regarded as right, in contrast to the more primitive reliance on strong prohibitions against 'wrong' impulses after they have arisen. In the child's development, the external prohibitions are replaced by the internal control of the super-ego, and with increasing maturity the conflict grows less between the super-ego and the impulses it controls. One aim of psycho-analysis is to replace the crude inhibitory power of the super-ego by the ego's more delicate discrimination. So, too, right behaviour among primitive groups depends more on taboos and the avoidance of sins, but in civilized societies more upon the sublimation of impulses into permissible channels.

(6) A progressively greater freedom from irrational anxieties is seen in the child's development and in the advance from primitive to civilized societies, superstitions and phobias being shed, bogies of all kinds less and less remembered. In psycho-analysis the patient's progress exemplifies the same trend.

(7) As development proceeds, the individual shows increasing self-responsibility. In controlling his behaviour he judges with greater autonomy, and is less at the mercy of the ready-made morality of the group or the super-ego. The same tendency is seen socially in the advance from generalized taboo to reliance on individual conscience; and, politically, towards democracy instead of submission to a dictator.

(8) The eighth developmental trend shows moral judgments increasingly penetrated by intellectual understanding. The cognitive approach to what we disapprove of begins to displace the mainly affective and conative procedures of condemnation and attack. In reply to discussion on this point, Prof. Flugel made it clear that a moral judgment must always remain, and action must be taken against what we condemn; but with increased maturity the means adopted will be chosen in the light of much fuller intellectual understanding. The handling of delinquents illustrates the point: the modern effort to investigate, to view separately the sin and the sinner, is an advance beyond the simple condemnation and punishment which, considering that they have been practised for some millennia, have achieved relatively little.

Prof. Flugel suggested these eight tendencies only as a first approximation, and he later inclined to agree with Dr. Thouless that a ninth should be added—the tendency towards greater voluntary control of action, the passage from uncontrolled to controlled behaviour. While adding this ninth tendency, however, Dr. Thouless was emphatic that he could not regard such tendencies as aspects of 'progress'. He viewed them as a description in psychological terms of the criteria by which we distinguish between the better and the worse in conduct. That the better does in fact come later in the life-history of the individual and the social group is a separate question, to be decided only by an examination of the facts of child psychology and of anthropology. The term 'moral progress' implies an answer to this question, which may or may not be true. He doubted, for example, whether the tendency towards sociality and away from ego-centricity is greater in civilized than in primitive groups.

Prof. Mannheim, reading the first paper in comment upon Prof. Flugel's thesis, had already given critical attention to the concept of 'progress'. Speaking as a sociologist—and welcoming a discussion that brought both psychology and his own science to bear on the problem—he pointed out that the notion of progress grew up in the nineteenth century, an era of industrialization and economic expansion. Impressed by the seemingly endless possibilities of material advance, thinkers of the time carried over the same optimistic attitude into their view of the human mind. But this confidence in social and moral advance as an inherent feature of the historical process has been deeply shaken by the political and international events of the twentieth century.

In Prof. Mannheim's view, society shows no inevitable cultural development through recognizable stages. Such a phenomenon as Germany's return to the tribal mind and over-socialization is not to be termed a 'regression', for the trend in the opposite direction is not a normal or natural process. To suppose that it should be, is to blind ourselves to the more important moulding of behaviour by environmental conditions. For a detailed understanding of a group at any period our chief need is, not to know what point it has reached on a linear scale of progress, but to relate its current mental attitudes to its concrete environment, social and technical.

As an example, Prof. Mannheim pointed out that an industrial society, appearing late in the historical sequence, may nevertheless produce—through its uniform repetitive tasks and its social institutions which reduce the opportunity for individual choice—far less individualized personalities than an earlier society without mass production. It depends on the particular organization of society whether the trader, for example, grows acutely aware of the difference between his own interests and the interests of others, as he did under *laisser-faire*, or whether he thinks rather in terms of collective action by a group of associated merchants or a guild of craftsmen.

As a member of our contemporary culture, Prof. Mannheim is ready to agree that he, too, values the eight tendencies which Prof. Flugel identified. But as a sociologist he challenges the frame of reference within which the psychologist makes his judgments.

Dr. Thouless, in his comment on Prof. Flugel's paper, not only objected to the suggestion that the eight tendencies represent 'progress', but also doubted whether they are all aspects of any single process or at all closely related with one another. For example, one might go far towards realistic thinking (3) without becoming any less aggressive (4). Rather than assume a unified stream of progress we should do better to recognize that there are many ways in which men and societies can improve.

Like Prof. Mannheim, Dr. Thouless stressed the limitations of moral judgments made within our contemporary frame of reference. Thus our own readiness to talk as if aggressiveness were the principal evil may seem to later observers as relative and

peculiar a characteristic as the nineteenth century's readiness to regard sexual indulgence as the chief of sins. Again, the sense of guilt has gone through cultural vicissitudes. Puritanism made it a moral good in itself. Psycho-analytic writers now speak as if it were merely pathological. But it has a valid function to perform: it can serve to deter us from a repetition of those acts which we ourselves condemn. In fact, in Dr. Thouless's opinion, the modern tendency to belittle the idea of sin goes too far. The fact of sin (whether we take a religious view of it or not) occurs whenever a man's voluntarily controlled behaviour falls short of his own accepted standards. Even in these modern times, we retain a vivid sense of sin when others commit it; nowadays a man is prone to repent of his neighbour's sin and to apply the light of scientific understanding to his own.

In general, Dr. Thouless believes that the psycho-analytic approach represented by Prof. Flugel's eight principles suffers from an intellectual bias. It describes moral betterment as if that were primarily a matter of getting better principles and moral ideas, and seems to neglect the problem of bringing actual behaviour into line with those moral principles. For this reason he proposed the ninth tendency already referred to—a progressive increase in the voluntary control of conduct. But, as he was careful to point out, this trend by itself does not ensure an improvement in conduct, since voluntary effort may be directed towards wrong ends. The ethical questions remain.

The meeting was left to decide whether, as Dr. Thouless suggested, the effort to discuss the nature of right and wrong in the new technical language of psycho-analysis is primarily a test of the adequacy of that language; or whether, as Prof. Flugel holds, certain psycho-analytic conceptions, such as that of the super-ego, actually throw new light on moral problems.

OBITUARIES

Prof. Gustav Gilson

NEWS comes from Belgium that M. Gustav Gilson, embryologist at Louvain, fisheries expert at Ostend, died last winter. He was eighty-two years old, and though he kept busy to the end the best of his work was done well-nigh sixty years ago.

Gilson was Carnoy's favourite pupil: when Carnoy started his famous journal, *La Cellule*, Gilson figured as co-editor, and the first number contained his "Etude comparée [or part of it] de la Spermatogénèse des Arthropodes". The next was by Carnoy himself, "Sur la cytodiérèse chez les Arthropodes", in other words, on mitotic cell-division. It was a great enterprise to start this costly journal in a small university like Louvain; but natural science was no new thing in that University. It was there that Theodor Schwann wrote his "Observations microscopiques", and laid the foundations of the cell-theory. P. J. van Beneden had been professor there for forty years, and his "Ostéographie des Cétacés" was famous. His son Edouard was a leading embryologist of F. M. Balfour's time, and had just published a paper which became classical, on the egg of *Ascaris megalocephala*; but he left Louvain for Liège (as Schwann also had done), and Louvain and Liège seldom saw eye to eye. Other papers of Gilson's, more or less important at the time, were for example on "Les glandes odorifères de Blaps mortisaga" (1886); a whole series on "La soie et les appareils sériciganes" (1890–94); and a careful histological study of "Les cellules musculo-glanduleuses de l'Owenia", a genus of Annelides (1898). When Carnoy died all too soon in 1899 Gilson pronounced the customary *Éloge*, and did it with grace and tenderness: he carried on *La Cellule* as sole editor until it came to an end, like much else in Louvain, during the War of 1914–18.

Gilson carried on the Department of Zoology well and efficiently, but did little more histological or embryological work after Carnoy's death. He had a family connexion with Ostend, and the latter years of his life were spent there; he began to interest himself in the local fisheries, and in course of time established a Fisheries Laboratory, and even issued a journal (*Annales de l'Institut*) in connexion with it. He was not one of the founders of the Conseil International, but he took part in our second meeting in Copenhagen (1903), and attended regularly thereafter. One of the first of his fishery publications was on the reproduction and migrations of the eel, a burning question at the time; another, about 1910, was an elaborate statistical study of the great plaice-fishery; yet another, and an interesting one, was on the 'Guai', or winter-herring of the Belgian coast. Other fishery papers mostly dealt with the busy fleet of motor and sailing cutters, trawling and shrimping off the Belgian coast, and landing, or still worse destroying, prodigious quantities of 'undersized' fish. A report which he made to the Council in 1928 was the completest account of such a fishery that had ever been drawn up, and the many million of small fish destroyed made a startling story.

Gustav Gilson married late in life, but very happily. He was reticent of speech, austere of manner, of grave and intellectual countenance; during fifty years acquaintance I found him a faithful friend, a real scholar and a true man.

D'ARCY W. THOMPSON.

Mr. H. Tetley

MR. H. TETLEY, curator in zoology at the Bristol Museum and Art Gallery, died on September 26 at the relatively early age of fifty-four. Educated at Malvern College and graduating B.Sc. in the University of Leeds in 1916, he carried out postgraduate research in entomology in the University of Manchester. During the War of 1914–18 he served as a paymaster in the R.N.V.R. and on demobilization was appointed assistant demonstrator in zoology and curator of the zoological museum in the University of Sheffield.

After a serious illness—the effects of which really undermined his health for life—Tetley was appointed in 1927 to take charge of the Zoological Department of the Bristol Museum and Art Gallery. There he overhauled the extensive collections, prepared and arranged new exhibits, and instituted the organization of records concerning the local distribution and occurrence of many groups of animals. It was a severe blow to him when in 1940 many of these records and much of the collections were destroyed by enemy action. He was especially conversant with local birds and mammals, and his publications reflect these interests. Many of these papers were published in the *Proceedings of the Bristol Naturalists' Society*, and by far his most important work was an

extensive paper on the "Land Mammals of the Bristol District" published in 1940. Papers on British polecats, the Scottish fox and wild cat were published in the *Proceedings of the Zoological Society* between 1939 and 1941 and various notes appeared between 1933 and 1942 in *British Birds*.

Tetley was a first-class observer in the field, and was always ready to place his comprehensive knowledge of local animals at the service of interested inquirers. Many of his papers bear witness to these detailed observations, while others give evidence of his bibliographical researches and are fundamentally compilative in character.

He held several offices in the Bristol Naturalists' Society, being president at the time of his death. He was a fellow of the Zoological Society of London and was recently engaged upon collecting details for the third volume of the International Wildfowl Inquiry Committee and the University of Bristol sub-Committee of the Nature Reserves Investigation Committee. For several years he had been special lecturer in systematic zoology at the University of Bristol, where he also rendered valuable service in connexion with the Wiglesworth Library of Ornithology.

Dogged by ill-health, never strong and robust, Tetley carried out his duties faithfully even under adverse conditions. Of a gentle disposition, though rather non-receptive to new ideas and policies, he was held in high esteem by local naturalists, and the sympathy of his colleagues and friends is extended to his widow and two children.

F. S. WALLIS.

WE regret to announce the following deaths:

Prof. C. G. Barkla, F.R.S., professor of natural philosophy in the University of Edinburgh, on October 23, aged sixty-seven.

Dr. Olaf F. Bloch, formerly chief chemist of Ilford, Ltd., on October 19, aged seventy-two.

Prof. M. R. Wright, M.B.E., emeritus professor of education, University of Durham (King's College, Newcastle upon Tyne), on October 10, aged ninety.

NEWS and VIEWS

Prof. H. T. Flint

PROF. H. T. FLINT, the new occupant of the Hildred Carlile chair of physics in the University of London in succession to Prof. W. Wilson, was one of the latter's colleagues at King's College, London, in the days immediately following the War of 1914–18. Like his predecessor, he is chiefly interested in the theoretical aspects of physics and has made many highly original and important contributions to relativity and quantum dynamics. He showed that Wilson's quantum conditions fix an upper limit to the number of the chemical elements and gave an explanation of the existence of the elementary charge. The introduction of a matrix-length into the geometry of the microphysical world and of the imaginary gauge is due to him, and his work has anticipated much of recent nuclear field theories.

Prof. Flint's activities are by no means confined to theoretical subjects. He has recently devised a new method of measuring dielectric constants and absorptions, which has the merit of eliminating errors due to fluctuating input and enables dielectric properties in the region of centimetre, or even millimetre, waves to be investigated. He is also an expert on the manipulation of radium for hospital purposes. He is the author of well-known works on wave mechanics, geometrical optics and, in collaboration with Dr. Worsnop, of a much used text-book of practical physics.

International Convention for Civil Aviation

A WHITE PAPER, issued recently, lays down the British Government's policy for the future control of civil aviation. It visualizes a radical change from the pre-war outlook, proposing a new air convention covering six main objectives to be secured by international agreement. Proposals have already been made by the Canadian Government, and other Commonwealth Governments are known to hold favourable views. Previous to the War, regulation by agreement was confined to technical aspects covering safety, the right of innocent passage across territory and access to aerodromes. This convention, although ratified by thirty-three States, was never adopted by the United States, the U.S.S.R. and China. Many countries heavily subsidized their air-transport companies, either for national prestige or war potential, and consequently bargaining for international flying rights became political and gave rise to much friction. The new proposals would cover the economic and commercial, as well as the technical aspects, and thus by agreement avoid the political and narrow national outlook in administering air transport over world routes.

The British Government suggests that the proposed convention will secure the following objectives: (1) meet the needs of the world for plentiful, efficient and cheap air transport; (2) maintain equilibrium between the world's air transport needs and capacity; (3) ensure an equitable participation of each country in the world's whole air transport scheme; (4) eliminate wasteful competition and in avoiding unnecessary expenditures and fixing rates of carriage, limit the need for, and to control, subsidies; (5) standardize technical matters dealing with the safety of flight; (6) contribute to world security by encouraging international travel and exchange. It is suggested that the administration should consist of an international air authority, with operational executive panels, probably regional, and sub-commissions to deal with technical matters. The authority would consist of representatives of the ratifying States, and would need to be placed in proper relationship to any world security organization as may exist. The composition of the executive and technical bodies would have to be by mutual agreement between the air authority and the ratifying powers. The Government has explained that these proposals are a broad outline only, and may need to be modified in the light of views expressed by other countries.

