

# NATURE

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## RECONSTRUCTION IN THE CIVIL SERVICE

IN the debate which took place in the House of Commons on January 28, 1943, on the sixteenth report for the session 1941-42 of the Select Committee on National Expenditure, on "Organization and Control of the Civil Service", the Chancellor of the Exchequer, Sir Kingsley Wood, welcoming the general tenor of the Committee's observations on the establishment of a Civil Service staff college, stated that he proposed to start at once an investigation into the general question of the training of Civil servants, including that of the establishment of a staff college, its form and character. A committee was appointed for this purpose in February 1943 under the chairmanship of the Financial Secretary to the Treasury, the Right Hon. Ralph Assheton, and its report was duly presented to Parliament in May last.

In the meantime, the importance of the question of training of Civil servants has steadily become more widely recognized. In the attention which has been given to the machinery of government by such bodies as Political and Economic Planning, the importance of men as well as the right methods has been repeatedly emphasized. The same question has been to the fore in current discussions on the reform of the Foreign Service and on proposals for a civil or economic general staff. Already education for the public services has been considered in a special report of the British Association Committee on Post-War University Education, while further discussion of the question has been stimulated not only by the White Paper on Education but also by subsequent papers on health services and employment. The proposals in the latter paper for a strong central economic staff were rightly stressed by the present Chancellor of the Exchequer and were warmly welcomed by many members of Parliament in the debate.

It has, in fact, become increasingly clear that in the successful execution of whatever plans we may make for our post-war reconstruction, much will depend on the calibre of the men to whom their execution must perforce be entrusted. It is, of course, above all in the technical field that complexities multiply; and the larger the part that science has to play in the ordering of our affairs, the greater the need for decisions and policy to be based impartially on scientifically ascertained facts. If the State is to discharge effectively its more active duties of planning and supervision, the more imperative is the need for the Civil Service to be trained for the job it has to do. The Assheton Report does not, it is true, pursue in detail the training of the professional and technical grades. That is not the special issue at present, except in so far as it is bound up with the general question of technical education in relation to industrial efficiency under the plans for educational reconstruction. What is at issue is that members of these classes should, as was most emphatically stated in more than one recent debate in Parliament, have fuller opportunities of transfer to the administrative class, when they show themselves to possess administrative ability. There must be much

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more adequate encouragement of a process of such direct value to the machinery of government, apart altogether from its indirect effect, through the higher status and wider prospects given to the scientific worker, in attracting to the service of the State a freer supply of men of outstanding scientific as well as administrative ability.

For this reason, as a preparatory step, recruits to the professional and technical classes might, as the Report suggests, usefully share in the reception arrangements and background training which are recommended for all Civil servants, so that they may be seized of the functions of the government machine generally and the procedure of their own departments in particular. Again, members of these grades, who are in certain respects analogous with the administrative class and with the higher levels of the executive class, should also be given, where appropriate, the same opportunities for acquiring wider experience by the study of outside methods and by other measures such as are recommended by the Report. Training, it is observed, cannot be considered in isolation; such matters as recruitment, allocation, probation, transfer and promotion are all involved. All indeed are considered by the Report in so far as they are factors in determining the character and extent of training, and the efficient performance of those functions which must fall to the lot of a Civil servant more and more concerned with the affairs of the community and acting as the servant of the State in numerous ways which involve contact between the government and the individual citizen.

The Report itself is in two parts. The first deals with general considerations and principles; the second indicates some of the ways in which they can be applied to the various grades that have come under review. Looking first at general principles, the Report recommends that the Treasury should exercise general control over training and should appoint a director of training and education. Within each department there should be a planned training scheme under the general control of the head of the department, with at least a part-time departmental training officer. The National Whitley Council should be associated with general training policy, and departments should invite the co-operation of staff representatives in working out departmental schemes. Not only should great care be taken in the selection of teachers, but also attention should be paid to the surroundings in which people work.

The reasons for these recommendations are cogently set forth in the Report. There can be no dissent from the Committee's view that training schemes will not prosper unless responsibility for their success is firmly placed on some individual. The Treasury's responsibilities for establishment work and the new development of the Organization and Methods Division make it logical that general responsibility for training should also be with the Treasury. Again, the element of staff co-operation is emphasized in a way which represents a break with tradition and a look forward to that closer integration of the service with the community, which is just as important as that of industry with the community, in order that the needs

of to-morrow may be served. The emphasis on personality in teaching and on environment equally betoken a forward-looking mind. Indeed, it cannot be too clearly emphasized that the Report is largely breaking new ground and that its recommendations are experimental; that, far more than shortcomings or defects of the past laid bare in the Report, is what matters, and what should ensure it a sympathetic reception and patient and full discussion.

The objects of the training to be given could, in fact, scarcely be better put than in this Report. Public confidence is essential if the Civil Service, however admirably trained for its more positive functions, is to discharge its new duties effectively. We may take for granted that training should endeavour to produce a Civil servant whose precision and clarity in the transaction of business are accepted. Equally we have no right to expect that the Civil servant will be attuned to the tasks he is called upon to perform in a changing world, or that he will be able continuously and boldly to adjust his outlook and methods to meet the new needs, unless we are prepared to support him with sympathy and understanding, and temper criticism with discernment.

It might well be observed in passing that the stress laid in this Report on the human aspect among the objects of training should do much to promote such understanding of 'the man at the other end', and a real integration of the Civil Service with the community it seeks to serve. Measures which prevent the Civil servant from becoming mechanized by making him aware of the wider setting of his work, by training him, not solely for the job which lies immediately to hand, but also to fit him for other duties and to develop, where appropriate, his capacity for higher work and greater responsibilities, all assist to that end, as does the attention to staff morale which is emphasized. In such matters as these, in its frank recognition of the human problem presented by routine work and mechanization, the Report is pointing to problems which industry, too, must face in increasing measure. They are indeed already being faced by many progressive firms, as well as by the joint production councils, but they must receive far greater and wider attention.

Returning to the general principles recommended in the Report, there is emphasis on a real period of probation which would facilitate the early elimination of misfits. Next, there should be a routine of training for all entrants under a responsible officer. Mobility in the early years of service, both from branch to branch and from headquarters to out-stations, and easier transfer from one department to another are also recommended. Clearly much will depend on the careful selection of supervisors and their training in the principles of supervision, as well as on the ability of establishment officers, who should study staff management and office organization.

Despite many unexceptionable recommendations, much of the interest of scientific workers in this general part of the Report centres in the considerations which lead the Committee to reject the proposal that the Government should associate itself with the establishment of a national administrative staff

college, though if such a college is set up some Civil servants might attend experimentally. In the first place, the Committee concludes that little or no centralized or institutional training is needed for the clerical, executive and professional grades: the necessary training is most readily and effectively given by departments. For the administrative officer, however, the Committee sees a real need for a central organization to give the appropriate teaching about the background and methods of Civil Service administration to recruits to this grade of all departments. Further, such an organization should serve a useful purpose in bringing together administrators at a later stage for discussion and investigation of common problems.

The Committee thus visualizes training primarily for new entrants and not, as in the staff colleges of the Armed Forces, for those selected as suitable for promotion after some years of experience. Again, while heartily in favour of encouraging contact between Civil servants and workers in other departments of life, especially in commerce and industry, the Committee does not think that these contacts can best be secured through a common course of instruction in administration. Both the lessons and the illustrative matter of Civil Service administration are regarded as too specialized to be made useful in a college of the kind suggested to the Committee. Further, from the evidence, the Committee thinks that there is a danger that such an institution would end by becoming a commercial college concerned with office methods, and that a real opportunity of assisting the Civil Service administrator to a rapid comprehension of the nature of his problems and of the lines of thought and action he should follow would be lost if such training were merged in a generalized administrative course for both business and the Services.

The Committee's own proposals are elaborated more fully in Part 2 of the Report, in considering the post-entry training of the administrative class. Here more than anywhere, the Report breaks new ground, and it is satisfactory to note that there is no suggestion that Civil servants should not receive their training in the universities or other institutions of similar rank in company with men and women destined for other careers. We can find nothing in the Report to warrant the anxiety expressed last year in these columns (*Nature*, 151, 512; 1943) that entry will be unduly restricted or the functions of the universities be adversely affected. It may, indeed, be argued that something more of the principles of administration might well be taught prior to entry to the service than the Committee is inclined to admit; but incontestably there is much training in internal methods and background that has hitherto not been given at all, or at best unsystematically, and which can only be given effectively after entry to the service.

The section of the Report in which the Committee's own ideas are outlined deserves careful attention, for if some of the proposals are admittedly experimental, the Report reveals an urgent need for action. Moreover, if as it appears the Committee has taken rather too narrow a view of its scope and under-estimated the potentialities of the staff college idea, it is to public

discussion that we must look for the corrective in the first instance.

As regards the administrative cadet, the Committee suggests a course of two to three months requiring an average attendance of about two days a week, the object of the course being to shorten the process by which the recruit forms his own administrative standards, and to inculcate from the beginning of his service a professional approach. As set forth in the Report, much of the syllabus appears to be of wider validity than the Committee is disposed to admit. The reference to training in methods of preparing and presenting statistics, and the logical principles underlying their interpretation, is welcome, and the Committee is on firm ground in urging that the close relation of such a course to a Civil servant's particular job might well increase its vitality and value. Moreover, from the comparatively modest beginnings outlined, the Committee visualizes the development of a centre which could serve as a clearing-house of ideas for Civil Service administrators and a repository of schemes, successful and unsuccessful, which have been tried out in practice. In fact, after rejecting the idea of a staff college, the Committee sees such a centre organizing refresher courses in which something resembling the methods of the military staff college could be attempted, officers of various departments meeting in study groups to work out hypothetical or actual administrative problems. Participation of representatives of commerce and industry and other organizations in such discussions is suggested, and the sharing of experience between business men and Civil servants is recognized as mutually valuable.

In recommending the fullest use of the centre for all these purposes, the Committee does not appear to be entirely consistent, despite its belief in the value of contacts between Civil servants and commerce and industry. Moreover, it must be admitted that the Committee does not seem to be sufficiently alive to the dangers of departmentalism, and however unexceptionable may be its further suggestions for training the recruit by discussions, visits, field-work and the like, some legitimate doubt may well be entertained of their effectiveness in dealing with an evil which is not confined to the Civil Service. Something of the same timidity characterizes the discussion of the training of those intended for positions of high administrative responsibility also.