Gift to University of Leeds

MR. CHARLES BROTHERTON has just given the University of Leeds (1) £1,000 a year for seven years for the establishment of a Brotherton research fellowship in physical chemistry tenable in the Department of Colour Chemistry and Dyeing; (2) £1,000 a year for seven years for the establishment of a new lectureship in chemical engineering in the Department of Coal Gas and Fuel Industries; and (3) an additional sum of £1,000 to each of the two Departments for the purchase of equipment.

These are not the first gifts which have come to the University of Leeds from Mr. Brotherton. In September 1940 he provided a valuable addition to the resources of the Colour Chemistry and Dyeing Department by providing funds for the institution of two Charles Brotherton entrance scholarships tenable by students reading for the degree of B.Sc. with honours in colour chemistry, and two years later he increased the number of scholarships to three. Mr. Brotherton has expressed his gratification at the success of this scheme and has now extended his interest in the work of the Department by his further contributions. For some time past the investigation of problems of fibre technology, dyeing and some aspects of colour chemistry has necessitated the increasing application of methods of physical chemistry. The addition of a physical chemist to the staff of the Department has long been desirable; but the mere institution of such a post would have been ineffective in the absence of a suitably equipped laboratory. Mr. Brotherton's generous gift, which allows complete freedom in the expenditure of the funds as between the salary of the research fellow and the equipment of an appropriate laboratory, will make possible at an early date the realization of this most important development.

The Department of Coal Gas and Fuel Industries with Metallurgy, which also benefits by Mr. Brotherton's latest gift, co-operates with the Institution of Gas Engineers in research supported by the Institution and guided by a joint committee of the Institution and the University of Leeds. The Livesey professorship was endowed in 1908 from a fund raised by public subscription from the gas industry in memory of the late Sir George Livesey. The Department has for some thirty-seven years provided degree courses in fuel and metallurgy. The training in gas engineering has been based on chemistry and engineering, followed by instruction embracing chemical engineering and fuel technology, mainly to meet the needs of the gas industry. A separate curriculum was established in 1942 in chemical engineering and is intended to provide instruction particularly in plant design and in the so-called unit processes of the chemical industry. It meets the special need of those passing either into the contracting side of the gas industry or into the chemical industry generally. The provision of up-to-date equipment and staff in such technological departments is costly, and the University has largely to rely on the support of industry. Mr. Charles Brotherton's generous gift to provide for the special needs of chemical engineering is most opportune and should materially help to establish one of the best training grounds in the country. The need is vital, for British universities have been unable during the years between the two wars to make advances in this field comparable with those of the United States.

An International Association of University Teachers

THE sixth general meeting of the Association of Allied University Professors was held in London on September 25. The meeting was called specially to consider the statutes for a proposed International Association of University Professors and Lecturers. These were, after some amendment, adopted as provisional statutes, so that what has hitherto been a domestic association, bringing together those university professors and lecturers of the Allied countries who, in recent circumstances, have reached Great Britain, now takes on a wider international function under a new name. It is hoped that in each country where there is academic freedom a national group of members may come into existence. In order to establish contacts and bring into being such groups, a Provisional Central Council has been formed, mainly of university teachers of various nationalities who are domiciled in Great Britain, the duty of each member of which is to arouse interest in the Association in the universities of his own country. As soon as circumstances permit, representatives from these countries will replace the original provisional member and the Central Council will become a representative body, and will confirm or amend the statutes. The Provisional Central Council at present comprises members representing some twenty different countries, and it will be enlarged as further contacts are made. One result of the change in structure of the Association will be that in Great Britain, where membership has hitherto been restricted in order to preserve some balance between British members and those from other countries, membership will now be widely open in university circles. After the more formal business of the meeting was completed, Dr. Grayson N. Kefauver, of the American Educational Delegation, gave an address on "The Role of the University in Social Reconstruction".

British Standards Institution

THE annual general meeting of the British Standards Institution was held on October 17, when Lord Woolton was elected president, Sir Percy Ashley vice-president, and Sir William Larke succeeded Sir Percy Ashley as chairman of the General Council. Dr. E. F. Armstrong, chairman of the Finance Committee, explained that the income and expenditure for the year had increased by 28 per cent and was now about £69,000. The sales of copies of British Standards had gone up 39 per cent. The Government grant-in-aid was nearly double and was now £12,900. While there was an increase of some 15 per cent in the number of subscribing members he pointed out the need for greater support from local authorities and industry. Sir Percy Ashley concluded his term of office as chairman of the General Council with a brief review of the work done as a direct aid to the war effort by the British Standards Institution, and the progress made during the same period in the preparation of British standards for industrial and commercial materials and appliances. The war work covered the preparation of war emergency British standards for A.R.P. materials for the Ministry of Home Security, packaging schedules and code for the Ministry of Production, steel and non-ferrous metal standards as well as standards for many other materials, tools and appliances for the Ministry of Supply and for the Services generally, and schedules for clothing and hardware for the Board of Trade. Many of the war emergency standards were made

compulsory by the issue of statutory rules and orders. The preparation of standards for building materials and appliances now being carried out in support of the programme of house-building of the Ministries of Works and Health has already reached substantial proportions. Sir Percy concluded by emphasizing the importance of industrial standards, which provide for accurate and precise trade descriptions, methods of sampling and testing, and standards of performance, and of an independent body, set up and maintained by the national industry as a whole, with Government support but not under Government control, for the preparation of such standards. Progress will be most widespread and continuous if the policy of 'standardization by consent' is consistently pursued.

Harvesting Machinery

THE inaugural meeting of the 1944–45 session of the Institution of British Agricultural Engineers was held on October 17 at the Institution of Electrical Engineers under the chairmanship of Mr. C. I. C. Bosanquet, and Mr. Cornelius Davies read a paper on harvesting machinery. Mr. Davies, who has for many years been closely associated with the South-Eastern Agricultural College at Wye, Kent, traced the developments in methods of harvesting from the earliest times to the present day. His paper dealt not only with the harvesting of corn and potatoes but also with machinery for handling sugar beet, grass, silage, hops, vegetables and fruit. On the combine harvester Mr. Davies reminded the audience that this machine cuts and threshes the grain in one operation, and there is no period in the stook when final ripening can take place. Adequate drying facilities are necessary, and serious attention to grain storage is required. Nearly all combine owners are faced with a straw problem. He considers that to burn straw is evidence of bad husbandry. On some farms pick-up balers are used, but the cost of these is nearly as high as that of a combine; further, the use to which the baled straw can be put must be considered.

On the question of potato harvesting Mr. Davies discussed the relative merits of the spinner and the elevator lifter, and stressed the need that still exists for a really satisfactory potato harvester. In conclusion, Mr. Davies stated that in addition to the provision of more and better harvesting machines, there must be more skill in handling and greater care in maintaining and managing agricultural machinery. In the discussion which ensued, community ownership of expensive machines, the employment of contractors, and the development of simple and relatively inexpensive machines within the scope of private ownership on small farms were discussed.

Cultural Co-operation

UNDER the title "The Cultural Co-operation Program 1938–1943" (Washington: Govt. Printing Office. 15 cents), the U.S. Department of State has issued a report by H. Hanson describing the development since its inception of this programme for fostering international relations on a basis of mutual understanding and appreciation. The programme is conceived by the General Advisory Committee of the Division of Cultural Relations as a long-term one of continuing activities which should be as broad as intellectual and cultural activities themselves. A statement of policy issued by the Department on March 31, 1944, on the participation of the United States in educational and cultural reconstruction in Europe, indicated the Department's intention of co-operating in the formation of a United Nations organization for educational and cultural reconstruction. This emergency programme to meet this need may consist of assistance in restocking essential educational facilities, especially books and scientific and other teaching aids; in the provision of opportunities for training carefully selected foreign students in American educational institutions; in re-establishing essential library facilities; and in the recovery and restoration to their rightful owners of scientific, artistic and archival materials looted by the Axis countries. The report includes some notes on professional and scientific relations, and on the various activities under the programme: these include travel and study grants, including student exchange, and the provision of technical experts for China; cultural centres, such as libraries, including the reference library opened by the Office of War Information in London in December 1942, which seeks by a careful loan service to place each new American book in the hands of selected people in the British Isles; cultural materials, such as books for libraries in the Western hemisphere, book translations, microfilms for China and the Near East, science news letters and motion pictures and radio activities.

Pitfalls of Positivism

IN a most timely article entitled "Positivism" (*Mind*, July 1944), Prof. W. T. Stace throws great light on the doctrinaire character of the so-called logical positivists. After making a useful distinction between the 'meaning' of a word and the 'significance' of a sentence, he states the positivist principle as follows: "what makes a sentence significant is that some actual or possible observation can be deduced from it in conjunction with certain other premises, without being deducible from those other premises alone". He then makes his main point, that underlying this principle is another one more fundamental, which he calls the "Principle of Observable Kinds", and states as follows, "a sentence, to be significant, must assert or deny facts of a kind such that it is logically possible directly to observe some facts which are instances of that kind".

Prof. Stace points out that this principle is different from the positivist principle in that it introduces the notion of direct verification, whereas the positivist principle makes use of that of indirect verification. Further, this latter principle neither follows from the positivist principle nor is it self-evident. Nor again does it follow from the empiricist principle which states that all our simple ideas come from impressions, because this provides no guide as to how the former are to be combined to make significant sentences. In fact, Prof. Stace holds that there is no reason to think the principle true. It would follow that we should discard it and with it the positivist principle, if in fact this latter is based on it. But the proof which Prof. Stace gives that the two are related in this way is weak. Nevertheless, all those inclined to flirt with modern forms of positivism should study the article.

Physical Society's Exhibition of Scientific Instruments and Apparatus

THE Physical Society's long and almost continuous series of annual exhibitions of scientific instruments and apparatus was, of necessity, suspended during the War. Its resumption has recently been considered by the Council of the Society and by the Exhibition

Committee, now under the chairmanship of Prof. G. I. Finch, who succeeds the late Mr. R. W. Paul, and it is proposed that the thirtieth exhibition (which was planned to take place in January 1940) shall be held in January 1946. It will take place in the Physics Department of the Imperial College, Imperial Institute Road, London, S.W.7, as on previous occasions, and will be on about the same scale as the exhibitions of the immediate pre-war years.

Edward Emanuel Klein, F.R.S. (1844–1925)

DR. EDWARD EMANUEL KLEIN, a pioneer in histological and bacteriological research, was born at Ersek in Hungary on October 31, 1844, and studied at Vienna, where he devoted himself to microscopic anatomy. In 1869 he came to England and served at first as histological assistant to Burdon Sanderson, but afterwards devoted himself entirely to bacteriology, of which he was the first representative in England. He was lecturer in histology and later of bacteriology at St. Bartholomew's Hospital Medical School, where Ronald Ross was one of his pupils. He was the author of "The Anatomy of the Lymphatic System" (1873–75), "Atlas of Histology" with Mr. Lobb Smith (1879–80), "Elements of Histology" in collaboration with J. G. Edkins (1883), "Micro-organisms and Disease" (1884), "Asiatic Cholera" (1884) and "Oriental Plague" (1906). He was also collaborator in a "Handbook for the Physiological Laboratory" (1873). He was elected a fellow of the Royal Society in 1875. He died at Hove on February 9, 1925.

The Night Sky in November

NEW moon occurs on Nov. 15d. 22h. 29m. U.T. and full moon on Nov. 30d. 00h. 52m. The following conjunctions with the moon take place: Nov. 5d. 00h., Saturn 0·1° N.; Nov. 10d. 18h., Jupiter 4° S.; Nov. 17d. 05h., Mercury 5° S.; Nov. 19d. 02h., Venus 3° S. The following occultations of stars brighter than magnitude 6 take place: Nov. 2d. 23h. 12·0m., *i* Tauri (*R*); Nov. 3d. 22h. 06·1m., 20° 1105*m* (*R*); Nov. 8d. 04h. 19·1m., 8 Leon. (*R*). The times refer to the latitude of Greenwich and *R* refers to reappearance. Mercury sets 8 minutes after the sun on Nov. 1 and 52 minutes after the sun at the end of the month. Venus can be seen in the evenings, setting at 17h. 45m., 18h. 12m., and 18h. 18m. at the beginning, middle and end of the month respectively. Mars is too close to the sun for favourable observation. Jupiter rises at 2h. 19m. at the beginning of November and can be seen about midway between σ and υ Leonis. At the end of the month the planet has moved into the constellation of Virgo and rises at 0h. 48m. Saturn, in the constellation of Gemini, sets at 12h. 09m., 11h. 12m. and 10h. 11m. at the beginning, middle and end of the month respectively. The times have been computed for the latitude of Greenwich and the effects of refraction are ignored in all cases. The Leonid meteors are due on November 13–14 but the shower has been very feeble for some years, and the same remark applies to the Andromedids, which were once fairly active during November 18–27.

Anncuncements

AT a meeting of the Council of the Royal Society held on October 12, amendments were made to the statutes so as to make it clear that, since the passing of the Sex Disqualification (Removal) Act of 1919, there is no barrier to the admission of women into the fellowship of the Society. This decision was reached after the fellows of the Society had been consulted by postal vote and had approved the amendments ratified by the Council on that day.

THE U.S. National Academy of Sciences, which serves as an official liaison agency between American scientific men and the Government, is to receive the Ordnance Distinguished Service Award of the U.S. Army. In a letter to Dr. Frank B. Jewett, president of the Academy, Maj.-General L. H. Campbell, jun., Chief of Ordnance, says: "It is my pleasure as Chief of Ordnance of the Army to tell you on behalf of the Ordnance Department that I am most grateful for the outstanding contributions the National Academy of Sciences has made to Ordnance progress in this war. The degree of that progress is best shown by the success of our fighting forces in all theaters of operations".

THE Lord President of the Council has appointed Sir Robert Robinson to be chairman of the Water Pollution Research Board of the Department of Scientific and Industrial Research, in succession to the late Mr. H. C. Whitehead.

MR. A. V. WILLIAMSON, reader and head of the Department of Geography of the University of Leeds, has been elected to the newly instituted chair of geography, as from the beginning of the present session. The title of honorary reader in the history of economic theory in the University has been conferred on Mr. H. D. Dickinson, lecturer in economic history.

SIR SAMUEL COURTAULD has offered the University of Oxford £2,000 a year for seven years, for research into the relative efficiency of small- and large-scale business and allied problems of industrial structure and organization and kindred subjects, to be carried out under the direction of the warden and fellows of Nuffield College.

FOR the third successive year, a course of lectures on the application of statistical methods to industrial problems is being given by Dr. B. P. Dudding at the University of Sheffield on Friday evenings, commencing October 20. These lectures are of a rather more advanced type than those given in earlier courses and although primarily intended for students of engineering are open without charge to suitably qualified men from industry.

THE following scholarships, which are tenable for three or four years, according to the length of the course at the university selected, will be offered for competition by the Institution of Naval Architects in 1945: Martell Scholarship (£130 per annum); Trewent Scholarship (£125 per annum) in naval architecture; Denny Scholarship (£130 per annum) in marine engineering. The Denny Scholarship, age limit nineteen, is tenable for four years at the University of Glasgow only, with apprenticeship of five years. Entries for the Martell Scholarship close on January 15, and for the other Scholarships on May 31. The Wrought Light Alloys Development Association Research Scholarship (£400 per annum, tenable for two years) is to be awarded to graduates in applied science preferably less than thirty years of age on October 1, 1945: entries close on July 31. Particulars can be obtained from the Secretary of the Institution of Naval Architects, 10 Upper Belgrave Street, London, S.W.1.

LETTERS TO THE EDITORS

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

Filamentous Carbon

P. AND L. SCHÜTZENBERGER[1] reported that when cyanogen was passed down a porcelain tube containing gas carbon with powdered cryolite on its surface, heated to a cherry-red heat, decomposition occurred and elementary carbon separated in a bulky mass of very slender filaments. The filaments had some elasticity, were friable and marked paper. When aluminium was mixed with the gas carbon, non-elastic filaments separated round it which, on gentle compression, resembled graphite.

FIG. 1.

This filamentous or woolly form of carbon is sometimes found in beehive and recuperative coke-ovens, particularly near the ascension pipe. C. and H. Pélabon[2] found that the wool consisted chiefly of grey cylindrical threads with a glazed surface and occasional bundles of much finer threads. The average length of the threads was 5 cm. and the diameter varied between 0·03 and 0·15 mm., the finer threads being only about 0·002 mm.

A similar filamentous form of carbon has been obtained by cracking methane, diluted with nitrogen, hydrogen and carbon monoxide on an iron surface at 1,000° C. The bulk of the carbon was deposited in the form of a hard, brittle, grey mass, on the surface of which was a large number of slender carbon filaments all running more or less parallel to each other (Fig. 1). These filaments are very fragile, but we succeeded in mounting a small bundle of them and taking an X-ray photograph. Unfiltered cobalt *K*-radiation was used with a specimen to film distance of 48 mm. The photograph (Fig. 2) indicates that the carbon present is the ordinary 'amorphous' variety ($\theta_{002} = 14 \cdot 8°$, inter-layer plane spacing about 3·5 A.) with the *c* axis perpendicular to the fibre axis, that is, the hexagon layer planes more or less parallel to the fibre axis, with a maximum deviation of about 30°.

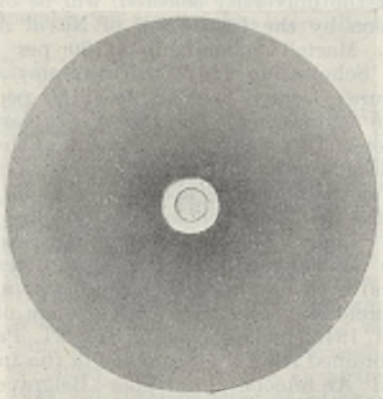

FIG. 2.

So far as we know, this is the first example of a fibre built up from lamellar units.

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Sept. 15.

[1] *C.R. Acad. Sci.*, 111, 774 (1890).
[2] *C.R. Acad. Sci.*, 137, 706 (1903).

The Divergence Difficulty of Quantized Field Theories

IN the theory of interaction of particles like photons and electrons or mesons and nucleons, etc., the experiments are always made in such a way that the different kinds of particles are observed in different parts of space with different instruments. In these parts of space one can speak of pure kinds of particles and describe them by pure quantized fields—Maxwell's field, Dirac's field, etc. However, in the part of space where the collisions really take place, the pure fields are not simply additive but have to be supplemented by an interaction field. All effects due to the interaction can be obtained by considering the stationary states of the whole system.

Because of the complication of the problem, one has to use a method of successive approximation called the perturbation method in which the interaction is regarded as small. It is well known that then special care must be taken to remove the degeneracy of the states of the unperturbed system in a way so as to anticipate the eigenstates of the perturbed system. This preliminary step has, however, been ignored in the usual practice for the interaction of fields; and consequently divergent expressions appear as soon as the next higher order of the perturbation method is attempted.

The results obtained by the usual practice were in good agreement with observations in the case of the photon-electron interaction, although the divergence of the higher approximation indicates that some mistake must have been made, which might be physical or mathematical. No such agreement with observation has been found in the case of the meson field. Some time ago an improved method[1] based on physical reasoning was developed which takes account, to the first approximation only, of what is classically known as the 'radiation reaction'. This method is well confirmed by its applications, especially to the meson field, but hitherto its theoretical basis was not satisfactorily established.

It has now been found that this provisional method can be rigorously established by a systematic application of the ordinary perturbation theory for degenerate systems adapted to the case of the continuous

spectrum. I have found that the treatment of the radiation reaction referred to above constitutes exactly the preliminary step of the removal of degeneracy. The continuation of the perturbation method to higher approximations is then possible without any difficulty.

With this mathematical improvement, it might be that the present field theories (without any change—such as that proposed by Dirac[2], or that by Born and Peng[3]) are sufficient to explain most of the known facts. For example, the anomalous value of the magnetic moment of the proton or the neutron can now be rigorously dealt with. It seems possible that the infinite self-energy of the point electron, which has always been a difficulty in the classical theory, will also become finite in the quantum theory.

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[1] Heitler and Peng, *Proc. Camb. Phil. Soc.*, **38**, 296 (1942).
[2] Dirac, *Proc. Roy. Soc.*, A, **180**, 1 (1942).
[3] Born and Peng, *Proc. Roy. Soc. Edinburgh*, A, **62**, 40 (1944).

Interpretation of Patterson Diagrams

UNDER this title, Robertson[1] has published a simple optical method of constructing Patterson diagrams. Hägg[2] has suggested a modification of this method. Bragg[3] described a further improvement by the introduction of a lens in the path of the light rays, so that both patterns, the diagram of which is required, are on the same scale. The Patterson is then formed in the focal plane of the lens, and can be photographed, viewed on a screen or with the aid of an eyepiece. The whole arrangement then consists of an ordinary camera or telescope, in front of which are held two identical and properly oriented patterns. The scale of the Patterson can be varied by varying the distance in between the patterns. If the aperture of the lens is made large enough to accommodate all the relevant rays, the second screen need not be in contact with the lens. If punched screens are used, the only disadvantage is the lack of continuous adjustment of the pattern, possible in the original sphere and thread method of Robertson.

Very interesting arrangements are obtained if one of the patterns is replaced by an image of the other pattern in a plane mirror M (Fig. 1). One pattern only is then necessary. The illumination can be obtained by means of a 45° glass plate G (see Fig. 1*a*), in between the pattern and the objective L. If movable opaque disks are placed at BB', black spots will appear on a bright background at AA'. The Patterson resulting from this arrangement at CC' has unfortunately very poor contrast, peaks in the Patterson appearing as only slightly more luminous spots on an already luminous background. If an opaque sheet in which holes are punched is placed at BB', bright spots on a dark background will appear at AA', and the Patterson at CC' would have luminous peaks on a black background, thus giving a very good contrast. However, the virtue of the continuous adjustment possible with disks is lost.

Another arrangement is represented in Fig. 1*b*. The atoms are here represented by disks, the upper surfaces of which are blackened, and the lower surfaces whitened. The white sides illuminated from below would appear at AA' as bright spots on a black background, and the Patterson at CC' would have peaks represented by darker spots on a bright background. This arrangement has the advantage of the continual adjustment, for example, by placing movable disks on a glass plate P.

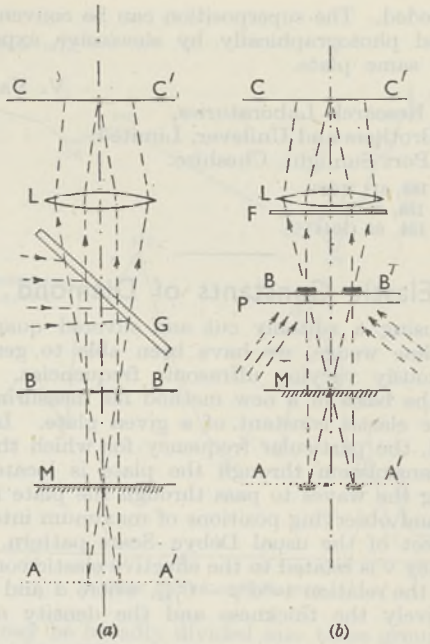

FIG. 1. THE CONSTRUCTION OF A PATTERSON DIAGRAM BY MEANS OF A MIRROR IMAGE. (*a*) ILLUMINATION BY 45° GLASS PLATE. (*b*) ILLUMINATION OF FLUORESCENT DISKS FROM BELOW.

In this method, the appearance of the Patterson is that of a negative of the pattern produced by a punched screen, the central peak being completely dark in the middle. This kind of pattern, although representing the Patterson function faithfully in terms of the difference of light intensities, is in some cases not so suitable for a direct visual examination as the positive pattern produced by the first method using a punched screen, due to the non-linear (logarithmic) response of the eye to the light intensity. However, if a photograph is taken, it is easy to examine either the positive or the negative, and both methods are equivalent in performance. In the second method, care must be taken to provide uniform illumination of the disks and at the same time to prevent the light from the light source entering the objective directly. This can be most conveniently overcome by using a mercury ultra-violet lamp with a Wood's glass filter for the illumination of the disks at BB', and by painting the under sides of the disks with a yellow fluorescent paint. If a yellow filter F is placed immediately in front of the objective, the direct radiation from the lamp will be cut off, and only the yellow light emitted by the disks would enter the objective. A contrast image is thus obtained.

Pattersons corresponding to two-dimensional multicellular structures are sometimes needed, whereas methods using continuous adjustment are practicable for the production of a Patterson of a single cell only. A Patterson of a multicellular structure can be easily obtained by superposition of a properly spaced double array of Pattersons of a single cell, the spacing in the array being equal to the lattice spacing of the original lattice. As the single-cell Patterson is twice the size of the original cell, the superposition of only four single-cell Pattersons would give in the central overlapping part all the informa-

tion needed. The superposition can be conveniently achieved photographically by successive exposures on the same plate.

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[1] *Nature*, **152**, 411 (1943).
[2] *Nature*, **153**, 81 (1944).
[3] *Nature*, **154**, 69 (1944).

Elastic Constants of Diamond

BY using a suitably cut and silvered quartz or tourmaline wedge, we have been able to generate continuously varying ultrasonic frequencies. This forms the basis of a new method for measuring the effective elastic constant of a given plate. In this method, the particular frequency for which there is best transmission through the plate is located by allowing the waves to pass through the plate into a liquid and observing positions of maximum intensity in respect of the usual Debye–Sears pattern. This frequency ν is related to the effective elastic constant C'_{33} by the relation $4\nu^2 d^2 \rho = C'_{33}$, where d and ρ are respectively the thickness and the density of the plate.

By making such observations on an octahedral and a dodecahedral plate of diamond, two independent effective elastic constants have been obtained. It is not possible to get the third one by this method, but by combining the results with the known bulk modulus $5{\cdot}9 \times 10^{12}$ dynes per sq. cm. (which represents the mean of observations by Adams[1] and by Williamson[2]), the following values expressed in dynes per sq. cm. have been obtained for the elastic constants of diamond:

$C_{11} = 9{\cdot}4 \times 10^{12}$; $C_{12} = 4{\cdot}2 \times 10^{12}$; $C_{44} = 4{\cdot}2 \times 10^{12}$.

These results are now reported in view of their importance, but their significance will be discussed and the details of the method given in a fuller paper in the *Proceedings of the Indian Academy of Sciences*. It may be remarked here that we have found these elastic constants to be in satisfactory agreement with the force constants derived from the known frequencies of the diamond lattice.

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Guntur. Sept. 12.

[1] *J. Wash. Acad. Sci.*, **11**, 45 (1921).
[2] *J. Frank. Inst.*, **193**, 491 (1922).

A Reversible Contraction Phenomenon in Animal Hairs

ALTHOUGH the action of cuprammonium hydroxide on cellulose has been studied in considerable detail, comparatively little is known of its effect on keratin, except that under certain conditions hair and wool can be dissolved in the reagent[1,2]. It is therefore of interest to describe some observations on the action of cuprammonium hydroxide on wool which promise to yield valuable information on the mechanism of long-range elasticity in animal hairs and on the structure of proteins.

If a wool fibre (Lincoln) is immersed in a solution prepared by dissolving purified copper hydroxide in concentrated ammonia solution, it will, after a time depending on the copper content of the solution, become stained greenish-blue and contract in length. Prolonged washing in water fails to remove the stain and has little effect on the length, although a further small contraction may occur. Under the correct conditions it is possible to realize in this way a contraction of 28 per cent of the initial length. If the fibre is now placed in a dilute solution of sulphuric acid for a few minutes, the blue stain disappears and the fibre returns practically to its original length. Subsequent washing in water produces no further change in colour or length. The power of the fibre to recover its original length depends on the severity of the treatment; after prolonged immersion in concentrated solutions the recovery may stop when the fibre is still some 10 per cent shorter than the initial length. Even though the fibre retains its power of recovery, it is weakened by the treatment with cuprammonium hydroxide, and evidently side-chain breakdown takes place in the solution.

The dimensional changes are accompanied by changes in the X-ray photograph, which becomes weaker and vaguer without loss of orientation or pronounced spacing changes, until, when the contraction is a maximum, it has almost disappeared. This is in striking contrast to the effects in ordinary supercontraction, where the normal α-photograph may still be present for contractions of the order of 20 per cent, although the disoriented β-photograph may appear under certain conditions[3]. After acid treatment to remove the copper, the α-photograph returns, comparable in every way with the original photograph. This sequence can be repeated several times.