Here the Committee accepts the general view that in the early thirties a complete change of environment or an opportunity to stand back from one's job and to shake oneself free from the daily routine is most desirable to gain a broader vision and some fresh experience. Without questioning the value of transfer within the Service from one department to another, or from headquarters to out-station, or vice versa, for refresher purposes or for widening experience, it rightly insists on the need for opportunity to get away for a time into a different atmosphere altogether, by a period of secondment elsewhere, for example, to outside business or a local authority. The former is regarded as of little value unless for a period of anything up to two years, so that the Civil servant could do a real job of work and be entrusted with real

responsibility. This method is therefore considered one for tentative experiment rather than definite recommendation. Seconding to, or interchange on a two-way basis with, a local authority is, however, a more promising and less difficult way in which the Civil servant should have opportunities for appreciating more readily the impact of action at the centre upon local government and upon the general public. The Committee recommends accordingly that departments such as the Ministry of Health and Board of Education should consider and report on such possibilities. Beyond this, the Committee suggests that selected Civil servants, say in the early thirties, should be granted a period of sabbatical leave to pursue an approved course or to undertake research, either in Great Britain or abroad. Such leave should be with pay and should count as service for purposes of pension.

The Committee is clearly in sympathy with the proposal of the recent British Association Committee on Post-War Education, but contemplates something beyond the social studies suggested by that report. Again, it takes up a suggestion emphasized in a Planning broadsheet, "A Civil General Staff", in commenting on the ignorance of Civil servants of the relevant experience of other countries, and strongly commends the idea of giving selected officials an opportunity of travelling abroad to study aspects of government or public administration likely to be of value. Study of the way in which problems of government are tackled abroad would be worth while in itself as a safeguard against insularity, as well as providing a stimulant which would be of great benefit to the Service.

The Committee does not overlook the current criticism that the Civil Service is not sufficiently alive to the possible effect of its actions upon business undertakings; and that its members, in those departments which come into daily contact with commerce and industry, should be equipped with a fuller understanding of their problems. This contact, it suggests, should be secured by visits and periods of observation, varying in duration from a week to a maximum of two or three months. By such arrangements it is believed that selected Civil servants might acquire a better insight into the methods and problems of the industrial and commercial world, while at the same time business men might gain a better understanding of the point of view of the Civil servant.

There can be no doubt that a number of these suggestions need to be explored seriously and thoroughly and with some urgency, whether or not the Committee is unduly optimistic as to the effect, particularly of this last suggestion. On the other hand, the Committee is assuredly correct in pointing out that the need for Civil servants to acquire the right attitude of consideration and sympathy towards the public should not lead us to forget that this attitude should be mutual. A spirit of service cannot be expected to flourish among public servants if they feel with reason that their efforts are being disparaged and their difficulties overlooked by those whom they are endeavouring to serve. A more generous appreciation by the public of the work of the Civil Service

would go far to ensure that such appreciation was increasingly deserved. It is somewhat surprising that the Report appears to overlook the influence which the considerable number of temporary Civil servants recruited for war purposes—estimated in a debate last year at some 300,000—might well exert in this respect; but the point is one which should not escape the public relations officers of the Service.

The Report must now be subjected to constructive and informed criticism, to ensure that full advantage is taken of any fresh experience acquired as a result of the experiments which the Committee suggests. Judgment may well be reserved on a number of points: some of the present defects may be more deeply embedded in the administrative system than the Report admits. Here, however, is positive and constructive criticism comparable with that which characterized the report of the Select Committee on National Expenditure. Defects are laid bare and weaknesses admitted, and it is unthinkable that the situation will remain as it is. Neither the Government nor the Civil Service can allow the charge of neglect of systematic post-entry staff training in peace-time to be levelled again. Whether or not the measures at present advocated are entirely adequate to attain the objectives so admirably stated, they should at least promote the ever-present consciousness of the importance of clarity of thought, directness of action, simplicity of expression, speed, initiative, considerateness and other virtues, in which Civil servants are often said to be deficient—and which are not always conspicuous in their detractors. The Report clearly believes that training and good staff management will do much to make these the keynotes of daily practice in all ranks from the highest downwards, and the confidence it shows thereby in the essential qualities of the present Civil Service in Great Britain is in keeping with the whole spirit of the searching debate in the House of Commons which initiated the inquiry.

## FARMING IN WORCESTERSHIRE, PAST AND PRESENT

A History of Worcestershire Agriculture and Rural Evolution

By R. C. Gaut. Pp. xvi+490. (Worcester: Littlebury and Co., Ltd., 1939.) n.p.

**WORCESTERSHIRE** is one of the smaller counties of England and is neither a tourist nor a holiday resort; but connoisseurs know it as one of our most interesting regions. Through it pass three peaceful and attractive rivers, the Severn, the Avon and the Teme; its scenery is varied by Bredon Hill, the Malverns, the Clent and Lickey Hills and by the Forest of Wyre. Some of the most intensive culture in England is to be found in the Vale of Evesham. The county is rich in archaeological interest, for the monastic movement played an important part there, and parts of the great Abbeys of Evesham and Pershore still survive in a setting enriched by interesting churches, attractive country houses and quiet, pleasing villages.

Mr. Gaut has had a long and honourable connexion with the county as its chief agricultural adviser, and

he has had the energy and enterprise to record his unique knowledge of its agriculture past and present.

Records of varying degrees of completeness go back to very early times, and Mr. Gaut begins with the Celtic settlements, of which, however, very little can be said. His method here is to fit the local information into a more general framework, thus giving the book a wider interest than would be attached to a purely local history. From Norman times onwards much more material is available; Domesday Book, the Inquisitions, church records and other sources are all utilized. In the thirteenth and fourteenth centuries sheep seem to have been the mainstay of the agriculture: a wether in good condition weighed about 40 lb. and yielded about 1-1½ lb. of wool, worth about 3d. per lb. Several diseases were troublesome; 'rot' was prevalent in wet seasons and there was much scab, for which iron sulphate, verdigris and mercurial ointments were used until the fourteenth century, when tar became the universal medication for skin diseases. Sheep seem to have been worth about the same as wild rabbits. The carcase weight of the cattle was about 400 lb.; oxen were worth about 11s. each. Early horticultural records are scanty; but the county appears always to have produced good vegetables and fruit, including vines. Specialization had not yet begun, however, and Leland, who visited the Vale of Evesham in the years about 1540, was impressed not by its fruit and vegetables but by the quality of the corn grown there. Even then, however, the orchards of the county were notable, for they are praised in a Latin distich of Henry VII's time (1485-1509), which we should like to have seen quoted.

From the seventeenth century onwards the references to fruit and vegetables become more numerous: they may have gained in importance as the forests were cleared to provide wood for the making of charcoal for the smelting of iron. There are early eighteenth-century complaints that hops and potatoes were "destructive to land because they breed no manure: they take from it, but give nothing back to earth". Leases imposed a penalty of £5 per acre for breaking up grassland to grow hops or corn without permission. There is a curiously modern ring about the further complaint that hops are bad for the farm because they receive all the manure, nothing being left for other crops.

By the second half of the eighteenth century the special character of Worcestershire agriculture was already established. In 1782 the Vale of Evesham was described as "the Eden of England in respect to gardening". In some years, the account continues, one hundred thousand bushels of cucumbers were sent to the different neighbouring counties; asparagus went to Bath and Bristol; early potatoes, kidney beans, lettuce, broccoli, cauliflower, endive and other vegetables were produced in quantity.

Marked progress in horticulture set in after the formation of the Royal Horticultural Society in 1804; this stimulated the formation of local societies, which by their shows and premiums greatly encouraged the introduction of better methods and the selection of improved varieties of crops. Accounts are given of the activities of some of these early societies and of the gardeners and nurserymen of the county to whom so much of its subsequent progress is due.

But all Worcestershire is not market gardening, and the heavy-land farmers passed through a very difficult period in the latter part of the nineteenth

century: by 1877 thousands of acres were tenantless. Wheat had been the chief crop, and to maintain soil fertility the farms had been well stocked with sheep and cattle. The ancient practice of burning the stubble still survived and was considered highly beneficial. Fortunately not all farmers suffered so badly: Benjamin Bomford, described by Mr. Gaut as the greatest arable farmer Worcestershire has ever produced, learned to use big farm machinery and added farm to farm until at his death in 1880 he was farming some six thousand acres. It is said that on one occasion he brought together and set to work for his guests £9,000 worth of steam tackle which in a few hours ploughed an area equal to that of a good-sized farm. Happily, his descendants have continued to develop farm mechanization and to maintain the family tradition of efficiency and hospitality: it is not long since the writer attended with special pleasure a demonstration of modern implements and methods on one of their farms.

The Worcestershire County Council was set up in 1888 and soon began to arrange for agricultural education. In 1891 it made grants for the establishment of a County Dairy School and for the work of the Chamber of Agriculture and the Union of Workmen's Clubs; but the procedure was soon changed and the County Council itself undertook to provide instruction.

The County narrowly missed having one of the early schools of agriculture for farmers' sons. In 1898, Mr. John Corbett of Impney Hall offered to devote £50,000 for foundation and maintenance; but various legal difficulties arose and a special Act of Parliament was being drafted when the outbreak of the South African War put an end to the negotiations. Meanwhile, other provision was being arranged by the Board of Education. Later on, in 1925, the Avoncroft Residential College for Rural Workers was opened at Offenham and ten years later transferred to Stoke Heath. An experimental garden was established at Droitwich, but will now be transferred to Norton Hall, Worcester.

As in other counties, the population of the purely agricultural parishes has declined: in the cases quoted the fall from the peak in 1871 to what one hopes will prove to have been the minimum in 1931 was about 30 per cent; on the other hand the populations of the market-gardening parishes have gone up: some have more than doubled.

The book is full of interest and can be strongly recommended to all who are concerned with country life, agriculture or horticulture. In a future edition it would be well to insert some maps: these would heighten the value of the book and would considerably elucidate the text.

In other counties also there are men who have long served their farmers and growers and who have very full knowledge of the county agriculture. It is greatly to be hoped that they will follow Mr. Gaut's excellent example and record the information while the men who passed through the revolutionary changes of the past forty years still survive to give those details without which agricultural statistics are very lifeless. The success of the reconstruction after the War will depend on the amount of sound knowledge that can be put into it, and if each county could have as full and illuminating a record as this which Mr. Gaut has prepared, we could indeed feel that the basal facts were available to all charged with the duty of carrying out what is bound to be a difficult task.