The coloration of the fibres after treatment with cuprammonium hydroxide and washing in water is clearly due to the adsorption of copper. Our measurements showed that the amount of copper adsorbed under conditions corresponding to those giving maximum contraction is about 29 per cent (by weight, calculated on the dry weight of the fibre), the observed values lying between 26 and 32 per cent for different concentrations of the reagent. This corresponds approximately to one copper atom per two amino-acid residues. The total increase in weight (40 per cent) suggests that the copper is present as a complex.

The observed contraction may be attributed to the powerful attraction of the copper for the appropriate active groups (for example, amino- and imino-groups) in the keratin complex. This contraction would be resisted by those side-chain cross-linkings between the polypeptide chains which are not broken by the reagent itself, and at first enough would be left stressed but unbroken to assure the return of the fibre to the initial length on removal of the copper. Prolongation of the treatment, however, would ultimately reduce the number of unbroken cross-linkings below the minimum required for complete recovery.

We have observed a similar phenomenon in fibres treated with solutions of some, but not all, related copper compounds.

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Sept. 11.

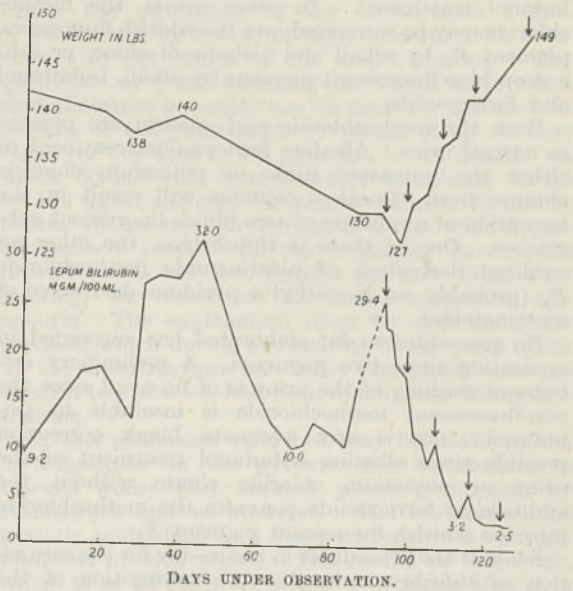
[1] Bergmann, M., D.R.P., 445,503.
[2] Rimington, C., and Wool Industries Research Association, *Brit. Pat.* 343,838.
[3] Astbury, W. T., and Woods, H. J., *Phil. Trans.*, A, **232**, 333 (1933).

The Sulphur-containing Amino Acids in Jaundice

WE have read with interest the letter from Peters *et al.* on "The Sulphur-containing Amino Acids in Jaundice"[1]. The authors would appear to have misunderstood the statements made in our previous note[2] concerning the value of methionine treatment. We said only "that results would appear to show that the clinical course is influenced beneficially and the period in hospital significantly shortened". This statement is supported rather than contradicted by the data contained in their note, though statistical analysis of figures based only on serum bilirubin levels may not yield entirely reliable results. We would like to repeat our claim that "in *gravely ill* patients, the results obtained by methionine treatment have been so striking as to leave no doubt as to the efficacy of the treatment especially in those cases which have remained jaundiced for weeks or months". Such cases, we note, were not included by Peters *et al.* in the 150 cases selected by them for statistical analysis. They are, of course, not susceptible to statistical analysis, yet it is precisely in such cases, relatively uncommon though they are, that the clinical value of any special treatment can be most readily assessed. Moreover, it is in such cases which do not show the rapid and spontaneous recovery so typical of the ordinary jaundice case that some form of specific treatment is urgently required. The results obtained in such cases are best recorded by describing a typical example.

The patient was a young Canadian officer who was wounded in Italy in September 1943, transferred to North Africa for treatment and arrived in England in November. In December he developed a severe attack of infective hepatitis. Three months after the onset of the disease he was still icteric, in poor clinical condition and had lost 42 lb. in weight. Throughout this period he was anorexic, had frequent attacks of vomiting and was wasting steadily. In March 1944 he showed signs of an acute relapse and became gravely ill. He was transferred to one of our investigation wards for treatment. There was no suggestion of any cirrhotic change within the liver. Methionine was given intravenously in doses of 10 gm. on the first day he came under our care and on four subsequent occasions. After each infusion (indicated on the graph by an arrow), with the exception of the last which was given after the patient was obviously well and fit for discharge, the response was quite clear cut. Within twenty-four hours appetite improved and the liver receded, the serum bilirubin level fell sharply and four days later a marked gain in weight commenced (see graph). Occurring once, such a correlation between subjective symptoms, objective signs and therapeutic measures might well be coincidental. For this reason we withheld further methionine treatment until there was evidence of deterioration in his condition. It is probable that complete recovery would have been more rapid had methionine been given at shorter intervals. That recovery was eventually complete is suggested by the fact that a severe attack of hæmolytic streptococcal tonsillitis three weeks after discharge caused no apparent regression of his liver condition nor any rise in his serum bilirubin level. After discharge he continued to gain weight and reached his normal level within a few weeks.

We would make it clear that not all severely ill patients show such a gratifying response. Severe



cases may be broadly divided into three groups. In the first the illness is due to an apparently uncomplicated hepatitis. This may be long-standing, but is apparently unaccompanied by any marked degree of cirrhosis, and the response to methionine is good. In many chronic cases there is an acute hepatitis imposed on a pre-existing cirrhosis. Here there is a limited improvement the extent of which depends on the degree of cirrhotic change. A third group consists of those cases which have progressed to the stage of 'acute yellow atrophy'. The degree of hepatic autolysis is usually sufficient to produce a marked elevation of the blood amino nitrogen level. In such cases cellular destruction is so extensive that methionine is of no value.

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Sept. 7.

[1] *Nature*, **153**, 773 (1944).
[2] *Nature*, **153**, 525 (1944).

Simultaneous Determination of Aneurin and Nicotinamide Methochloride

NICOTINAMIDE methochloride, the principal urinary derivative of nicotinamide, nicotinic acid and nikethamide, can be estimated in urine by adsorption on 'Decalso', elution with potassium chloride and extraction of the eluate with alkaline *iso*butanol[1]. By this procedure the methochloride is converted into a whitish fluorescent derivative, F_2, the concentration of which is estimated fluorimetrically. Aneurin is also estimated in urine by adsorption with 'Decalso', elution with potassium chloride and extraction of the eluate with *iso*butanol after the addition of alkali and potassium ferricyanide[2]. The thiochrome thus formed is estimated fluorimetrically in much the same manner as that employed for F_2. It has been found, however, that pure aqueous solutions of nicotinamide methochloride are also converted into a deep blue fluorescent pigment closely resembling thiochrome by alkaline-ferricyanide-*iso*-

butanol treatment[3]. In other words, the methochloride may be converted into the whitish fluorescent pigment F_2 by alkali and *iso*butanol alone, or into a deep blue fluorescent pigment by alkali, *iso*butanol and ferricyanide.

Both the methochloride and aneurin are present in normal urine. Alkaline ferricyanide treatment of either the untreated urine or potassium chloride eluates from 'Decalso' columns will result in the formation of a mixture of two bluish fluorescent substances. One of these is thiochrome, the other an oxidized derivative of nicotinamide methochloride F_3 (probably an N-methyl α pyridone derivative of nicotinamide).

No procedure so far elaborated has succeeded in separating these two pigments. A preliminary *iso*butanol washing of the urine is of no avail since the non-fluorescent methochloride is insoluble in *iso*butanol; nor is any adequate blank correction possible since alkaline *iso*butanol treatment of the urine or potassium chloride eluate without the addition of ferricyanide converts the methochloride into the whitish fluorescent pigment F_2.

Some of the procedures in use to-day for the estimation of thiochrome involve the subtraction of the fluorescence of the F_2 (blank) from the combined fluorescence of F_3 and thiochrome. This necessarily introduces an error in the assay since Najjar and Ketron's[3] observation that the fluorescence of F_2 is much greater than the fluorescence of the F_3 has been confirmed.

We have observed that if known amounts of the methochloride are adsorbed on 'Decalso', eluted with potassium chloride and treated with alkali, ferricyanide and *iso*butanol in the manner employed for aneurin assays, it is possible to determine the 'aneurin equivalent' of the F_3 formed by comparing it with the thiochrome standards used for the aneurin determination. By assaying the methochloride content of urine (alkaline *iso*butanol treatment of the eluate without the addition of ferricyanide) the fluorescence of the alkali-ferricyanide treated extract which is due to F_3 can be computed.

A procedure has been devised which makes it possible to estimate aneurin in the presence of nicotinamide methochloride and to estimate accurately the methochloride content by means of fluorescence standards in place of the usual commercial fluorimeters. The method is applicable to urine or extracts from foods. 1 gm. portions of 'Decalso' are washed into thistle funnels with an internal bore of 4 mm. The adsorbant is activated according to the procedure of Hennessy and Cerecedo. Urine or food extracts are adjusted to *p*H 4·0 and filtered through the columns; these are then washed with 20 ml. of 1 per cent acetic acid and eluted with 8 ml. of 25 per cent potassium chloride. Half of each eluate is treated successively with 0·25 ml. 0·5 per cent potassium ferricyanide, 1 ml. 20 per cent caustic soda and 5 ml. *iso*butanol and then shaken for one minute. The fluorescence intensity of this extract which contains the F_3 and thiochrome is compared with thiochrome standards prepared from aneurin solutions treated in the same manner. 1 ml. caustic soda and 5 ml. *iso*butanol are added to the other half of the eluate which is also shaken for one minute and compared with F_2 standards prepared from pure nicotinamide methochloride. The fluorescence due to the F_3 is computed from the methochloride assay and subtracted from the total blue fluorescence due to F_3 and thiochrome.

Certain precautions must be observed to ensure a fair degree of accuracy. The 'Decalso' obtainable in Great Britain will not completely adsorb aneurin or nicotinamide methochloride from concentrated urine if the volume is more than 10 ml., regardless of the care taken in activating the adsorbant. The urine should be diluted to a volume equivalent to an excretion of 150 ml. per hr., and if 1–10 ml. of this diluted sample is taken for assay the adsorption will be complete. The average values of the assays of three different volumes of urine should be taken. The potassium chloride eluates obtained in urine assays are invariably non-fluorescent, which indicates that no pre-formed thiochrome is present in untreated urine. Although a great many highly fluorescent pigments are present in urine, they are either not adsorbed on 'Decalso', or if they are adsorbed they are not eluted with potassium chloride and therefore they do not interfere with the assay.

It has not been possible to estimate aneurin by this method with a consistent error of less than $\pm$ 10 per cent. The addition of large amounts of both aneurin and the methochloride to urine containing known amounts of these substances and the subsequent assay of the mixture have given good results. It is felt that some workers have claimed too high a degree of accuracy for the thiochrome method in the assay of natural products since different laboratories using the same method in the assay of identical samples have not obtained a high degree of concordance[4]. Our method gives reliable and reproducible values in the nicotinamide methochloride estimation, which show an error of $\pm$ 5 per cent. The precautions suggested by Wang and Harris[5] and others for the development of fluorescence in the aneurin assay must be observed. The fluorescence of the reagents used must also be rigidly controlled.

In view of the great dissimilarity of chemical constitution, it is surprising that the F_3 derivative of nicotinamide methochloride and thiochrome are so similar in fluorescent properties and chemical stability. The fluorescence of both can be decreased or completely destroyed by the addition of strong oxidizing or reducing agents, exposure to light or by strong alkali. For most urines the addition of 0·25 ml. 0·5 per cent potassium ferricyanide is sufficient to convert the methochloride into F_3 and the aneurin into thiochrome. The assay of urines from subjects who have ingested large amounts of aneurin or nicotinamide or both is best accomplished by the dilution of the urines. It is unwise to add more than 0·25 ml. of ferricyanide without first calibrating the amount needed for the oxidation.

The presence of nicotinamide methochloride in meat, liver and milk of animals which methylate nicotinamide has been detected; the methochloride appears to be absent from cereals. An assay of a complete diet, if one assumes complete extraction of the methochloride by the methods recommended for the aneurin extraction, has shown that the total intake of the methochloride is about 7 mgm. a day. This concentration is sufficient to cause an appreciable error in the aneurin assay if no correction is made for the presence of F_3. It would seem that the assay of nicotinic acid in animal products gives results which are too high, since the alkali hydrolysed extracts of the physiologically inactive methochloride give a positive cyanogen bromide reaction. The methochloride does not seem to promote the growth of *Lactobacillus arabinosis*[6]. Whether it is active for

other micro-organisms used for vitamin assay is not determined.

This work forms part of an investigation on nutritional deficiencies carried out on behalf of the Air Ministry under the direction of Wing-Cmdr. T. F. Macrae; the author is a member of the Civilian Technical Corps.

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[1] Coulson, R. A., Ellinger, P., and Holden, M., *Biochem. J.*, **38**, 150 (1944).
[2] Jansen, B. C. T., *Rec. trav. chim.*, **55**, 1046 (1936). Hennessy, D. J., and Cerecedo, L. R., *J. Amer. Chem. Soc.*, **61**, 179 (1939).
[3] Najjar, V. A., and Ketron, K. C., *J. Biol. Chem.*, **152**, 579 (1944).
[4] Report by the Vitamin B, Sub-Committee of the Accessory Food Factors Committee of the Medical Research Council and the Lister Institute, *Biochem. J.*, **37**, 433 (1943).
[5] Wang, Y. L., and Harris, L. J., *Biochem. J.*, **33**, 1356 (1939).
[6] Elvehjem, C. A., and Teply, L. J., *Chem. Rev.*, **33**, 185 (1943).

Determination of Aneurin by the Thiochrome Method after its Uptake by Yeast

FOR the determination of aneurin there are both chemical and biological methods. Among the former the thiochrome method is the most outstanding[1]. The biological methods are very tedious, and the error involved is considerable. For routine analysis, which necessitates the rapid attainment of a reliable result, the thiochrome method is the only one at present available. It involves the oxidation of the aneurin in alkaline solution to the fluorescent substance thiochrome, the latter being extracted with *iso*butanol or amyl alcohol and determined in a fluorimeter. The aneurin often occurs to a large extent as phosphate esters, for example, cocarboxylase, the thiochrome derivatives of which are not soluble in *iso*butanol. The thiochrome method gives excellent results with pure aneurin solutions or, for example, extracts of compressed yeast. In the determination of aneurin in certain materials, however, such as cereal products (especially flours of high extraction, bran, etc.), urine, blood, milk or molasses, complications arise, since interfering substances are present which in the oxidized or unoxidized state have different fluorescent powers, or influence the oxidation of the aneurin itself to thiochrome. A number of modifications have already been described, which, however, to judge from the literature, are not altogether satisfactory.

These difficulties have been overcome by the following method which is based on the previous work of Sperber and Renvall[2] and Sperber[3], who have shown that aneurin is very readily taken up by baker's yeast, especially under aerobic conditions and in the presence of a substrate. It has been found in these investigations and in those of Westenbrink and co-workers[4] that the aneurin in yeast occurs almost exclusively as pyrophosphate ester (cocarboxylase). This, however, is split up when the yeast is boiled; consequently the aneurin in the boiled extract is principally in the free form. Our procedure consists in shaking the material the aneurin content of which is to be estimated with baker's yeast, and afterwards determining the aneurin content of the extract obtained by boiling the yeast. Interfering factors present in the substance do not pass into the yeast extract.

Our investigations have shown that the capacity of the yeast for taking up aneurin is very great. Under the conditions of our experiments 1 gm. of yeast took up 900–1,000 μgm. aneurin from flour extract in the course of one hour's shaking. The quantities of yeast necessary are therefore so small that allowance generally can be made for the aneurin content of the yeast itself by means of an average value (in our case *c.* 4·5 μgm./gm.). In general we shook 50–200 ml. flour extract, containing about 60–120 μgm. aneurin, for ninety minutes at 25° C. (water thermostat) in Fernbach flasks with 2 gm. compressed yeast. In the beginning our results proved to be too low, despite the fact that, after shaking, the substance no longer contained any aneurin. The explanation must be that the phosphatase, which during the heating of the yeast splits up the cocarboxylase and other phosphate esters to aneurin (see above), had been inactivated during the shaking.

In this connexion reference may be made to the investigations on the pyruvic acid metabolism in starved yeast and aerated yeast performed by Runnström and co-workers[5]. The metabolism of pyruvic acid added to a yeast suspension is strongly inhibited in such yeasts. The results of this work, which is to be resumed, made it probable that it is the decarboxylation of the pyruvic acid through the agency of the cocarboxylase that is affected by the starvation or aeration treatment. It is possible that in this case also the above-mentioned dephosphorylation of the cocarboxylase plays a decisive part.

Attempts to use 'Diastase Merck', which, according to Ritsert[6], contains sufficient phosphatase to split the cocarboxylase, gave results which were not fully satisfactory. When this method is employed, the yield of thiochrome from the oxidation of the aneurin is diminished. The procedure is, moreover, rather lengthy. We therefore tried to employ the phosphatase of the yeast, adding fresh yeast to the shaken material. This proved to be without effect. It proved possible, however, to dephosphorylate the cocarboxylase in the shaken yeast by adding cytolysed yeast to the previously boiled extract of the shaken yeast and reboiling. Repeated analyses of the same flour gave values with a standard deviation of 2·6 per cent.

Aneurin added to flour extract was recovered, and in the determination of a cocarboxylase preparation values were obtained which corresponded well with the results of Warburg determinations on the same material. The method of analysis described is also used for the estimation of aneurin in molasses and urine.

A detailed account of these investigations will be published elsewhere.

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[1] Jansen, B., *Rec. trav. chem.*, **55**, 1046 (1936).
[2] Sperber, E., and Renvell, S., *Biochem. Z.*, **310**, 160 (1941).
[3] Sperber, E., *Biochem. Z.*, **313**, 62 (1942).
[4] Westenbrink, H. K. G., van Dorp, D. A., Gruber, M., and Veldman, H., *Enzymologia*, **9**, 73 (1940).
[5] Runnström, J., and Marcuse, R., *Ark. f. Kemi*, 18A. nr. 14 (Stockholm, 1944).
[6] Ritsert, K., *Klin. Wochenschrift*, 1371 (1939).

Configuration and Antiplasmodial Activity

THE current view[1,2] that there is no relationship between optical activity (configuration) and antiplasmodial action in the Cinchona series does not appear to be fully justified.

Neither the configuration of the asymmetric centres at C_3 and C_4[3] nor the bridged structure of the quinuclidine skeleton in quinine[1] has an influence on its activity. This latter statement follows from the fact that niquine and niquidine are biologically active[2] and that the same is true of the (6-methoxy-quinolyl-4)-α-piperidyl-carbinol (II) of Ainley and King[4]. The part of the molecule which is crucial for our discussion is, therefore, C_8 and C_9.

Furthermore, the *l*-alkaloids (with respect to both C_8 and C_9) are, at least frequently, not significantly different in activity from *d*-bases. The quinine equivalents are for:

d-apo-quinidine methyl ether	1·0	*l-α-iso*-quinine	0·6
niquidine	1·5	niquine	0·9
dihydro-niquidine	1·1	dihydro-niquine	0·6
dihydro-cupreine	0·9	dihydro-cupreidine	0·7
dihydro-quinine	1·35	dihydro-quinidine	0·8
apo-quinine	1·0	*apo*-quinidine	0·4

Epimerization at C_9 alone, however, causes complete loss of activity[5], whatever the configuration of the active compound epimerized is. One is, therefore, led to the hypothesis that alkaloids with the same sign of partial rotation at C_8 and C_9 have antiplasmodial activity; those with different sign of rotation at these two centres are inactive[2,6].

The following two conclusions which can be drawn from these considerations appear to be borne out by experiment.

(*a*) The quinine equivalents of optical antipodes (with respect to C_8 and C_9 only) do not differ more than by a factor of 1·5–2. Examples:

Quinine	Quinidine
dihydro-cupreine	dihydro-cupreidine
epi-C_9-dihydro-quinine	*epi*-C_9-dihydro-quinidine
epi-C_9-quinine	*epi*-C_9-quinidine, etc.

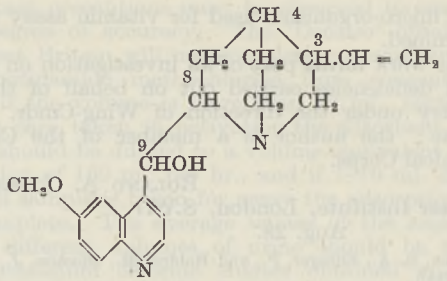
(*b*) The quinine equivalents of diastereomerides (with respect to C_8 and C_9 only) differ by a factor of 5–10. Examples:

Alkaloid	Rotation at ($C_3 + C_4$)	Rotation at C_8	Rotation at C_9	Quinine equivalent
(1) Quinine	+	—	—	1·0
(2) *epi*-C_9-quinine	+	—	+	0·1
(3) Quinidine	+	+	+	0·5
(4) *epi*-C_9-quinidine	+	+	—	0·1

(The pairs 1–2, 3–4, 1–4 and 2–3 are also diastereomerides.)

In view of these data, it is significant that the two isomers of Ainley and King's substance (II) have rather different antiplasmodial activity (the isomer of m.p. 162–163° about the same as quinine, that of m.p. 187–188° only 25 per cent of it). As, according to the synthesis, the two substances are diastereomides, one is tempted to suggest that the signs of rotation at the two asymmetric carbon atoms (which correspond to C_8 and C_9 in the quinine formula) are the same in the more active isomer of m.p. 162–163° and are different in the less active isomer of m.p. 187–188°. (Both of them are, of course, racemates.)

The somewhat unusual regularities which emerge from the accumulated experimental material seem to suggest that—in contradistinction with so many other biological effects—an optically active selective chemoceptor[7] is not responsible for antiplasmodial activity.



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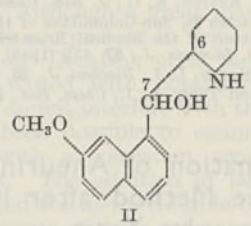

II

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[1] Goodman and Gilman, "The Pharmacological Basis of Therapeutics" 905 (New York, 1943).
[2] Buttle, Henry, Solomon, Trevan and Gibbs, *Biochem. J.*, **32**, 47 (1938).
[3] See Henry, Solomon and Gibbs, *J. Chem. Soc.*, 592 (1937), in conjunction with King and Palmer, *J. Chem. Soc.*, **121**, 2577 (1922).
[4] Ainley and King, *Proc. Roy. Soc.*, B, **125**, 60 (1938).
[5] Thron and Dirscherl, *Liebigs Ann.*, **521**, 48 (1935).
[6] Henry, *Chem. and Ind.*, **55** T, 111 (1936).
[7] Cushny, "Biological Relations of Optically Isomeric Substances" (Baltimore, 1926).

Antibiotic Action of *Aspergillus fumigatus* against *Mycobacterium tuberculosis*

MANY papers have been published on the antagonism of certain micro-organisms against acid-fast bacteria, particularly *Mycobacterium tuberculosis*[1,2,3,4], recording varying results. I have tested during the past year various fungi for antagonism to acid-fast bacteria and have found *Aspergillus fumigatus* No. 367 of the National Collection of Type Culture to be the most effective.

Of the different media tested, Czapek-Dox medium with 2 per cent tryptone, 4 per cent brown sugar and 5 per cent glycerine yielded the best results. The active filtrate will be referred to as 'aspergillin'. The antibacterial power of the culture, which reaches its maximum in about 15–20 days, was determined by making serial dilutions of aspergillin in fresh broth with 5 per cent glycerine contained in 50 c.c. conical flasks, or 2-oz. flat medicine bottles. Then these were inoculated with a small amount (1–2 mgm.) of a young culture of acid-fast bacteria on glycerol broth or egg medium. In each test control cultures were also seeded. The cultures were incubated at 37° C.

The degree of growth in the various dilutions of aspergillin was compared with the growth on the control cultures at intervals of time. The final examinations of the cultures were made after 4–6 weeks in the case of *Mycobacterium tuberculosis* bovine and human type, with *Mycobacterium tuberculosis* avian type and *Mycobacterium phlei* after six days. For

the routine testing of activity *Mycobacterium phlei* was employed. *Mycobacterium tuberculosis* bovine, human and avian types were inhibited in the media containing 5–10 per cent, *Mycobacterium phlei* in the media containing 1–2 per cent of aspergillin. Two strains of Staphylococci tested were not inhibited. Judging from sub-culture tests, aspergillin seems to be bacteriostatic rather than bactericidal. It is not toxic to experimental animals in large doses and boiling for one hour does not destroy it. The next step is to purify this substance and then to test it as a chemotherapeutic drug against *Mycobacterium tuberculosis*, and to establish the possible relation or difference in the chemical and biological nature of other substances produced by *Aspergillus fumigatus*.

My thanks are due to Mr. C. A. McGaughey, acting director of this Institute, for laboratory facilities and his keen interest in the work and to Mr. M. O. J. McCarthy for the test of toxicity in the animals.

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[1] Vaudremer, A., *C.R. Soc. Biol.*, **73**, 51 (1912); **74**, 278, 752 (1913).
[2] Schiller, I., *Zbl. Bact. Abt. I. Orig.*, **96**, 54 (1925); **103**, 304 (1927).
[3] Barglowski, D., *Amer Rev. Tub.*, **38**, 393 (1938).
[4] Zorzoli, G., *Amer. Inst. Carlo Forlanini*, **4**, 208, 221 (1940); abstr. *Vet. Bull.*, **11**, 833 (1941).

A Powerful Inhibitory Substance produced by Group *N* Streptococci

IN 1933[1] Whitehead and Riddet, in New Zealand, observed that bulk milk stored overnight in cheese factories sometimes inhibited the growth of the 'starter' culture added to develop the acidity necessary for the cheese-making process.

From the stored milk Whitehead isolated a streptococcus and showed that it produced an inhibitory substance which he considered to be of protein or polypeptide nature[2]. Similar strains have been isolated from milk and starter by others[3,4], and those we have used in our work have been found to fall into Group *N*[5]. The inhibitory substance appeared to be powerful and it occurred to one of us that pathogenic organisms, in particular Group *B* streptococci causing bovine mastitis, might be similarly inhibited.

We have found that many groups of pathogenic streptococci are in fact inhibited even in media containing high proportions of serum or blood. Some species of Bacillus, Clostridium and Lactobacilli are also inhibited but staphylococci so far tested are less susceptible. All Gram-negative organisms so far tested were unaffected.

Since the substance proved to have marked inhibitory properties *in vitro*, preliminary attempts to concentrate it by chemical means were made. A product of high potency was obtained and a serial dilution technique used to assay it.

It completely inhibited the growth of the test organism (*Str. agalactiæ*) in a dilution of 1/640,000, and partial inhibition was observed at 1/1,000,000. The percentage of active substance in this product is, we know, small, so that these dilutions underestimate the activity of the prime inhibitory substance.

Using this impure material in a small preliminary mouse protection experiment, it was found that a single intravenous dose of 2 mgm. following inoculation with about 1,000 lethal doses of a mouse virulent hæmolytic streptococcus had marked therapeutic properties.

A further experiment using twenty control and twenty treated mice was therefore carried out. Each mouse in each group received about 10,000 lethal doses of the streptococcus used in the preliminary experiment, the virulence of which had been raised by animal passage. The untreated control group all died within twenty-four hours. Each mouse in the treated group received, subcutaneously, a total weight of 10 mgm. of the inhibitory substance in three-hourly doses spread over forty-five hours. All the animals were alive and active at the end of this time, when treatment ceased. At the end of seven days from the beginning of the treatment 40 per cent were apparently completely cured. Little or no local or general reaction was observed and toxicity tests with guinea pigs receiving 10 mgm. of the substance in a single dose were completely negative.

The product appears to have certain properties desirable in an inhibitory substance of biological origin. The crude preparation, at least, is heat-stable. The substance is produced in a simple broth medium, and pure culture on a large scale is not difficult. Strains of high potency are easy to select and appear to be stable for months at least.

Even the crude substance is well tolerated on subcutaneous and intravenous injection in distilled water solution. It is dialysable and is therefore a comparatively small molecule. Experiments in purification and application are continuing.