E. J. RUSSELL.

## LIMITS OF EXTRA-SENSORY PERCEPTION

### Paranormal Cognition

Its Place in Human Psychology. By Dr. Laurence J. Bendit. Pp. 79. (London: Faber and Faber, Ltd., 1944.) 5s. net.

THIS short essay contains the substance of a thesis recently submitted to the Department of Medicine of the University of Cambridge, and approved for the degree of doctor of medicine. Although it contains little from the medical point of view and would seem more suitable as a thesis submitted to some psychological faculty, the book is of interest as it directs attention to a question which is bound to excite greater attention as time goes on.

For the purpose of his work, Dr. Bendit takes it for granted that what he calls "psychic" modes of perception exist apart altogether from the ordinary channels of sense. Indeed, he maintains that "science to-day accepts as fact that man has channels for obtaining knowledge of the world about him which are not those of the ordinary senses". Although he does not say what he means by "science" in this connexion, it is clear that the statement does not apply to scientific men taken as a body, although the opinions of the chemist on questions of parapsychology are no more valuable than those of the parapsychologist on chemistry unless both parties have studied each other's interests.

In the present volume Dr. Bendit assumes that what he calls paranormal cognition is a fact, and under this name he includes a number of forms of perception which do not fall within the range of abnormal hyperacuity of the senses but beyond them into a region where normal perception, however acute, no longer operates. Thus the 'paranormal cognition' of Dr. Bendit includes what the American school calls 'extra-sensory perception', although he seems to extend the scope somewhat to include other phenomena the precise nature of which is still a subject of controversy.

In the course of his discussion the author mentions the possible emergence of such material in the statements and dreams of patients undergoing psychological treatment; and he appears to think that the reports of psycho-analysts who state that they have found such instances among their patients constitute "an important class of literature" in this connexion. This brings us to the most important part of Dr. Bendit's thesis, in which the author seems to have fallen (or appears about to fall) into what might be grave sources of error of a type which have vitiated so much serious work in the past. Having become convinced that paranormal cognition is a fact, he goes on to assume that it can be suspected in cases contributed by persons, some of whom he names, whose work can only be regarded with much scepticism as to its reliability. Indeed, Dr. Bendit is so anxious to suggest that such cognition is widely distributed that he uses the work of E. N. Marais on termites as an example, although few entomologists would regard the theory of this author as proved, and indeed it has been characterized by one critic as "a poetical invention which gets us nowhere". It is the growth of this tendency to see something 'psychic' in phenomena hitherto not fully described or adequately studied that so many psychical researchers feared might be the result of an

acceptance of some form of paranormal cognition on the basis of properly controlled and statistically analysed experimental data. One of Dr. Bendit's own collaborators in his thesis, to whose "specialized knowledge and experience of psychic matters" he owes a good deal, has published some of the results of using her alleged power of paranormal cognition, and it appears that she accepts many of the so-called physical phenomena of mediumship, including such almost wholly discredited manifestations as apports and slate-writing, and even claiming through her paranormal 'vision' to see the so-called ectoplasmic rods used in levitating tables! How far Dr. Bendit is right in believing that these remarkable results are justified is for himself to judge. Others may be tempted to accept paranormal cognition just as far as the results of scientific experiment may compel them to do so, leaving the vast inchoate mass of borderland psychological phenomena to be included or rejected as our knowledge increases and as the range of our experiments becomes extended.

E. J. DINGWALL.

## A RUSSIAN TRIBUTE TO NEWTON

Isaac Newton, 1643—1943

(In Russian.) Pp. 82+4 plates. (Kazan: Kazan Aviation Institute, 1943.) 10 roubles.

THIS booklet contains four addresses read at the celebration of Newton's tercentenary on April 9, 1943, in the Institute of Aviation in Kazan. The plain fact of such a celebration when a vital part of the U.S.S.R. was still under the German yoke is noteworthy, especially when it is realized that the man thus honoured was, after all, for Russians, a foreigner. In the general introduction and also in two of the addresses the same comment recurs—the U.S.S.R. celebrates Newton's memory amidst all her war-time occupations and worries, since she is fighting for "freedom of scientific, artistic, and philosophical creation".

In the first address, Prof. M. M. Kusakov reviews Newton's life and work, including his theological publications. Kusakov considers Newton to be the founder of the prevalent philosophy of the men of science of eighteenth and nineteenth centuries, which "represents a combination of primitive mechanical materialism with deism".

The fourth paper, by L. F. Rakusheva, deals specially with Newton's philosophy. Apparently, Newton did not bother to formulate his philosophy, if he had any; and the clarity and precision of his physical and mathematical passages contrast with his timid and contradictory pronouncements on philosophical problems. But Newton's scientific discoveries had a decisive effect on later philosophers. Quotations from Marx, Engels and Lenin show the relation between Newton's point of view and that of the dialectical materialism.

P. M. Dulski spoke on Newton's iconography. Unfortunately, the material expected from the Royal Society did not arrive, and the lecturer had to use only well-known published sources.

B. Stolbov gives an interesting account of Newton's optical work. He states that, contrary to the usual belief, Newton was just as much inclined to the wave theory as to the corpuscular theory of light.

J. J. BIKERMAN.

**Illustrated Technical Dictionary**

Containing Standard Technical Definitions of Current Terms in the Applied Sciences, Graphic and Industrial Arts, and Mechanical Trades; including Air Navigation, Meteorology, Shipbuilding, Synthetics and Plastics; with Illustrations, Technical Data and Interconversion Tables. Edited by Maxim Newmark. Pp. xii+352. (New York: Philosophical Library, Inc., 1944.) 5 dollars.

**T**ECHNICAL dictionaries are multiplying rapidly to meet the growing needs of a progressive civilization, and the Philosophical Library, New York, is placing itself in the vanguard of publishers who respond to this demand. Its new illustrated technical dictionary will be welcomed by scientific and technical workers of almost every kind; the book should find a home in most general libraries. The explanatory sub-title gives a good idea of its scope, with the emphasis on the mechanical arts, and the illustrations, which have been supplied mainly by engineering firms of standing, will be found very useful. The multiplicity of subjects and the necessarily limited space will doubtless invite some adverse criticism concerning lack of balance; but what may be important to the engineer or 'wireless' expert may be of little interest to the chemist, and vice versa. A primary consideration is that first things should be placed first, and in this respect there is little to cavil at in the present work; only a few slips and omissions have been noticed. The definition given of permeability refers only to gaseous diffusion: electric and magnetic permeability are not mentioned. The Baumé hydrometer is defined as a *scale* for measuring the density of a liquid. The chief use of ammonium sulphate, namely, as a fertilizer, is not given, nor is the use of urea in the manufacture of plastics. The uses of so many chemical products for so many purposes suggest that there is scope for a separate publication on this subject. It would be compendious and need constant revision, but it would be a boon to many manufacturers and industrialists; and it would form a useful companion volume to the present work of reference. E. H. T.

**Joint Progress Report on Reservoir Efficiency and Well Spacing**

By the Committees on Reservoir Development and Operation of the Standard Oil Company (New Jersey) Affiliated Companies and of the Humble Oil and Refining Company. Pp. xix+77. (New York: Standard Oil Development Co.; London: Anglo-American Oil Co., Ltd., 1944.)

**T**HIS report embodies the findings of two committees appointed respectively by the Standard Oil Co. (New Jersey) Affiliated Companies and the Humble Oil and Refining Co. to collate and interpret data on the effects of field operating practices and well spacing on the efficiency of oil recovery from natural underground resources. Each of the committees carried out pool studies of actual fields to obtain information on reservoir behaviour and oil recovery under various well-spacing and operating practices, in addition to a review of all available theory and research data.

It is concluded that the degree to which basic oil recovery mechanisms (dissolved gas drive, gas cap drive and water drive) will operate in practice, and possible oil yields obtainable, together with optimum economic well-spacing for a particular field, are

dependent on physical conditions in the reservoir and on the limiting effect of economics or other imposed restrictions. Probably the most important physical factors governing potential recovery are sand permeability and oil viscosity, high permeability and low viscosity being nearly always conducive to high yield. Economic conditions determine the point at which operations must be abandoned for reasons of cost, and equally they govern decisions on optimum well spacing. As a result of their studies the committees advocate that the securing and recording of requisite data should be a major objective in field development and operation. Records required from each individual reservoir include data on structure and sand-thicknesses, complete analyses of sub-surface samples of reservoir fluids, sub-surface pressure survey readings, productivity factors, and gas, oil and water production figures.

**Introductory Magnetism and Electricity**

By T. M. Yarwood. Pp. vii+159. (London: Macmillan and Co., Ltd., 1944.) 2s. 6d.

**I**N writing this small volume, the author has provided mainly for those preparing to enter one of the technical branches of the Services. It should be very suitable for cadets in the Air Training Corps. The subject-matter admirably covers all that is necessary in pre-service training. In this, it fulfils one of the two objects stated in the preface. It might not be, however, so successful in achieving the other, which is to stimulate further reading in the subject. It is too condensed and 'heavy-going' to be inspiring to the beginner.

It is surprising that alternating current is not dealt with at greater length. One would have expected to find a whole chapter on this topic.

The book is well arranged and well printed, with many diagrams. Its chief defect is the limp cloth binding. It is to be regretted that war-time economy does not permit a more attractive and permanent binding.

At its published price the book should have a good circulation and is, without doubt, an excellent, though brief, text, superior to many others at much higher prices.

**Manual of Laboratory Glass-Blowing**

By Prof. R. H. Wright. Pp. ix+90+11 plates. (Brooklyn, N.Y.: Chemical Publishing Co., Inc., 1943.) 2.50 dollars.

**I**N this manual the author describes a number of processes which are constantly needed for the construction of laboratory glass apparatus. After discussing the composition and the characteristics of various glasses, a description is given of tools and their usage in the construction of both simple and advanced types of glass apparatus.

In dealing with such a subject no written directions can take the place of personal instruction or individual skill, so that the value of such a manual is enhanced if the diagrams show salient features of the process in progress. The author has attempted to do this by means of original photographs.

The book contains much useful information, and will be of service to the laboratory worker. Its usefulness would have been further increased, at least for the beginner, if more details had been given as to the most suitable gas or oxy-gas flame to use for various types of work. A. J. A.