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[1] Whitehead, H. R., and Riddet, W., *N.Z. J. Agric.*, **46**, 225 (1933).
[2] Whitehead, H. R., *Biochem. J.*, **27**, 1793 (1933).
[3] Meanwell, L. J., *Proc. Soc. Agric. Bact.* (1943).
[4] Nichols, A. A., private communication (1944).
[5] Shattock, P. M. F., and Mattick, A. T. R., *J. Hyg.*, **43**, 173 (1943).

A Case of Choline Poisoning in Cattle

IN cattle at Kiriat Anavim (Palestine) the following pathological symptoms were observed. After the first calving the uterus did not contract but remained open and atonic for a considerable time, thus forming a source of secondary infections. This condition, which could not be influenced by the usual medical treatment, resulted frequently in inability to conceive and in abortions. No primary infectious disease could be found nor did anatomical or histological examinations of the sexual organs yield any result. The foodstuffs given were the same as employed usually in Palestine dairy farming. They were not deficient in nutrients, minerals and vitamins. The only unusual foodstuffs given were wet brewer's grains, which formed a considerable part of the rations for some years. Infected barley is known to have had detrimental effects in some cases, owing to an excessive content of amines[1], especially free choline[2]. Since normal barley generally does not contain appreciable amounts of free choline, we undertook to compare the brewer's grains with normal barley in respect to their choline contents.

The choline was obtained by extracting the materials with 60 per cent alcohol, and, after evaporation of the alcohol, removing the proteins, salts and other

impurities and precipitating the choline as the $HgCl_2$ compound. The choline was determined quantitatively as the reineckate[3]. Analyses of the $HgCl_2$ compound and of the reineckate confirmed the identity of choline. The amounts extracted were 20·0 kgm. fresh brewer's grains (containing 22 per cent dry matter) and 2 kgm. dry barley. Brewer's grains yielded 0·25–0·28 per cent choline (calculated as dry matter), whereas normal barley contained *no free choline*. A yield of 0·17 per cent choline was obtained only after saponification with barium hydroxide.

These findings seem to justify the conclusion that free choline can act as a poisoning agent when fed over long periods of time.

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[1] Hoyman, W. G., *Phytopath.*, **31**, 871 (1941).
[2] Schroeter, G., and Strassberger, L., *Biochem. Z.*, **232**, 452 (1931).
[3] Engel, R. W., *J. Biol. Chem.*, **144**, 701 (1942); *J. Nutrit.*, **25**, 441 (1943).

A Possible Gene Duplication in New Zealand Romney Sheep

THE mode of inheritance in New Zealand Romneys of the N-type birthcoat, in which there is very high abundance of halo-hairs on the main area of the body, has been shown to be simple in three stocks of sheep[1,2]. In two stocks of independent origin N-type is a simple dominant to non-N. In the third, which is related to one of the dominant stocks through a common ancestor, the breeding experiments of the last two seasons have given further proof that N-type is a simple recessive to non-N. In addition, a small inbred N-type flock in which the mode of inheritance is multifactorial has been gradually but rapidly built up by selection.

Nearly all N-type rams, of whatever stock, are horned. It was formerly thought that in dominant-N sheep horns were conditioned by a sex-influenced factor linked with the factor for N-type with about 10 per cent crossing-over. It is now better to regard horns as a usual expression in males of any genetic make-up which gives an N-type birthcoat. In females the breeding results point to homozygous dominant-N animals ordinarily having horns, which are much smaller than most rams' horns. Occasional heterozygous dominant-N ewes are horned or have scurs or buttons, the latter being hard projections which do not pierce the skin. Recessive-N ewes have so far all been polled. So have most multifactorial-N ewes, but a few have horns, and several have scurs or buttons.

The central problem in genetic analysis is the relation between dominant-N and recessive-N. In developing earlier ideas, as two more crops of lambs have been born, emphasis is put the more on duplication, and it no longer seems helpful to think in terms of a dominigene or a suppressing factor. The present hypothesis is simply that the dominant factor for N-type is a duplication of the recessive gene for N-type. There is a substantial chance that in the experimental stocks the recessive gene has been duplicated on one or more occasions, and that the supposed dominant duplication has, once or a few times, been halved to give a germ cell possessing the recessive gene. The grounds for thinking that these things happen are not yet conclusive, and the main purpose of the breeding experiments has become to test the hypothesis that has been stated. We must ascertain whether dominant-N, non-N and recessive-N are multiple alleles, and must give more lambs suggestive of unequal crossing-over or the halving of a duplication the chance to be born.

If such crossing-over does indeed take place the data suggest its frequency to be nearer 1 in 100 than 1 in 10 to any other power. For an event that one thinks of as a rare abnormality this frequency seems high, but that it can happen so often is believable in the light of Drosophila work[3,4,5]. If a duplication were advantageous to the live-stock breeder, and took place with a frequency of this order, it would be worth while for him to watch for it. Moreover, the recent work on Drosophila, following the discovery that 'bar' is a duplication, suggests that this phenomenon is more than an out-of-the-way oddity. In the mouse, too, duplication may well be involved in the work of Dunn and Caspari[6]. Without the Drosophila work the present hypothesis seeking to explain sheep-breeding results would assuredly not have been put forward. Problems of selection in slow-breeding animals being so difficult, it is tempting to speculate on the possible significance for live-stock breeding of the duplication of a gene which thereby becomes in some way more powerful.

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[1] Dry, McMahon and Sutherland, *Nature*, **145**, 390 (1940).
[2] Dry and Sutherland, *Nature*, **148**, 563 (1941).
[3] Demerec and Hoover, *Genetics*, **24**, 271 (1939).
[4] Lewis, *Proc. U.S. Nat. Acad. Sci.*, **27**, 31 (1941).
[5] Oliver, *Proc. U.S. Nat. Acad. Sci.*, **26**, 452 (1940).
[6] Dunn and Caspari, *Proc. U.S. Nat. Acad. Sci.*, **28**, 205 (1942).

The Commutation of Annual Subscriptions

I WAS interested in Dr. David Heron's letter in *Nature* of September 23, p. 400. The Royal Aeronautical Society allows compounding of annual subscriptions after payment of the entrance fee and first annual subscription, as follows: fellows, 12 years subscriptions; associate fellows and other grades, 15 years subscriptions. The amounts are reduced by one guinea a year for each year of membership after five years. The minimum ages for fellows is twenty-eight and associate fellows twenty-five. An additional compounding fee is payable on transference from associate fellow to fellow if the former has already compounded his subscriptions, on a *pro rata* basis of annual subscriptions. The whole of the entrance fees and life compositions are invested in an endowment fund, the interest only of which is available to the Society's funds. It will be noticed that the composition fee is irrespective of age. An associate fellow elected at twenty-five can compound for fifteen years subscription, while one elected at thirty-five will still have to pay the same composition fee. The fees were adopted on the advice of the Society's honorary accountant.

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RESEARCH ITEMS

Management of Small Artificial Lakes

GEORGE W. BENNETT gives a "Summary of Fisheries Investigations, 1938–1942" on this subject (*Bull. Illinois Nat. Hist. Surv.*, 22; 1943). The primary objective of fish management is to produce and maintain good fishing. The author defines 'good fishing' as including the element of numbers of fish caught for unit of time or effort, as well as that of size of individual fish. There is much to be done in maintaining these small artificial lakes, and this report gives a valuable summary of researches. The best fishes for these Illinois artificial lakes are large-mouth bass *Huro salmoides*, white and black crappies *Pomoxis nigro-maculatus*, bluegills *Lepomis macrochirus* and black and yellow bullheads *Ameiurus natalis natalis*. Other fish are apparently of little value in hook-and-line fishing. The chief causes for poor fishing are past improper stocking, large population of rough fish or other fishes of little use for angling, and stunting as a result of over-population. Lakes should be cropped in order to produce and maintain good yields. A cropping plan should include measures to control the numbers of fish of small size as well as the total poundage of large fish taken by anglers. Simple combinations of fishes tested to determine their value for angling shows the bass-bluegill combination to be one of the most satisfactory.

Individual Variability of Micro-organisms

INTENSIVE studies in the polymorphism of cells of *Saccharomyces cerevisiæ*, carried out for 70–80 successive generations by N. A. Krasilnikov (*J. Gen. Biol.*, Moscow, 4; 1943), suggested a definite connexion between the individual variation and the formation of stable strains. It was established that the individual characters of each variation type are transmitted to the progeny, but with unequal degrees of persistency. In some cases, certain characters may persist through tens, and even hundreds, of generations; in others they do not extend beyond the third generation; and sometimes such individual characters are not inherited at all. Polymorphism tends to increase with the age of a culture and individual variants gradually become stabilized. The new strains formed in this manner are not reversible, but their eventual fate in the culture depends on the outcome of the competition with the initial strains from which they had split off; this fate is influenced by the nutrient medium being more favourable to one of the competing strains.

The Tetrapod Middle Ear

THE study of new material of the hyomandibular and its relationships to the auditory and occipital regions of the skull in *Eusthenopteron*, a member of the rhipidostian crossopterygian fishes, has enabled T. S. Westoll (*Trans. Roy. Soc.*, B, **131**; 1943) to give a more complete and accurate account than was furnished previously by Sternberg, who had only badly crushed material at his disposal. With this as a basis, Westoll proceeds to examine the general question of the tetrapod middle ear. The hyomandibular, he agrees, in conformity with a theory that has been suggested previously, becomes transformed into the stapes and its processus opercularis becomes the extracolumella. The development of a freely movable neck articulation early in the tetrapod stock resulted in considerable modifications of the hyobranchial apparatus, and further changes ensued with the transfer of the bones at the posterior end of the lower jaw in the reptiles. The homology of the tympanic cavity and membrane throughout the series has been denied by some authorities; but the author holds that from a primitive, dorsally situated tympanic diverticulum exemplified in the anuran amphibia arose a ventral, infra-stapedial recess in many reptiles and a further, more ventral mandibular recess in the theromorph reptiles, so that the whole form a homologous series the primitive parts of which are reduced in the mammals.

Carbon Dioxide Metabolism in Insects

ACCORDING to current views, the blood of insects has no respiratory function, gaseous metabolism being carried out through the tracheal system, the organism getting rid of carbon dioxide not only directly through the tracheæ but also by the diffusion of carbon dioxide through the tissues. Under these conditions, any tendency of carbon dioxide to hydration, that is, to conversion into H_2CO_3 and HCO_3, would be hampering the elimination of carbon dioxide from the organism. Investigations by Kreps and Chenikayeva on the blood of orthopterous insects (*Bull Acad. Sci. U.R.S.S.*, No. 5; 1942) have shown that no carbonic anhydrase could be detected in it. In fact, it was discovered that the blood has a pronounced inhibitory effect on the hydration reaction of carbon dioxide. The inhibition factor contained in the blood is thermostable, withstands intensive boiling, is insensitive to poisons (for example, cyanide, sodium azide, etc.), prevents enzyme action, and is not bound to proteins. It is suggested that the inhibitor is not an enzyme. The biological significance of the inhibitor consists, presumably, in preventing hydration of the highly diffusible carbon dioxide to the slowly diffusible H_2CO_3 and HCO_3. The inhibitor, therefore, appears to form an essential feature of tracheal respiration.

Pairing of Sex Chromosomes

GENETIC crossing-over between the sex chromosomes in the male of *Drosophila pseudoobscura* is rare or probably does not occur, yet these chromosomes are conjoined over part of their length during the diakinesis-anaphase period of meiosis; conversely, autosomes pair normally and genetic crossing-over occurs. In Darlington's chiasma hypothesis of metaphase pairing, chiasmata provide the primary, if not only, means of conjunction of chromosomes as bivalents. It is therefore assumed that the sex chromosomes in the male of *Drosophila pseudoobscura* are held together by chiasmata which are reciprocal and confined to inert regions of the chromosomes. K. W. Cooper has followed meiosis in the male of another fly, *Olfersia bisulcata*, which shows apparently similar phenomena (*Proc. U.S. Nat. Acad. Sci.*, **30**, 50; 1944). In this type the sex chromosomes of the male do not pair until after condensation and then form the *X–Y* bivalent by means of approximation of localized pairing segments, which presumably do not form chiasmata. From observations by Darlington on *Drosophila pseudoobscura* it seems not improbable that here also the *X–Y* bivalents may be the result of late pairing during or after condensation. Such cases of delayed pairing are not unique among

insects. The full significance of the observation is not clear but suggests that bivalent formation in *Drosophila pseudoobscura* would repay closer analysis and that the chiasma hypothesis of metaphase pairing may not be capable of covering all the facts.

Incompatibility in Tetraploid Clover

RECENT papers have given evidence of peculiar reactions of the incompatibility factors causing self- and cross-fertility in polyploids as compared with diploids. S. S. Atwood (*Proc. U.S. Nat. Acad. Sci.*, **30**, 69; 1944) has confirmed the behaviour of diploid and tetraploid clones of *Trifolium repens* in this respect. Two diploid plants, S_1S_2 and S_3S_4, gave rise after colchicine treatment to tetraploids. These tetraploids were self-incompatible, thus differing from results in *Petunia violacea* and *Oenothera organensis*. F_1 from the tetraploids were obtained with differing genotypes. By backcrossing and reciprocal crossing, the author shows that when only one type of heterozygous pollen is produced the presence of one or both factors in the style will inhibit growth; and that when several types of heterozygous pollen are produced none is inhibited in the pistil although there may be a similar factor in the style. It seems apparent that sometimes pollen growth depends on the total interaction of the pollen and style and not on a specific oppositional effect between one type of pollen and the style. Further evidence of this nature would be valuable in shedding light on the mechanism of inhibition of pollen tube growth.

Hornlessness in Goats

S. A. ASDELL (*Science*, **99**; [Feb. 11, 1944) suggests that the craze for selecting hornless goats has increased the percentage of intersexual animals. He has examined about three hundred animals which were intersexual and found that in every case they were hornless. He believes that intersexual goats are all females modified by a recessive gene which may be closely linked with hornlessness.

Contamination of Porcelain Insulators

ACCORDING to W. G. Thompson (*J. Inst. Elec. Eng.*, **91**, Pt. 2, No. 22; August 1944) in a paper on the mechanism of contamination, an analysis of the nature of the air-borne particles forming the main source of contamination on outdoor porcelain insulators, and of the forces acting upon them in the electrostatic field around an insulator, suggests that these forces are inadequate to account completely for the observed distribution and the quantity of the deposits. Direct measurements of the field-strengths close to the insulator confirm that the voltage gradients do not reach very high values in normal conditions, and that the electrical forces are proportionately weak. Investigations of the air flow over the insulators, and comparisons of the formations of air eddies observed in the flow over the geometrical forms associated with the complex shapes of insulators, show that the aerodynamic conditions have a considerable bearing upon the patterns formed by the deposits on the insulators. Wind-tunnel experiments provide results which illustrate the influence of the Reynolds' number, the applied voltage, the surface roughness, the wind velocity and the humidity upon the distribution and amount of deposited matter. Moisture films constitute a special case of temporary contamination, with sparking following the receding edges of the drying films. Finally, a method is suggested of estimating the flashover values of insulators from a consideration of the distribution of surface resistance as modified by the presence of deposited matter. In the final determination of insulator performance from the anti-dirt point of view, it is essential to have recourse to the test racks of the testing stations and the manufacturers' laboratories, and to supplement the evidence obtained by service experience on overhead lines. The complete account must involve a study of the means by which material deposited on insulators is removed by wind, rain and frost, but there seems little object in attempting a study of this nature using only artificial deposits.

Continuous Absorption Coefficient of the Negative Hydrogen Ion

RECENT attempts to find the source of the continuous opacity in stellar atmospheres, though they have strongly suggested that the negative hydrogen ion is responsible for much of the absorption, have resulted in only qualitative agreement between theory and observation. The quantitative breakdown of the theory in the visual region of the spectrum was traced a year ago by Chandrasekhar and Krogdahl to the use of a wave function of the ground-state of H^- which was not sufficiently accurate at distances of the order of five times the Bohr radius. Henrich has now computed new absorption coefficients (*Astrophys. J.*, **99**, 59; 1944) using an eleventh-order Hylleraas type of wave function (third- and sixth-order functions had been used previously), and finds that the absorption reaches a maximum at 7500 A., which is 30 per cent higher than the previous maximum, which occurred at 4750 A. This modification considerably reduces the discrepancy between theory and observation in the relation between effective temperature and colour temperature in the visual region of stellar spectra, and establishes on a firm basis the hypothesis that the negative hydrogen ion is an important contributor to opacity in stellar atmospheres.

Perturbations of Plato

IN *Observatorio Astronómico De La Universidad Nacional De La Plata*, **17**, 1941, Reynaldo P. Cesco has a paper with the title "Perturbaciones Seculares De Plutón". Owing to the close approach of the orbits of Pluto and Neptune, difficulties arise about the application of the Gaussian method which, in such circumstances, is unsatisfactory. The author attacks the problem by developing $1/\Delta$ in powers of e, e', and η^2, in a manner similar to the Laplace-Le Verrier method, but amplified by the use of certain corrections developed by Boquet. It is shown that the series converges even under the most unfavourable conditions for the two planets under consideration. The second chapter gives the formulæ for computing the coefficients and their derivatives, first for a definite value of the mutual inclination of the orbits, and then for the general case. In Chapter 3, reverting to the representation of the perturbative function and its derivatives by double integrals, by means of a convenient application of the theory of approximations by polynomials, a method for computing secular perturbations is developed. This method is sufficiently accurate, at least in the first approximation with respect to the mass. It is very suitable for Pluto and Neptune and its application to these planets is shown in Chapter 4.

RADIO AND ELECTRICAL ENGINEERS

THE application of electricity to signalling along wires in the latter half of the nineteenth century led to the foundation in 1871 of the Society of Telegraph Engineers. At a later date the title was changed to the Institution of Electrical Engineers and its scope expanded to enable it to cater for the interests of all those professionally engaged in electrical engineering in Great Britain. Moving with the growth and development of wireless telegraphy and telephony, the Institution inaugurated in 1919 a Wireless Section to deal with the subjects of high-frequency engineering and audio-frequency recording and reproduction. Shortly afterwards, the Institution was incorporated by Royal Charter, and the fully qualified members were granted the right to describe themselves as chartered electrical engineers. At the same time, it was recognized that, while maintaining the standard of the qualifications for membership, more opportunity should be afforded to the physicist engaged in radio work to become a member. It is particularly opportune to direct attention to this fact at the present time, when a large number of men engaged in scientific and technical radio work would probably describe themselves as radio physicists rather than as wireless or radio engineers. The Institution thus welcomes as potential members those who, although not having received the usual training of electrical engineers, nevertheless hold degrees or equivalent qualifications in physics and are fully expert in their own branch of radio technique. It is perhaps significant of the times to point out that for the past three years the president of the Institution of Electrical Engineers has been a member whose main professional interest has been in the field of telecommunications, the present holder of that office being Sir A. Stanley Angwin, engineer-in-chief of the Post Office.

On May 3 last, the Wireless Section of the Institution held a special meeting to commemorate the silver jubilee of its formation in 1919, and six past chairmen of the Section delivered short addresses which have now been published (*J. Inst. Elect. Eng.*, **91**, Part III, No. 15, September 1944). After an introductory address by the president, Dr. W. H. Eccles gave a short account of the technical events in the early progress of wireless communication which led to the formation of the Wireless Section. Prof. G. W. O. Howe followed with a survey of the development of the principles and theory of the subject, with special reference to the properties of the ionosphere. The early development of wireless telegraphy in the Navy from 1899 onwards was dealt with by Admiral Sir Charles E. Kennedy-Purvis, who referred to the fact that the close co-operation between the Navy and the General Post Office has from the beginning been a characteristic feature in wireless progress in Britain. The life of the Wireless Section of the Institution of Electrical Engineers has coincided with the growth of practical wireless telephony, for it was in 1919 that the early experiments in the transmission of speech and music took place in Great Britain and paved the way for the development of broadcasting. Starting from this point, Mr. H. Bishop traced the history of the British Broadcasting Corporation and its activities in providing a British and Empire broadcasting service. He also referred to the growth of television, in which field, prior to the present War, Great Britain held a decisive lead over all others, including the United States of America. Finally, Dr. R. L. Smith-Rose attempted to portray what the future might have in store when the greatly increased knowledge and experience gained during the War becomes available for application to peace-time requirements. The whole field of radio communication and navigation, and of aural and visual broadcasting would make rapid and important advances; and Dr. Smith-Rose looked forward to the day when radio-controlled pilotless freight-carrying aircraft would fly distances comparable with that of the North Atlantic route between Great Britain and North America. Reference was also made to the heavy debt which all the applications and advances that were mentioned by the various speakers at the meeting owe to those patient investigators and research workers, who in recent years have laid the foundations and established the essential facts which form the basis of all development work.

Since the jubilee meeting just referred to, the Council of the Institution of Electrical Engineers has decided to change the name of the Section from "Wireless" to "Radio", and to extend its scope to cover the field generally known nowadays as "electronics". In this way the Institution has shown itself fully alive to the progress of the art and science of radio technique, and to the necessity of keeping this Section virile and up-to-date, and capable of representing the best interests of those engaged in the radio profession.

The chairman of this Radio Section for the current year is Mr. H. L. Kirke, head of the Research Department of the B.B.C.; and on October 11 he delivered his inaugural address to the Section, the members of which now number about two thousand. In the first portion of his address, Mr. Kirke referred to the fact that it has been felt for some time that there ought to be closer co-operation with the Institute of Radio Engineers of America. War conditions made a definite move rather difficult, and it was clear that the matter needed oral discussion. An opportunity for this occurred early this year, when both Mr. Kirke and Dr. Smith-Rose, a past chairman of the Radio Section, were in the United States; they were invited, together with Mr. F. S. Barton, also a member of the Section and recently a vice-president of the American body, to attend a meeting of the Board of Directors of the Institute of Radio Engineers in New York. At this meeting a number of proposals were discussed and very well received; and in order to put these into effect, a special Liaison Committee has been formed in Great Britain to work with a similar committee in the United States. Thus a close link has been forged between the Radio Section of the Institution of Electrical Engineers in Great Britain and the Institute of Radio Engineers in the United States; and it is hoped that, as a result, there will be a freer interchange between the two bodies of papers, discussions and other matters of mutual interest.

In the second part of his address, Mr. Kirke dealt with the subject of impedance measurement at radio frequencies. There has been considerable development in this field over the past decade. Mr. Kirke described, with the aid of diagrams and photographs and an exhibition of the apparatus, five types of radio-frequency bridge which have been developed and used during the past ten years: reference was also made to the associated apparatus and to a low-

frequency capacitance bridge which was the forerunner of some of the radio-frequency equipment. Those interested in this type of apparatus technique will look forward to the publication of the address in the *Proceedings* of the Radio Section of the Institution.

GEOLOGICAL SERVICE OF THE U.S.S.R.

THE Soviet Geological Service is working hard on problems connected with the defence of the country, the development of industry and the rehabilitation of the national economy of the liberated regions.

I. I. Malyshev, the chairman of the Geology Committee of the Council of People's Commissars, states that this year Soviet geologists are concentrating on a search for new mineral deposits. The Committee has already sent out more than six hundred parties of geologists and experts for field work.

Newer methods of work have been adopted, among which is the use of geophysical instruments which reveal the magnetic, gravitational, seismic and other features of rocks. The employment of these methods in past years has led to a number of discoveries being made. For example, an aeromagnetic survey of Western Siberia led to the discovery of new iron ore deposits.

This year's prospecting is mainly to find new deposits of molybdenum, tungsten, tin, mercury, mica, etc. Great importance is placed on these surveys as increased quantities of raw materials are needed for the iron and steel mills now being built in Siberia, Kazakhstan and other parts of the country.

It is hoped soon to complete the work on composite hydrogeological maps of the industrially and economically important regions of the U.S.S.R. These maps will show sub-soil waters, their quality, the conditions under which they are found, and the possibility of their being used for industry, transport, agriculture, and the water supply of inhabited centres. This information is valuable in planning the economic development of the districts concerned. In compiling these maps, data obtained by specially organized hydrogeological expeditions were added to the mass of available geological material. An example of the importance of the work done in the realm of hydrogeology is the discovery last year of deposits of fresh, sub-soil water at an accessible depth in the seemingly waterless Kara Kum desert.

All work and expeditions of this nature are under the direction of the All-Union Research Institute for Hydrogeology and Engineering Geology. The All-Union Commission on Mineral Deposits will this year confirm the estimate of coal supplies available to all enterprises in the coal-mining industry; and the same will be done for the oil industry.

The scope of the State Geological Survey has been increased by almost 50 per cent this year. The Survey will give a complete picture of the geological structure of the U.S.S.R. and provide the foundation for all future prospecting and survey work. Aerial photographs are extensively used for this work.

Another important institution is the All-Union Geological Records which collects material on all the geological work done on Soviet territory. This year it is compiling a sort of encyclopædia of all known mineral deposits of the U.S.S.R. which will run into about 16,000 printed pages.

Soviet geologists are also busy at the front. Special detachments of geologists are working on all sectors of the front providing geological data for the advancing Red Army.

They supply the staff with necessary information when the Red Army has to force water-courses, pointing out places through which tanks can pass, help in organizing the army's water supply, search for building materials for dug-outs, roads and bridges, and give advice regarding camouflage. This work is frequently carried out under enemy fire. The selfless work of many geologists at the front has been marked by the award of Government decorations.

ECONOMY IN THE USE OF DRUGS

THE first edition of the Medical Research Council's War Memorandum No. 3, entitled "Economy in the Use of Drugs in War-time", was issued in March 1941. It represented the views of the Council's Therapeutic Requirements Committee and a first Supplement to it was issued in November 1941. A second revised edition is now issued (H.M. Stationery Office, 1944. 3*d*.). It includes an appendix on economy in the use of bactericides and disinfectants, large quantities of which are, the appendix says, used in hospitals and private practice under conditions in which they are not likely to be effective. Sterilization by heat is always preferable to the use of disinfectants and should be used if possible. Mercurial disinfectants have to be imported, and mercury is required for munitions, so that the indigenous coal-tar disinfectants should be used as much as possible. The same Council's War Memorandum No. 6 on "Prevention of 'Hospital Infection' of Wounds" contains recommendations for the use of disinfectants of the phenolic type.

An appendix to the first edition of the Memorandum described the production of drugs in the British Empire, but "the activities arising in this connection" have since been assumed by the Vegetable Drugs Committee set up by the Minister of Health. This Committee now works within the organization of the Ministry of Supply. Responsibility for the provision of drugs and therapeutic substances is now vested in the Ministry of Supply, which acts in consultation with the Ministry of Health, and both Ministries are represented on the Therapeutic Requirements Committee. Difficulties in obtaining supplies of important drugs should be referred to the Directorate of Medical Supplies, Ministry of Supply, Portland House, Tothill Street, London, S.W.1.

This second edition of the Memorandum revises and extends the lists given in the first edition. It adds many new items and incorporates the first Supplement. Further, the method of classifying the substances listed has been changed. In the first edition Class *A* brought together drugs which were regarded as essential and those which were readily available without indicating which of these reasons determined the inclusion of particular drugs in this Class. At the time of publication it was undesirable to publish this information. It has, however, become increasingly difficult to keep separate the ideas that a drug may be on one hand readily available and on the other essential. Too rigid a classification may defeat its own object unless there is a rigid scheme of rationing,

which has not yet been necessary. In any event no drug can be regarded to-day as being freely available, and economy is necessary in the use of all drugs. This second edition of the Memorandum has therefore classified substances into *A*, drugs which are important therapeutic agents and which should be made available so far as is possible; *B*, drugs which are needed for certain purposes, but supplies of them are limited—it is left to the good sense of the prescriber to use these only for purposes for which they are known to be valuable; alternatives to them are indicated, whenever this is possible; *C*, drugs which are not essential and do not justify importation or manufacture for home use in war-time. The list includes many substances which are used in chemical, biological and other laboratories, as well as those used by medical men and veterinarians.

SUMMER SCHOOL IN X-RAY CRYSTALLOGRAPHY AT CAMBRIDGE

THE second Summer School of X-Ray Crystallography, held at Cambridge during September 4–15, was opened by Sir Lawrence Bragg, and the nineteen lectures, followed by sessions of practical work, were shared by Miss A. M. B. Parker and Drs. N. F. M. Henry, H. Lipson, D. P. Riley and W. A. Wooster. The organization and syllabus of the course were similar to those of last year (see *Nature*, Oct. 2, 1943, p. 381).