## TRANSFORMATION OF CELLS AND VIRUSES

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RECENT papers by Rhoades<sup>1</sup> and by Sonneborn<sup>2</sup>, the first describing a new case of genic induction of a transmissible cytoplasmic difference (the earliest example of which is due to Imai<sup>3</sup>), and the second concerning a novel system of relations between the nucleus and cytoplasmic substances in heredity, are of considerable potential significance for the study of differentiation and growth, both normal and abnormal. Nowhere is this greater than in the field of cancer, where the prospect they afford of a clearer understanding of cytoplasmic inheritance must elucidate some at least of the fundamental problems involved. What these problems are, may briefly be considered.

### Genetic Relationship of Normal Cells and Cancer Cells

In the entire biology of cellular variation, the transformation of normal somatic cells to cancer cells may properly be regarded as a special case, although not necessarily a unique one<sup>4</sup>. The alteration involves some loss of differentiation, and a nearly concomitant gain in rate of growth, the extent of which is a characteristic and permanent property of individual tumours. In ordinary conditions the change is not reversible, so that the malignant variant continues to grow, whether in the original host or on grafting to new hosts, indefinitely, without restriction, and hence with every sign of marked competitive advantage as compared with the normal form. The new cell type can be evoked at will by the use of a wide variety of physical and chemical agents (notably by X- and ultra-violet radiation, by radium and other radio-active elements, and by the carcinogenic hydrocarbons and other compounds both related and unrelated), and we now possess a considerable knowledge of their possible modes of action, of the changes they effect in the cell economy, and of the ways in which the metabolic properties of the malignant cells, in certain cases, may differ from those of their normal precursors.

Much less is known of the precise genetic relationship between the two forms. While many observers have been impressed, justifiably, by evidence which suggested the modification or loss of growth-regulating genes as a primary factor<sup>5</sup>, these impressions are such as it is impossible to prove by ordinary genetical methods, that is, in the absence of sexual reproduction as a test. As Haldane expressed the position<sup>6</sup>, "cancer cells do not reproduce sexually, and it is only by sexual reproduction that the geneticist can distinguish nuclear changes from plasmatic changes or virus infections".

Short of any decision, much other information, albeit of a secondary or collateral kind, or incomplete, has been derived from the study of genetic constitution as determining rates of susceptibility (whether to the spontaneous development of specific types of cancer, or to the action of carcinogenic substances), and secondly, by the production of tumours through hybridization. Thus spontaneous tumours occurring in the  $F_1$  hybrids between *Nicotiana glauca* and *N. langsdorffii* have been ascribed to a cytoplasmic dis-

turbance brought about by the introduction of chromosomes of *langsdorffii* into the cytoplasm of *glauca*<sup>7</sup>; and cross-breeding of *Mus musculus* and *M. bairdianus*, which differ widely from each other in size, fertility, and rate of growth, leads to a considerably augmented incidence of epithelial and connective tissue tumours in the first generation hybrids<sup>8</sup>.

Although the nature of his material does not always allow the application of genetical methods, the student of cancer is nevertheless dependent on contemporary genetics to assist him in deciding which at least are the feasible mechanisms in the origin of tumours. To the present time, questions of detail have been wholly obscure, and it has always seemed likely that their solution must ultimately depend upon advances in cytogenetics as a whole. Furthermore, certain accepted characteristics of tumour cells have appeared, until comparatively recently, inexplicable and perplexing by ordinary tenets. This specially applies to the recognized irregularity of the chromosome equipment in cancer cells: while in given tumours no nuclear abnormality may be discernible, other cases present every appearance of extreme heterogeneity. In contrast with this is the fidelity and specificity with which the structural and physiological features of individual tumours are maintained, often through hundreds of transplanted generations, and apparently indefinitely. The matter has been summarized by Mohr<sup>9</sup>: "This pronounced uniformity of tumour tissue as regards phenotypical characteristics is just the opposite of what we would expect from the exceedingly variable chromosome relations of the tumour cells".

### Cytoplasm and Growth

Considerations of this kind have led some few workers<sup>10</sup> to the belief that malignancy is attributable to a cytoplasmic alteration, and Koller<sup>11</sup> carried out an analysis of aberrant chromosome and spindle mechanism in malignant cells in an endeavour to correlate this with the behaviour of the nucleolus, which appears to hold a key position in the interrelations of nucleus and cytoplasm<sup>12</sup>. These anomalies have also stimulated an interest in evidence from other fields, that the more general and fundamental activities of the cell can take place even in the absence of the chromosome apparatus (if only for a time), and are governed to some extent by elements present in the maternal cytoplasm. For example, evidence has been sought<sup>13,14,15</sup> whether cleavage-rate in echinoderms is a function of the cytoplasm or of the nucleus. In hybridization and other experiments (with *Dendroaster* and *Strongylocentrotus*) the speed of fission, in every case, was that characteristic of the cytoplasm. Secondly, E. B. Harvey's studies<sup>16</sup> of the growth of enucleated egg fragments (for several echinoderm species and in the annelid *Chaetopterus*) in parthenogenetic merogony, that is, where maternal and paternal chromatin are entirely lacking, appeared to modify, or even to minimize, the role of the chromosomes and genes in early development.

Since in nearly all species the properties of the cytoplasm are controlled by the chromosomes, and because cytoplasmic factors which can be perpetuated in the absence of the appropriate chromosomes have been recognized only in exceptional cases<sup>17</sup> and almost entirely in plants, the problem takes the form whether the capacity of the cytoplasm to determine growth is due to a chromosomal effect persisting after removal of the nucleus, or whether it is innate and independent.



### Cytoplasmic Transmission of Breast Cancer in Mice

Cognate questions arise from the so-called 'extra-chromosomal' transmission of breast cancer in mice. Since mammary cancers were found to arise with special frequencies in certain strains, attention was directed at an early stage to the presumptive importance of genetic constitution, as a factor determining the origin of such growths. The tumour-rate in hybrid strains was studied by Lathrop and Loeb<sup>18</sup> as long ago as 1918, when they wrote: "... the fact . . . that several times (but not in all cases), in reciprocal crosses, the hybrids followed the tumour rate of the mother strain, suggests the possibility that as far as the hereditary transmission of mammary cancer in mice is concerned, the mother may be more important than the father. . . ." Much later, the role of the female sex hormone was disclosed, from records of the varying incidence of cancer in virgin, breeding and ovariectomized females, by ovarian transplantation in castrate males, and by artificial administration of oestrogens to both males and females.

Further progress followed the establishment of homozygous strains, when the importance of the maternal factor was clearly established by reciprocal crosses<sup>19</sup>. Bittner then discovered<sup>20</sup> that the cytoplasmic factor is conveyed by the mother's milk, and that when young from mothers of a high-incidence line are suckled by mothers from low-incidence lines, the frequency of breast cancer in the fostered females is very considerably reduced. It is now known that the agent is present in tumour tissue, the lactating mamma, and many of the organs of high-incidence lines, and that it retains its potency in lyophilized, desiccated or glycerolated tissue, and in Seitz filtrates. Although its exact nature is not certain, it is probably a colloid of high molecular weight<sup>21</sup>, with properties suggesting virus activity, and may seemingly arise *de novo* apart from contact<sup>22</sup>.

According to W. S. Murray<sup>23</sup>, the degree of mammary cancer which appears in any generation is dependent partly upon the concentration or amount of the extra-chromosomal factor which the mother transmits, and partly upon the resistance or receptiveness of animals of various genetic constitutions to this stimulus. There still remain considerable differences of opinion regarding the relative importance to be attached to the three components (cytoplasmic, nuclear, and hormonal), whether separately or in interaction. van Gulik and Korteweg<sup>24</sup> apparently believe that the cytoplasmic factor becomes inactive after a number of generations when a chromosomal factor is not present at the same time. But from Bittner's most recent statement<sup>25</sup> hormonal stimulation, inherited susceptibility (which was transmitted by males and females of cancerous stock as a dominant), and the milk agent, are of approximately equal etiological importance in mice of known constitution under normal conditions: "that is, any one of the three factors or influences may be completely determining in its effects".

### Filterable Agents of Avian Tumours

A final problem concerns the induction of malignant change in normal connective tissue cells (more strictly the free histiocytes) in birds, by means of a sub-microscopic and particulate agent extractable from the cells of tumours of the avian mesenchyme, of which the virus of the Rous chicken sarcoma I is the

best known example. Tumours arising after inoculation of this and similar agents are derived from the prototype cells of the recipient host. They invariably conform in the minutest detail with the growth from which the agent was obtained, and they usually continue in their turn to produce further large amounts of the specific virus. In serological experiments<sup>26</sup> the purified Rous agent is neutralized by the serum of rabbits immunized with normal fowl serum or with normal fowl tissues, and stronger neutralization is obtained with the sera of rabbits immunized with large quantities of the purified agent itself. Further, both anti-fowl and anti-agent sera are deprived of neutralizing activity by absorption with normal chick embryo. The Rous I agent therefore appears to contain (in addition to a specific antigen) a second antigen which is also present in normal fowl tissue—a relationship which is possibly unparalleled in the whole range of animal viruses. The discovery of the Rous agent was made more than thirty years ago, and it represents one of the key observations of cancer research: yet here again it is likely that full comprehension can only be achieved through fundamental advance in other fields, such as is promised by the newer trends referred to, and the implications of which may be examined.

### Cytoplasmic Determinants and their Gene-controlled Mutation

Possibly the earliest relevant observation was made by Imai<sup>3</sup> when he described random and irreversible mutation of a proportion of green plastids (giving green cells) to white plastids (giving white cells) in the recessive 'variegated' homozygote of barley. These plastids showed maternal transmission, and the white plastids proved autonomous and independent of nuclear control or activity, since they did not return to the green condition even under the influence of the 'green' nucleus.

Rhoades's contribution<sup>1</sup> concerns the gene-controlled character *iojap* in maize. Plants homozygous for the recessive gene (*ij*) develop a chlorophyll striping or variegation, interpreted as due to induction, by the gene, of modification in the plastid. Evidence is given, as for Imai's case, that the modification is irreversible, that the variant plastid possesses genetic continuity, and that this is therefore independent of nuclear control: the mutant plastid continues to give rise to mutant plastids, in cells of whatever nuclear constitution (*ij ij*, *Ij ij*, *Ij Ij*). These relations are suggestive—and Rhoades clearly recognizes their bearing—of a mechanism whereby the expression of growth, the rate of growth, and the closely associated property of degree of differentiation, might be governed by a system of independent entities in the cytoplasm.

A more complex arrangement is revealed in Sonneborn's study of the heritable characters 'killer' and 'sensitive' in diverse races of *Paramecium aurelia*. Fluid in which the killer race has lived, kills individuals of the sensitive races, and when pure races of the two types were crossed, the two exconjugants of each pair were found to produce phenotypically different clones. It was then demonstrated that the  $F_1$  killer clones derive their cytoplasm from the killer parent, and that the  $F_1$  sensitive clones are those with cytoplasm from the sensitive parent. By means of technically favourable material, the phenomenon was shown to be not cytoplasmic inheritance simply, but the continued production of a cytoplasmic sub-

stance under the influence of the single gene *K*. *Addition of the cytoplasmic determinant to an organism, lacking the character dependent on it, but containing the required gene, results in the continued production of the cytoplasmic substance, in the development of the character determined by the combined presence of gene and cytoplasmic substance, and in the hereditary maintenance of the character in successive generations.*

The potential significance of these relations, both for the cytoplasmic transmission of mammary cancer and the propagation by virus of the Rous sarcoma, is sufficiently striking. They also exemplify the characteristics of cytoplasmic inheritance described by Darlington<sup>27</sup>: "... not only co-adaptation of the types of nuclear gene and plasmagene but also some degree of genotypic control in regard to the conditions of reproduction and equilibrium of the plasmagene".

#### Nature of the Cytoplasmic Entities: Plastogenes, Plasmagenes and Viruses

Apart from the visible plastids responsible for cytoplasmic inheritance in plants, the nature of the cytoplasmic entities remains a matter of conjecture. It is therefore reasonable to inquire what light may be thrown on cytoplasmic determiners by recent investigations of the morphological and chemical structure of protoplasm, and especially of the sub-microscopic particles (microsomes) of Claude<sup>28</sup>. These range in size from 0.06 to 0.2  $\mu$ , and allowing for certain quantitative differences, present many similarities to the mitochondria, and appear to serve as centres for enzyme localization, both, for example, being capable of oxidizing succinic acid and giving a reaction for cytochrome oxidase<sup>29</sup>. Chemically, the microsomes have been found to be complex structures composed of ribose nucleoproteins and phospholipids, associated in definite proportions. By differential centrifugation, Claude isolated the active fraction from chicken tumour extracts in a form resembling fractions obtained from normal chick embryo by the same method; and he further finds that an important and possibly essential constituent of the tumour-producing particles, as of the normal microsomes, may be a nucleic acid of ribose type. The size of the Rous agent has now been determined by electron microscopy (0.07–0.1  $\mu$ ), as well as in the ultracentrifuge (0.07  $\mu$ )<sup>30</sup>. In shape the particles are short ellipsoids, and fairly homogeneous from electrophoretic behaviour.

With the suggestion of an intrinsic origin for the avian tumour viruses may be related the view that many of the plant viruses are autocatalytic proteins of ultimate host-cell origin; and both possibilities should be compared with those different but partly relevant hypotheses which envisage many viruses arising by a process of retrograde evolution, that is, by a progressive loss of enzyme systems and synthetic functions and an increasing degree of dependence upon the cellular host<sup>31,32</sup>. Woods and DuBuy<sup>33</sup> have recently brought evidence that the characteristics of plastid-controlled variegations are intermediate between those of normal plants and virus-diseased plants, and have endeavoured to connect virus proteins phylogenetically over the variegation-inducing agents (abnormal plastids) with proteins of the normal plastids. They also attempted graft transmission of plastid-controlled variegation, which would afford direct proof of the ability of abnormal plastids to infect, and invade, previously normal cells. Although these experiments were mainly negative, such graft invasion has already been established as the cause of

variegation in a number of plant species, and there is little reason to doubt that variegation-inducing plastids frequently behave like viruses, just as the plant viruses have properties often shown by plasmagenes in interspecific crosses<sup>27</sup>. In particular, it is likely that the changes evoked by many viruses are due to their competing for substrate with physiological elements of the cell, and thus diverting the normal metabolism. From Darlington's interpretation of Sonneborn's data<sup>41</sup>, the 'sensitive' plasmagene in *Paramecium*, which is determined by the action of a nuclear gene, is suppressed by the competitive reproduction of another plasmagene. So too the variegation-inducing plastids can multiply in previously normal cells, and may restrict the development of normal plastids in those cells. The manner in which the influence of plant viruses can be likened to that of agents already present had already been noted by Stanley<sup>34</sup>.

#### Induction of Heritable Change in Bacteria and Viruses

Sonneborn compared the system of determination and inheritance in *Paramecium* with the environmental control of genetic characters in bacteria, especially with the inter-conversion of specific types of *Pneumococcus*. This phenomenon was first described by Griffith<sup>35</sup>, and it depends upon the degradation of a given specific, virulent, 'smooth' type (*S*), possessing the characteristic capsule with its specific polysaccharide antigens, into a non-specific, avirulent, 'rough' variant (*R*), lacking these features but convertible into the same or another specific and differentiated type (*S*) by growth in the presence of heat-killed *S* cells of the type to which conversion is desired. The transformation was afterwards induced by means of sterile extracts of *S* cells<sup>36</sup>, and represents one of the most striking examples of the artificial induction of heritable change. The agent required for conversion was recognized to be not the specific polysaccharide itself, but some other component of the *S*-type cell, and Avery and his co-workers<sup>37</sup> have now isolated from type III pneumococci a desoxyribonucleic acid fraction which is capable of transforming unencapsulated *R* variants (derived from type II pneumococci) into fully encapsulated type III cells: the inducing substance appears to be a highly polymerized form of sodium desoxyribonucleate. It is a striking fact that the substance evoking the reaction, and the type-specific capsular substance produced in response to it, are chemically distinct. Once transformation has occurred, the newly acquired characteristics are thereafter transmitted without any further addition of the transforming agent; and from the transformed cells themselves a substance of identical activity can be recovered in amounts far in excess of that originally added, or needed, to induce the change. Assuming the transforming activity to be an inherent property of the nucleic acid, its biological specificity remains to be explained on a chemical basis. Little is known of the effects which slight differences in molecular configuration may exert on the biological action of this class of compound, although the constituent units and general structure of the nucleic acid molecule have been defined: this in itself must represent an entirely new and highly promising field.

A similar principle probably obtains for certain virus transformations. Berry<sup>38</sup>, applying the methods discovered by Griffith, succeeded in changing the virus of rabbit fibromatosis (Shope)—in which the

lesions consist of masses of spindle-shaped cells which may recall the structure of malignant connective tissue tumours—into that of infectious myxomatosis (Sanarelli), a highly contagious disease in which tumour-like formations appear in the sub-epidermal tissues, and in which the type cell is not spindle-shaped but stellate or polygonal. In this case, however, the reaction is initiated only with difficulty, and a large excess of the transforming factors is required. A serological connexion between the fibroma and myxoma agents had already been noted, and it would seem that the immunological configuration of the killed myxoma virus particle remains sufficiently intact to provide a template for the formation of active myxoma virus, in the presence of a developing fibroma lesion. This specific mutability is a property of a considerable number of strains of fibroma virus, and the capacity of various myxoma strains to serve as transforming agents also seems to be both general and stable. The factor which induces the alteration of fibroma to myxoma virus is an integral part of the so-called elementary bodies of the latter, and Berry records a number of facts suggesting that the essential substance is the myxoma virus nucleoprotein. The transformation itself has emphasized the close relationships in a single group of viruses, which has been called the fibroma-myxoma 'spectrum', and which is capable of exciting the most widely diverse pathological effects.

#### Reversibility of Cellular Changes

By a few workers (for example, Dobzhansky<sup>39</sup>), pneumococcal transformation has been interpreted on genetic lines, the inducing substance (only later recognized as probably a desoxyribonucleate) being likened to a gene, and the capsular antigen which is produced in response to it being regarded as a gene product. The subject has also been of considerable interest to those engaged in the investigation of cancer, and Murphy<sup>40</sup> compared it with the virus propagation of fowl tumours, and coined the term 'transmissible mutagen' to describe the Rous and similar agents. This analogy with a mutation-producing gene is, however, only valid in a general sense, and proves less accurate in points of detail. Thus most observers have been impressed not by any resemblance of  $R \rightarrow S$  transformation of pneumococci and the conversion of normal cells into malignant cells, but by the affinities of the latter process with irreversible  $S \rightarrow R$  changes in bacteria. Hence, if the Rous virus corresponds with a cytoplasmic determiner, the factor inducing pneumococcal transformation conforms rather with the gene, and it converts a less differentiated cell into a highly type-specific form.

Other points of contrast arise from the differing reversibility of the two changes. Although the susceptible normal cell can easily be rendered malignant on infection with the chicken tumour virus, the tumour cell then continues to breed true, and cannot be re-converted to the normal. For certain instances of bacterial variation the  $R$  and  $S$  forms are mutually convertible, as we have seen; but in the majority, the  $S \rightarrow R$  change is induced with greater facility than the reverse, and in many cases the  $R$  type is highly stable, or even permanently so. Sonneborn provides some insight into such relationships from a consideration of the relative mutation-rates, killer  $\rightarrow$  sensitive, and sensitive  $\rightarrow$  killer, in *Paramecium*. Mutations from killer to sensitive are expected more frequently than in the reverse direc-

tion, since they will occur either if the cytoplasmic factor is lost, or if the gene mutates to a form that cannot control production of the cytoplasmic factor. Contrariwise, mutation from sensitive to killer, in those cases in which the sensitive gene is present, requires both mutation of the gene and *de novo* origination of the cytoplasmic factor. Therefore, mutation in the former direction involves either of two events, while mutation in the latter direction necessitates two events in a given order.

#### Implications for Growth and Infection

For the larger questions of genetics and heredity, Darlington<sup>41</sup> has shown the significance, and the stages in its discovery, of a positive influence of the cytoplasm which is based upon unattached determinants, vested in a molecular system depending for its permanence upon a chemical rather than a morphological equilibrium, and which shows a limited capacity for independence of the mechanically stable nucleus. As he makes clear, knowledge of the plastid and cytoplasmic systems was necessarily delayed, and is only now unfolding, since it could only be interpreted in terms of a prior understanding of the nuclear system. The new conceptions are equally certain to produce their impact upon almost every other department of thought in biology, not least in the special problems of the nature of viruses, and of growth and differentiation—problems which have indeed awaited just such an advance, for their proper development.