The application of X-rays to crystallographic problems of industrial importance has made dynamic advances, but remains a young science still largely cradled in the universities and similar academic laboratories. Many of the senior technical men attached to industrial organizations have had no opportunity of acquiring more than a superficial knowledge of the subject and its possibilities; while graduates just entering industry, though they may have received some training in X-ray methods, can scarcely be expected fully to appreciate their application to practical technology. A gap clearly exists which it was the purpose of the School in some measure to bridge; to quote the syllabus of the course, "the chief aim is to give scientists and technicians a training in the fundamentals of the subject, to bring them into touch with the wide range of methods used, to teach them the newest techniques, and to indicate the many types of industrial problems in which this work can be used with advantage". There is no doubt that these aims were admirably fulfilled.

Twenty-nine people assembled for the lectures, and as nearly half the number were concerned more or less directly with metals it is fitting that the course had a distinct bias, especially in its later and more practical part, towards the metallurgical field. During the first week attention was confined to the more fundamental aspects of the subject, dealing with the representation in projection of the symmetry and internal structure of crystals, the laws governing the 'reflexion' of X-rays from lattice planes and the several methods of taking and interpreting X-ray photographs of single crystals. In the second week, the knowledge so acquired was applied to the study of polycrystalline aggregates by means of 'back-reflexion' and 'powder' photographs, and the essentially practical nature of the course emerged. Familiarity was gained with such matters as the accurate determination of lattice spacings, the identification of crystalline substances and of the phases present in alloys; the assessment of preferred orientation, internal stress and grain-size in metals and the study of imperfect forms of crystals such as those occurring in rubber, textile fibres and plastics.

An important aspect of the more advanced work was the pains taken to point out the limitations of the methods at present available, and to indicate the probable lines of future progress. E. VOCE.

SPORE-FORMING BACTERIA PATHOGENIC TO PLANTS

IT is a curious fact that whereas the bacterial diseases of animals are due to many types including spore-formers, the large number of bacterial diseases of plants which have been carefully investigated are caused by bacteria which do not form spores. That some spore-forming bacteria of the *Bacillus subtilis* group can be pathogenic to plants has often been stated but never generally accepted by plant pathologists, either for lack of adequate proof or because of failure to obtain positive results on re-investigation.

There are, however, at least two accounts of experimental work which conform to the standards of rigid proof required in such work. Brierley (*Phytopath.*, 18, 819; 1928) presented good evidence to show that a bacterial rot of potato tubers was due to a spore-forming organism identified as a strain of *B. mesentericus*, and recently Madhok (*Indian J. Agric. Sci.*, 13, 129; 1943) has investigated a rot of tomato fruits due to a member of the same group and for which the name *B. fructodestruens* is proposed. A sticky bacterial rot of potato tubers is under investigation at Cambridge due to *B. polymyxa* which, according to Dowson (*Nature*, 152, 331; 1943), is pathogenic to a large number of plants including green tomato fruits when inoculated under laboratory conditions. Allen (*Nature*, 153, 224; 1944) has shown that certain strains of *B. subtilis* secrete pectinases which rapidly disintegrate pieces of raw potato when immersed in their solutions and which are concerned in the separation of flax fibres in retting.

From these investigations it would appear that some spore-formers of the *B. subtilis* group and *B. polymyxa* possess the necessary enzyme apparatus to attack and destroy the middle lamella of parenchymatous tissues under certain conditions, chief of which is the presence of water (not vapour), an adequate amount of which is necessary to start the enzyme system working.

The *B. subtilis* group has been recently investigated by Gibson (*J. Dairy Res.*, 13, 248; 1944), who has shown that this group of spore-forming bacteria can be considered as consisting of three main species each of which comprises a large number of closely related forms hitherto given distinct specific names. It seems possible, therefore, that failure to repeat some of the earlier work on the disintegration of plant tissues by some of these bacteria may be due to errors in identification. The possibility that other spore-formers may possess pathogenic powers as regards plants calls for further investigation and is much to be desired in view of the serious losses caused by bacterial rots.

FORTHCOMING EVENTS

*(Meeting marked with an asterisk * is open to the public)*

Saturday, October 28

TELEVISION SOCIETY (at the Institution of Electrical Engineers, Savoy Place, Victoria Embankment, London, W.C.2), at 3.30 p.m.—Mr. P. D. Saw: "New Types of Test Gear for Television Production".

Sunday, October 29

ASSOCIATION OF AUSTRIAN ENGINEERS, CHEMISTS AND SCIENTIFIC WORKERS IN GREAT BRITAIN (joint meeting with the ASSOCIATION OF AUSTRIAN DOCTORS) (at the Austrian Centre, 69 Eton Avenue, Hampstead, London, N.W.3), at 11.30 a.m.—Dr. F. Bergel: "Life Saving and Life Preserving Plant Products".

Tuesday, October 31

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 1.30 p.m.—Mr. B. E. B. Fagg: "Some Archæological Notes from Northern Nigeria".

CHADWICK LECTURE (at the London School of Hygiene and Tropical Medicine, Keppel Street, London, W.C.1), at 2.30 p.m.—Mr. Somerville Hastings: "The Management of Hospitals in Peace and War".*

INSTITUTE OF PHYSICS (ELECTRONICS GROUP) (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 5.30 p.m.—Mr. S. Rodda: "Beam Tetrodes".

PHYSICAL SOCIETY (joint meeting with the BRITISH INSTITUTION OF RADIO ENGINEERS) (at the Institution of Structural Engineers, 11 Upper Belgrave Street, London, S.W.1), at 6 p.m.—Prof. E. N. da C. Andrade, F.R.S.: "Physics and Radio".

Wednesday, November 1

ROYAL SOCIETY OF ARTS (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Dr. E. F. Armstrong, F.R.S.: "Chemistry in the Service of Man".

SOCIETY OF PUBLIC ANALYSTS AND OTHER ANALYTICAL CHEMISTS (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 3 p.m.—Dr. D. W. Kent-Jones: "Some Experiences of Microbiological Assays of Riboflavin, Nicotinic Acid and other Nutrient Factors"; Mr. W. N. Aldridge: "A New Method for the Estimation of Micro-quantities of Cyanide and Thiocyanate".

INSTITUTION OF ELECTRICAL ENGINEERS (RADIO SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Dr. E. B. Moullin: "Theory and Performance of Corner Reflectors for Aerials"; Mr. H. Page: "The Measured Performance of Horizontal-Dipole Transmitting Arrays".

Thursday, November 2

ROYAL INSTITUTION (at 21 Albemarle Street, Piccadilly, London, W.1), at 2.30 p.m.—Sir James Jeans, O.M., F.R.S.: "Old and New Descriptions of the Astronomical Universe", (i) "Planets".

INSTITUTE OF FUEL (YORKSHIRE SECTION) (at the Royal Victoria Station Hotel, Sheffield), at 3 p.m.—Mr. H. C. Armstrong: "Improvements in the Use of Fuels in Everyday Practice".

INSTITUTION OF ELECTRICAL ENGINEERS (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. J. Bruce: "Electrostatic Precipitation of Dust from Boiler-Plant Flue Gases".

Friday, November 3

ROYAL INSTITUTION (at 21 Albemarle Street, Piccadilly, London, W.1), at 5 p.m.—Dr. E. B. Bailey, F.R.S.: "Mountains that have Travelled over Volcanoes".

INSTITUTE OF PHYSICS (at the Institution of Electrical Engineers Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. E. F. Relf, F.R.S.: "Air and Fluid Motion".

INSTITUTION OF MECHANICAL ENGINEERS (in conjunction with the APPLIED MECHANICS GROUP) (at Storey's Gate, St. James's Park, London, S.W.1), at 5.30 p.m.—Prof. A. J. Sutton Pippard: "Stresses by Analysis and Experiment".

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS (in the Lecture Theatre of the Literary and Philosophical Society, Newcastle-upon-Tyne), at 6 p.m.—Sir Stanley Goodall, K.C.B.: "Some Technical Developments in Naval Construction" (Andrew Laing Lecture).

Saturday, November 4

ROYAL AERONAUTICAL SOCIETY (at the Institution of Mechanical Engineers, Storey's Gate, St. James's Park, London, S.W.1), at 10.30 a.m.—Discussion on Civil Aviation. General Critchley: "The Selection and Training of Personnel for Civil Aviation"; Major Thornton: "The Economics of Air Transport"; Mr. Roy Chadwick: "Civil Aircraft Design"; Mr. E. W. Hives: "Civil Aero-Engine Design"; Mr. W. P. Hildred: "Route Facilities (Radio, Aerodromes, Meteorology, etc.)".

GEOLOGISTS' ASSOCIATION (at the Geological Society of London, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Dr. L. Hawkes: "On Jet Coal in the Chalk of Kent".

APPOINTMENTS VACANT

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

AGRICULTURAL TRAINING OFFICER to organize the scheme for the training in agricultural and horticultural occupations of men and women released from War service—The Executive Officer, Bucks. War Agricultural Executive Committee, County Offices, Aylesbury, Bucks. (October 31).

VISITING PROFESSOR OF GEOGRAPHY, VISITING PROFESSOR OF HISTORY, and VISITING PROFESSOR OF EDUCATION, in the Farouk 1st University, Alexandria—The First Secretary, Royal Egyptian Embassy, 75 South Audley Street, London, W.1 (October 31).

WATER SUPPLIES OFFICER, and an ASSISTANT LAND DRAINAGE OFFICER—The Chief Executive Officer, West Riding War Agricultural Executive Committee, Stray Hotel, Harrogate (November 1).

ELECTRICAL PLANT ENGINEER with first-class experience of both L.T. and H.T. equipment for an important Lancashire chemical engineering textile firm—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. D.932.XA) (November 2).

ENGINEERS OR PHYSICISTS (2) for Research and Development Department of Aeronautical Instrument Manufacturers (Hampshire area)—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. A.647.XA) (November 2).

ASSISTANT (temporary) TO THE ADVISORY OFFICER IN MILK UTILIZATION—The Secretary, West of Scotland Agricultural College, Blythswood Square, Glasgow (November 3).

PSYCHOTHERAPISTS for work on a sessional basis with children and adults in the Psychiatric Out-Patient Clinic under the supervision of the Honorary Psychiatrist—The Secretary, Manchester Northern Hospital, 38 Barton Arcade, Manchester 3 (November 4).

HEAD OF THE ENGINEERING DEPARTMENT of Cardiff Technical College—The Director of Education, City Hall, Cardiff (November 6).

LECTURESHIP IN CIVIL ENGINEERING in the University of the Witwatersrand, Johannesburg—The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1 (November 6).

CIVIL ENGINEER (Reference No. N.1163.A) and an ASSISTANT ENGINEER SURVEYOR (Reference No. E.1164.A) by the Department of Comptroller of Development and Welfare, West Indies—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting the appropriate Reference No.) (November 7).

CHEMICAL ENGINEER with good Science Degree and experience in design and development (preferably also of operation) of Heat Exchange Equipment and Chemical Plant generally, as Assistant in Technical Department of Gas and Chemical Plant Contractors—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. C.2316.XA) (November 7).

COMBUSTION EXPERT who is accustomed to the application of scientific principles to large steam generators, by the London Power Company, Ltd. (a good Degree in Chemistry with Physics subsidiary, or vice versa, and research experience are desirable)—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. C.2240.XA) (November 7).

LECTURER (temporary, full-time) IN ELECTRICAL ENGINEERING SUBJECTS to Honours Degree and Higher National Certificate standards in the Cardiff Technical College—The Director of Education, City Hall, Cardiff (November 9).

GRADUATE TEACHER OF MATHEMATICS and/or SCIENCE in the Grimsby Technical College—The Director of Education, Education Offices, Grimsby (November 10).

GRADUATE ASSISTANT FOR GEOGRAPHY AND SCIENCE, in the School of Building, an ASSISTANT with ENGINEERING Degree or equivalent qualification in Structural Engineering, in the School of Building and Department of Engineering, and an INSTRUCTOR with experience in ELECTRICAL ENGINEERING, in the Department of Engineering, of the East Ham Technical College—The Secretary for Education, Education Office, Town Hall Annexe, Barking Road, East Ham, London, E.6 (November 11).

BACTERIOLOGIST on the staff of the Water Pollution Research Laboratory, Watford—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. F.2248.A) (November 11).

CIVIL ENGINEER, and an ASSISTANT to the Civil Engineer, by the Government of Seychelles—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. E.1167.A) (November 11).

LECTURER IN THE ELECTRICAL ENGINEERING DEPARTMENT, and a LECTURER IN MATHEMATICS—The Registrar, Technical College, Sunderland (November 13).

EDUCATIONAL PSYCHOLOGIST, and a PSYCHIATRIC SOCIAL WORKER—The Secretary for Education, County Education Offices, Northampton (November 13).

ASSISTANT LECTURER IN MATHEMATICS—The Registrar, The University, Manchester 13 (November 21).

PROFESSIONAL OFFICER (Grade I) in Ceramic and Refractory Research for the Government Metallurgical Laboratory, University of the Witwatersrand, Johannesburg—The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, W.C.1 (November 30).

RESEARCH WORKER (temporary) to assist in work on Fish which is being carried out in association with the Ministry of Agriculture and Fisheries—The Director, Freshwater Biological Association, Wray Castle, Ambleside, Westmorland (December 10).

DAVID JARDINE CHAIR OF ELECTRICAL ENGINEERING (with special reference to Electronics and the relations between Electrical Engineering and Physics)—The Registrar, The University, Liverpool (December 29).

LECTURER IN GEOLOGY (Grade IIb)—The Secretary, The University, Birmingham, 3 (December 31).

LECTURER IN MECHANICAL ENGINEERING—The Secretary, Woolwich Polytechnic, Woolwich, London, S.E.18.

TEACHER OF MATHEMATICS in the Maidstone Technical Institute—The District Secretary, Kent Education Committee, 13 Tonbridge Road, Maidstone, Kent.

ADVISORY DAIRY BACTERIOLOGIST for the West Midland Province—The Principal, Harper Adams Agricultural College, Newport, Shropshire.

KEEPER OF THE DEPARTMENT OF CERAMICS, TEXTILES, COSTUMES and FURNITURE—The Director, City Museum and Art Gallery, Birmingham, 3.

ERECTOR SERVICE ENGINEER for the Sisal Control, Tanganyika Territory—The Secretary, Overseas Manpower Committee, Ministry of Labour and National Service, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. 1441).