So far as infection is concerned, it may be recalled that the progress of bacteriology itself involved a not inconsiderable readjustment of ideas. But its spectacular rise as an applied science induced in turn a prevalent unwillingness to regard any agents with biological activity of the nature of infection (and particularly the filterable viruses) as other than entirely specific and independent living organisms. In course of time there gradually accumulated a body of facts, concerned, it is true, with only a few classes of these filterable entities, such as the plant viruses and the avian tumour agents, which nevertheless appeared inconsistent with this orthodox view. Little difference of opinion has ever centred on the validity of the facts themselves: the antithesis is one of theory, and not of observation. The comprehension of anomalous cases was therefore hindered by a too limited interpretation. It is in this sense that the newer development has significance, in facilitating understanding, and on a basis sufficiently wide to include data hitherto appearing incomprehensible, or even irreconcilable. Apart from any question of identity of nature, parallels had already been drawn between the *kinetics* of gene action and virus production<sup>42</sup>, and between the X-ray or ultra-violet inactivation curves of both viruses and genes<sup>43</sup>. But in certain cases similarity of behaviour becomes identity, and, for the Rous agent at least, no real distinction can be drawn between its typical activity and that of a mutant plastogene. Especially, this suggestion would account for the strict cytotropic specificity of fowl sarcoma agents, by which each transmits to the new host the characters of that particular tumour alone from which it was obtained.

#### Virus Etiology of Cancer in General

This broadened interpretation, valuable as it must prove to be, still affords no rationale of the curious distribution of non-cellular agents in the induction

and transmission of cancer. An agent of the Rous type may not be detected invariably, even in the Rous I tumour, its presence and absence being to some extent correlated with more rapid and less rapid growth of the cells, respectively. Other spontaneous connective tissue tumours of the fowl may completely fail to exhibit such an agent. Again, a comparable agent has not been found in any epithelial tumour, but only in those from avian mesoblast and the type cells of chicken leukaemia<sup>44</sup>. Finally, no such agent is present in malignant mammalian tumours, with the possible exception of leukaemia in mice. Attempts have been made to trace the source of this contrast between avian and mammalian tumours to some inherent cellular difference in the two classes. So far, the only distinction observed is a marked size-variation in avian chromosomes, the smallest particles in the metaphase plates being on the limit of resolution: this range was regarded by White<sup>45</sup> as characteristic of birds in general and quite unparalleled elsewhere.

Indications of infection in the natural history of cancer have rightly attracted considerable notice; but the great mass of fact shows them to be exceptional, and gives little hint of any such process as an indispensable feature of the induction of tumours. In particular, the zoological distribution of the disease—and the occurrence of somewhat analogous tumours in plants—is so wide as to lead us to suspect that the neoplastic change, by which the somatic cell, as it were, re-asserts its individuality, has in its nature something fundamental in biology, and is one to which almost every cell is liable in appropriate circumstances, quite apart from any process of infection in the bacteriological meaning, by independent and unrelated parasitic organisms. The entire evidence which might show that the avian tumour agents are independent parasites relies mainly on their unlimited capacity for multiplication in the presence of susceptible living cells either *in vivo* or *in vitro*, on the fact that cell-free filtrates of certain of the fowl tumours have been found to induce similar tumours in other avian species<sup>46</sup>, and on analogy with proliferative although non-malignant lesions, in man and animals, caused by acknowledged viruses in the older sense<sup>47</sup> (for example, the pox diseases epithelioma contagiosum and molluscum contagiosum, the filterable warts of man, dogs and cattle, and infectious papillomatosis of rabbits). The last comparisons are admittedly compelling, but the other criteria have proved less easy to maintain. The first (capacity for multiplication) can clearly no longer be accepted as necessarily attesting the living or extrinsic nature of the material undergoing increase.

Significance has also been attached to the transmission of the Fujinami fowl myxosarcoma to ducks and of the Rous I sarcoma and a fowl endothelioma by filtrate to pheasants, but it is pertinent<sup>48</sup> that transmission in both of these cases is still within the limits of blood relationship as judged by the precipitin reaction: moreover, propagation to the pheasant is within the limits not only of blood relationship but also of bastardization. (Apart from modern examples, it is of interest that Darwin made reference to *phasianus* × *gallus* hybrids in Chapter 9 of the "Origin of Species".) The successful transmission of a fowl tumour to pheasant or duck does not therefore make it less likely that the filterable agent is a cell-derivative on one hand, or more likely that it is an independent parasitic virus on the other.

The discovery of the plasmagene would have held a special interest for Boycott, who always found it difficult to escape the conclusion that the Rous agent arises intrinsically and *de novo*, and who said on a memorable occasion, "if one postulates a normal virus occurring in normal cells, one had better call it something other than a virus"<sup>49</sup>.

### Cytoplasm and Differentiation

Both Rhoades and Sonneborn are aware of the implication of their findings for differentiation, in explanation of the fact that while all the cells of an organism presumably have the same genetic constitution in the nucleus, they nevertheless exhibit wide morphological and physiological differences, which are not entirely due to differences in tissue environment: and the view is put forward<sup>1</sup> that cellular differentiation is determined by hypothetical particles in the cytoplasm. The production of different characters in cells with the same nuclear genes would thus be brought about by differential segregation of these cytoplasmic determiners at cell division<sup>2</sup> in a manner similar to that which governs the segregation of plastids. As has been emphasized, the question of differentiation is paramount in the study of cancer. The cells of a given tumour usually show some degree of structural and functional affinity to their normal parent cells: so a cancer of the breast may possess a glandular structure obviously related to the architecture of the normal organ, the cells of a cancer of the liver may retain a considerable degree of resemblance to normal liver cells, and tumours of secretory organs may continue to elaborate the characteristic product, whether hormone or enzyme, of their normal prototype. In general, however, the change from a normal to a malignant cell connotes some loss of special functions, and the tumours of a given lineage can be placed in a continuous series ranging from a near-perfect reproduction of the histology of the parent tissue to a condition in which no specific differentiation can be recognized whatever<sup>50</sup>. The extent of such departure is relatively stable for any given tumour, and the greater it is, the nearer (in many cases but by no means invariably) does the new cell tend to approach an embryonic type and the greater is its rate of growth.

These old and new facts, taken together, suggest a means whereby light may be shed on the central problem of the mode of action of carcinogenic agents other than virus-like influences; that is, the chemical carcinogens obtained by synthesis or from sources outside the body. In our approach to this problem one salient fact overshadows all others: that the growth of the tumour is not in any sense dependent upon the continued presence of the agent which provoked it. In other words, the chemical carcinogen produces a change in the habit of growth of the cell, but as the change is quite permanent, it persists indefinitely after the initial cause has disappeared or has been removed. It is patent that the carcinogen does not provide the real stimulus to growth, since growth proceeds without it. Hence the mechanism which permits unlimited growth must clearly reside in the cell itself. That it may reside partly at least in the cytoplasm, and conceivably in relation to the considerable quantities of ribose nucleic acids which the studies of Brachet, Caspersson and others have shown to be present there when rapid synthesis is taking place, is obviously a possibility for future investigation, both by cytological methods and by experiment.

The new discoveries have, therefore, the widest implications, and for specialized matters no less than for those of a more general nature. In many cases the relationships seem more than mere analogies, and strongly suggest an underlying unity of principle in the growth and differentiation of organisms of the most highly diverse kinds. They also testify to the particular value, notwithstanding its recognized limitations, of the study of variation in unicellular organisms, and sustain the belief, long held by Dobell and others, and now more widely shared, that more than one of the current conceptions in biology must undergo profound modification as a result.

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## RECENT DEVELOPMENTS IN POLAROGRAPHIC ANALYSIS

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ALTHOUGH almost twenty years have passed since the polarograph was devised by Prof. J. Heyrovský and his colleagues at the Charles University in Prague, it has only been during the last two years that use of the instrument has been widely accepted by industrial laboratories in Great Britain. Nevertheless, it is now generally agreed that the instrument is of unquestionable value, and the polarograph is taking its place in the equipment of the modern laboratory along with the spectrometer and photo-electric absorptiometer.

The fundamental principles of polarographic analysis were worked out in Prof. Heyrovský's laboratory and have since been confirmed in the United States. These principles are fully described in an excellent monograph by Kolthoff and Lingane<sup>1</sup> which surveys the literature of polarography up to the end of 1940. Since that date, many new applications have been developed, especially in the biological and organic fields, and it is these that I propose to survey.

Polarographic analysis depends essentially on the fact that when a gradually increasing potential is applied to an electrolyte solution in a special cell consisting of a dropping mercury electrode and a second non-polarizable electrode, it is possible to determine from the resulting current-voltage curve both the nature and the concentration of the reducible or oxidizable substance or substances present. It is these current-voltage curves that are recorded by the polarograph.

A typical polarogram obtained with an air-free solution of 0.001 *M* cadmium chloride in 0.1 *N* potassium chloride is shown in Fig. 1. Under standard conditions, the limiting or diffusion current (that is, the height of the step) is proportional to the concentration of the electroreducible substance. This serves as the basis of quantitative polarography. The half-wave potential, which, as its name implies, is the value of the potential of the dropping mercury electrode, standardized against an external reference electrode (usually the saturated calomel electrode), at that point on the current-voltage curve when the current is one-half its limiting value, is a special property of the particular electroreducible substance present and is independent of the concentration of

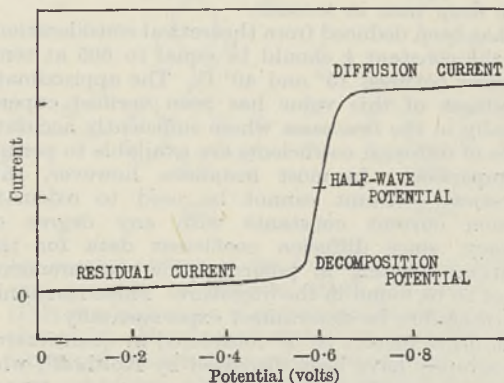


Fig. 1. CURRENT-VOLTAGE CURVE FOR SOLUTION OF 0.001 *M* CADMIUM CHLORIDE IN 0.1 *N* POTASSIUM CHLORIDE.

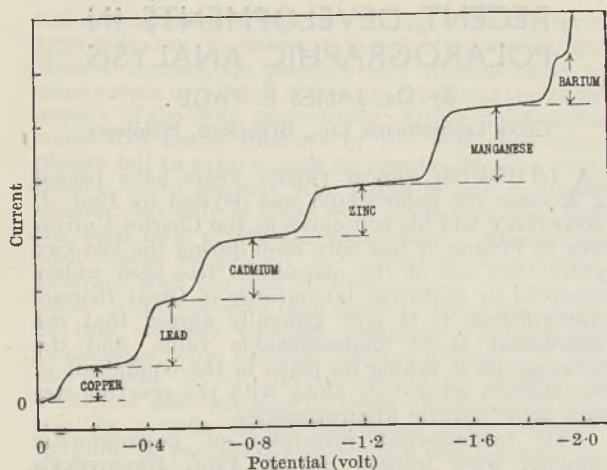


Fig. 2. CURRENT-VOLTAGE CURVE FOR SOLUTION CONTAINING COPPER, LEAD, CADMIUM, ZINC, MANGANESE AND BARIUM IN 0.1 N CALCIUM CHLORIDE.

the substance and of the characteristics of the electrode used. Qualitative polarography is based on this conception.

Theoretically, every substance can be analysed polarographically if it is electro-reducible or -oxidizable within the potential range of the electrode. The maximum range of the dropping mercury electrode is from +0.6 to -2.6 V. *v.* the saturated calomel electrode; but for most solutions it is much smaller. If there are several electro-active substances present in the solution, they can all be estimated, provided that their half-wave potentials are at least 0.2 V. apart. Fig. 2 shows a polarogram for a solution containing traces of copper, lead, cadmium, zinc, manganese and barium in 0.1 N calcium chloride. A further separation of steps can sometimes be achieved by altering the pH of the solution or by changing the reactants into complexes, from which they are deposited at potentials far enough apart for each step to be measured separately.

The diffusion current is governed by Ilkovič's equation,

$$i_d = knD^{1/2} Cm^{2/3} t^{1/6},$$

in which  $i_d$  is the diffusion current in microamperes,  $n$  is the number of faradays of electricity required per molar unit of the electrode reaction,  $D$  is the diffusion coefficient of the reducible or oxidizable substance in sq. cm. per second,  $C$  is its concentration in millimoles per litre,  $m$  is the weight of mercury in mgn. flowing out of the capillary per second, and  $t$  is the drop time in seconds.

It has been deduced from theoretical considerations that the constant  $k$  should be equal to 605 at temperatures between 15° and 40° C. The approximate correctness of this value has been verified experimentally in the few cases where sufficiently accurate values of diffusion coefficients are available to permit a comparison. In most instances, however, this theoretical constant cannot be used to calculate diffusion current constants with any degree of accuracy, since diffusion coefficient data for the conditions existing in polarographic measurements are not to be found in the literature. These constants must therefore be determined experimentally.

The other factors to be considered in quantitative polarography have been discussed by Kolthoff<sup>2</sup>, who has also directed attention to an anomalous 'water wave', which occurs in solutions containing a rela-

tively high concentration of a supporting electrolyte. This step usually starts at about -0.9 V. and reaches a maximum at -1.3 V.; but fortunately it can readily be eliminated by adding a trace of gelatin to the solution.

Several investigators have tried to develop schemes of polarographic analysis that would permit the systematic qualitative and quantitative analysis of any mixture of the common metallic elements, but before such a scheme can be developed it is necessary to obtain detailed information about the behaviour of each of the elements under different conditions. Recently, Lingane<sup>3</sup> has published such data for arsenic, antimony, bismuth, tin, lead, cadmium, zinc and copper in various supporting electrolytes, and has pointed out that if the diffusion current constant of a metal is known, there is no need to calibrate each dropping mercury electrode with known concentrations of the metal, provided that the characteristics of the particular electrode are also known.

The polarographic method is widely used in metallurgical analysis for determining trace metals in alloys; but it may equally be applied to the inorganic constituents of a host of other materials ranging from tap-water to various biological products. Since many organic substances are themselves reducible at the dropping-mercury electrode, it is frequently necessary to prepare the biological samples for analysis by special pre-treatments. Such methods have been described for the determination of lead<sup>4</sup>, arsenic<sup>5</sup>, and vanadium<sup>6</sup>.

A special application<sup>7</sup> of the technique has been used for the measurement of ter- and quinque-valent antimony in blood and urine when studying the metabolism of the therapeutic antimony compounds employed in the treatment of bilharziasis and kala-azar. Using ordinary chemical methods, it is difficult to distinguish between ter- and quinque-valent antimony in biological material. However, ter- but not quinque-valent antimony in normal hydrochloric acid solution forms a good polarographic step with a half-wave potential *v.* the saturated calomel electrode at -0.15 V. (cf. Fig. 3) and consequently can readily be determined in the presence of the quinque-valent form. The latter can be determined after reduction with sodium sulphite. The procedure proved to be surprisingly rapid as well as accurate, so that it was possible to make a large number of measurements, which would have been impracticable by earlier methods. Samples of blood needed relatively little pre-treatment, and urine could be examined directly. Since the half-wave potential for ter-valent antimony is relatively low at -0.15 V. *v.* the saturated calomel electrode, its characteristic step appears before those due to the other reducible substances in urine. The steps formed by the latter substances would completely mask those produced by small quantities of a substance less readily reducible than ter-valent antimony. A similar procedure may be adopted for the determination of bismuth.

Oxygen dissolved in electrolyte solutions is reduced at the dropping-mercury electrode and yields two distinct steps, the first step being due to the reduction of oxygen to hydrogen peroxide and the second to the reduction of hydrogen peroxide, either to water or hydroxyl ion. The second step coincides with that obtained for the electrolysis of an air-free solution of hydrogen peroxide. These oxygen steps have been extensively used for measuring the oxygen content of a wide range of materials, including body fluids<sup>8</sup>,

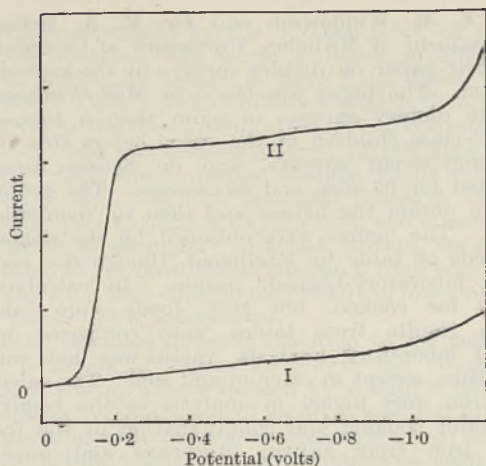


Fig. 3. CURRENT-VOLTAGE CURVE FOR ANTIMONY. I, 0.0001 M SODIUM QUINQUEVALENT ANTIMONY GLUCONATE; II, 0.0001 M SODIUM TRIVALENT ANTIMONY GLUCONATE.

technical gases, activated sludge and lake water, and for studying the photosynthesis- and respiration-rates of micro-organisms.

The polarograph is of considerable theoretical importance for the study of oxidation-reduction systems. An ideal example of a reversible reduction at the dropping-mercury electrode is given by quinhydrone and its components. In a well-buffered solution, the step due to the reduction of benzoquinone has the same characteristic half-wave potential as the step due to the oxidation of hydroquinone. If quinhydrone is examined, one half of the curve represents an oxidation of hydroquinone at the mercury anode, while the other half represents a reduction of benzoquinone at the mercury cathode. An oxidation-reduction system is thermodynamically reversible if identical polarographic half-wave potentials are obtained for the reduction of the oxidant and oxidation of the reductant. As would be expected, values for the oxidation-reduction potentials<sup>9,10</sup> of such systems determined polarographically are in good agreement with those obtained by the classical methods.

The electrolytic examination of most organic substances involves reactions which are not thermodynamically reversible, since products are formed which cannot be oxidized or reduced to give the starting material at the same electrode potential. The reductions of aldehydes, ketones, unsaturated acids and nitro-compounds belong to this group.

The polarographic behaviour of the various vitamins which contain reducible groupings has been studied extensively. Aneurin (thiamin; vitamin B<sub>1</sub>), riboflavin, nicotinic acid, pantothenic acid, ascorbic acid (vitamin C),  $\alpha$ -tocopherol (vitamin E) and vitamin K can be determined in pure solution, but further work is required before they can be estimated in the presence of other reducible substances. Cholesterol<sup>11</sup> and other constituents of fish liver oils interfere with the polarographic determination of  $\alpha$ -tocopherol. The mechanism of the riboflavin step has been investigated further by Brdička and Knoblock<sup>12</sup>.

The dropping-mercury electrode can be used for the determination of certain sex hormones<sup>13</sup>:  $\alpha$ :  $\beta$ -

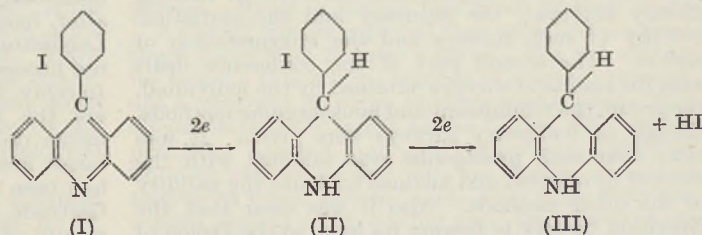
unsaturated keto-steroids (for example, testosterone, progesterone, corticosterone, and desoxycorticosterone) are reducible, while the 17-ketosteroids (for example, androsterone and isoandrosterone) are not. Nevertheless, the latter may be condensed with excess Girard reagent T (trimethyl acetylhydrazide ammonium chloride) to yield derivatives which have an electro-active molecule. The steps are well defined and can be used for the determination of the different ketosteroids in urine extracts; but unfortunately the method cannot be applied to mixtures of ketosteroids as the individual steps are too close together.

Kolthoff and his colleagues<sup>14</sup> have started a polarographic investigation of the sulphonamides with the view of testing theories as to their mode of action. Oxidation products of sulphonamides<sup>1</sup> such as *p*-hydroxylaminobenzenesulphonamide, *p*:*p'*-azoxybenzenesulphonamide and *p*-nitrobenzenesulphonamide are electro-reducible at the dropping-mercury electrode.

In addition to reversible and irreversible direct reductions, catalytic reductions may also occur at the dropping-mercury electrode. Brdička<sup>15</sup> observed that if sulphur-containing proteins were reduced in a buffered cobalt or nickel solution, a large double step formed. Cystine and cysteine behaved in the same way, but only gave a single large step. Since these special steps were not obtained in the absence of cobalt and nickel, Brdička concluded that the hydrogen evolution from the sulphhydryl groups is catalysed by the metals.

The curious behaviour of these catalytic steps attracted considerable attention. When blood proteins from different individuals were examined, it was noticed that serum from cancer patients gave a much smaller protein double step than that resulting from the serum of normal patients. This phenomena appeared to offer great possibilities for the diagnosis of cancer, but unfortunately it has since been found<sup>16</sup> that sera from patients suffering from pneumonia and arthritis show a similar effect.

The polarographic method may be used in synthetic organic chemistry to select the best conditions for carrying out electrolytic preparations at controlled potentials. Lingane, Swain and Fields<sup>17</sup> found that the reduction of 5-(*o*-iodophenyl)-acridine (I) proceeds in two stages, first to 5-(*o*-iodophenyl)-dihydroacridine (II) and then to 5-phenyl-dihydroacridine (III) with elimination of iodine, the reduction potentials at the mercury cathode of the two stages being separated by about 0.3 V.



By careful control of the potential of the cathode, it was possible to prepare either compound (II) or (III) in a high state of purity and in almost quantitative yield. The method should be of particular value whenever the selective oxidation or reduction of only one out of two almost equally reactive groupings in a molecule is required.

There is no room in this short account of recent research with the polarograph to deal with the rapidly growing field of amperometric titrations, which has been developed so extensively by Kolthoff and his collaborators at the University of Minnesota. Nevertheless, it is hoped that sufficient material has been incorporated to indicate the versatility of the polarograph and the general usefulness of polarography.

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## DIETARY STUDIES IN GREAT BRITAIN

THE lecture theatre at the London School of Hygiene and Tropical Medicine was well filled for the second part of the conference arranged by the Nutrition Society on "Budgetary and Dietary Surveys of Families and Individuals" held on May 20; and it remained full, practically to capacity, until the end. That there is an extraordinary and intense interest in the problems of nutrition, awakened largely as the result of the War, but drawing on the experience of those trained in nutritional problems during the War of 1914-18 and since, was manifest. Every paper was followed with close attention, though humour, conscious or unconscious—one member spoke of his "cooked figures"—received its reward.

The first part of the conference, held on February 5 (see *Nature*, March 11, p. 306), dealt with the practical and theoretical problems involved in making dietary surveys; the accuracy and the statistical validity of such surveys and the interpretation of results. The second part of the conference dealt with the results of surveys obtained by the individual, the group, the reminiscent and housekeeping methods, though no budgetary surveys were given. It was clear that each protagonist was satisfied with the method he adopted and inclined to doubt the validity of the other methods. Also it was clear that the Nutrition Society is bowing its knee to the Dagon of statistics, possibly with too little care to see that the figures before 'manipulation' approximate to reality. However that may be, there were gathered together a large number of people willing and able to bring their scientific ability to bear on the problem of feeding the people in the optimal way.

The chairman, Dr. J. Hammond, opened with almost the fewest possible remarks, and called on

Miss E. M. Widdowson and Dr. R. A. McCance (Department of Medicine, University of Cambridge) for their paper on dietary surveys by the individual method. The paper was based by Miss Widdowson on the dietary surveys of more than a thousand middle-class children in the years before this War, on some recent surveys, and on figures already reported for 63 men and 63 women. The problem was to obtain the figures and then to 'manipulate' them. The figures were obtained by the weighing of foods at table by intelligent, though not necessarily laboratory-trained, people. In calculation, tables for cooked, not raw, foods were taken. When results from tables were compared with actual laboratory analysis, there was not much difference, except in calcium and iron. The calcium and iron were higher in analysis as the result of tap-water cooking and contamination of the foods with iron from knives, saucepans and mincing machines. A week's survey is sufficient, but there are huge daily fluctuations in intake. The results obtained from the thousand children show almost as great a deviation from the mean as those of the 63 men and 63 women. At any age, one child in that age group might be eating twice as much as another in that same group. A boy of two years might be eating more of some dietary constituent than one of seventeen; protein and vitamin B<sub>1</sub> increase with age, calcium and vitamin C remain constant or fall as the age increases. Boys of fourteen ate four times as much meat as those of four, but only twice as many potatoes. Family and individual dietaries should be carried out side by side. If a family is getting its 'right' quota, but father is taking 4,500 calories, then the rest of the family (say mother and son) are being underfed.

Prof. V. H. Mottram (King's College of Household and Social Science, University of London) agreed that the man-value story has proved useless and should be buried. He believed that all this work points back to the calorimeter. The daily fluctuations cancel out in a group, so that a day's intake is sufficient guide. Prof. J. R. Marrack (London Hospital Medical School) asked what was done about made dishes which might vary in cooking, and suggested that the histories of these children who over- or under-fed should be followed up.

Dr. F. C. Happold (University of Leeds) said that the determination of expenditure of energy by medical students agrees with both weighed and estimated food intakes with small standard deviation. Others asked whether the readers' figures had been analysed statistically and whether colds did not alter food intake. Mr. A. L. Bacharach (Glaxo Laboratories) pointed out that what children eat is not necessarily a measure of what they ought to eat. In reply, Miss Widdowson admitted that made dishes are the nightmare of dietary surveys, minor ailments do influence food intake, though minor ailments are part of ordinary life and that her figures had been submitted to statistical manipulation. Dr. Gertrude Wagner (Wartime Social Survey) gave the results of surveys of methods used in preparing and cooking food. These investigated the ways in which people in different parts of England buy and prepare vegetables. 2,600 interviews were made. 100 per cent of families take potatoes, 90 per cent 'greens', 80 per cent carrots but only 47 per cent leeks. Higher income classes eat more vegetables than lower, but women at work often cook as many vegetables as those with more leisure. Only the well-to-do use



methods advocated by the 'kitchen front' or taught in the schools. Age seems to make no difference. Food 'education' seems to have little effect.

Mrs. B. Callow (School of Biochemistry, Cambridge) referred to the recent publication, "Food Consumption Levels", and said that we in Great Britain apparently receive food which, before cooking, yields sufficient vitamin C. The U.S. National Research Council recommends 75 mgm. a day for men, and a restricted standard of 50 mgm. In Great Britain, we obtain at least 85 per cent of one vitamin C from vegetables in war-time, and cooking may result in lowering that 75 mgm. below safety-level.

Later speakers directed attention to the fact that the freshness of vegetables affects the vitamin C, though wilting affects spinach more than it does the Brassicas. The amount of ascorbic acid left in vegetables after boiling depends more on the final amount of the boiling water than on its volume to begin with. Sodium bicarbonate does not influence the loss during boiling, but alkalinity of the vegetable when dished up accelerates the rate of oxidation of ascorbic acid after the dishing up. Officials from the Ministry of Food find that vitamin C estimations in cooked food are often below those calculated from tables even though the method of preparation is thoroughly known, and are pessimistic about the use of tables for estimating individual intakes of vitamin C. Shredding vegetables does not markedly alter their vitamin C content. Miss M. Olliver gave an account of the laboratory assessment of nutritive value of meals which Dr. G. N. Jenkins, Dr. L. W. Mapson and she had carried out. If sampling is conscientious, and bulking and mixing of the samples is adequate, and precautions are taken to prevent oxidation of ascorbic acid, the results of estimations are not so very different from those found by calculations from tables; but Miss Olliver stressed that anyone using tables for calculating the ascorbic acid intake must have considerable experience of the methods used in cooking and serving vegetables. She also demonstrated an admirable American machine for mixing samples of foods.

Dr. C. P. Stewart (Royal Infirmary, Edinburgh) opened the discussion on this communication. He said that the agreement between calculation and observations on ascorbic acid in foods is not bad. A hospital he had investigated reduced the figure of 8 mgm. per 100 gm. of potatoes down to 0.8 mgm. 'as served'.

Dr. Yudkin (R.A.F.) pointed out that the physiological state of members of an institution can be used to estimate the value of the diet given. After six months, the hæmoglobin figure for the W.A.A.F.s rose from 95 on the Haldane scale to 102. Dark adaptation is normal in the R.A.F. and W.A.A.F. The caloric value of the diet is more than 3,000 Calories a day, and though only 40 per cent of the protein in the diet is animal protein its biological value is that of milk protein.

The afternoon was devoted to the data obtained from analyses of institutional diets. Miss E. M. Langley (Board of Education) spoke of school meals. The Oslo meal is popular with children but takes long to eat and therefore is unpopular with the staff where quarters are cramped. 1,000 Calory-meals are not difficult to produce, but cooks are reluctant to use concentrated foods. The target is 3,000,000 meals a day. At the outbreak of the War, 250,000 were served. To-day, the figure is 1,500,000 despite cramped quarters, absence of kitchens and dining-

rooms. There is no doubt that school meals and school milk improve health and physique, and this service is becoming an integral part of the educational system of Great Britain.

Dr. M. Pyke (Ministry of Food) gave an account of investigations of factory canteen meals and service, and showed that the effect of a small change of the shift-time alters the spacing, times and natures of meals taken by work-people enormously. The pattern of the meals, the size and quantity of the nutrients taken varies immensely with a minor shift in hours and by no means in a predictable manner. There is a big variation, too, in the energy value of the foods taken by different workers, but there is considerable correlation between it and their work. Between different parts of the country, even in the same industry, there are marked differences in tastes. The coal miners in Wales eat cheese, the Durham miners refuse it. Are traditional methods of feeding justified, and should we pay attention to prejudices?

Dr. A. Lyall (University of Aberdeen) reported on hospital diets in three different hospitals. It was found that food brought in by friends of patients varied from 200 to 800 calories per day. As 40 per cent of patients in one hospital were on a light diet and 32 per cent on special diets, this extra food represents a marked interference with the feeding of the patients. It is doubtful if it should be allowed.

Miss M. C. Broatch (King Edward's Hospital Fund), who has had much experience in the feeding of school children, maintained that the Oslo type of meal should be preferred. The children have to sit longer to masticate it and get a rest during dinner-time. But often children are hurried through meals because, owing to inadequate accommodation, there have to be two sittings in the dinner hour. She said that no survey yet showed meals giving 1,000 Calories, and so children cannot be getting what the Ministry of Food recommends. Serving raw vegetables in the Oslo meal makes the 1,000-Calorie meal still more unlikely. Only by giving suet puddings can the 1,000-Calorie meal be attained.

Meals are best in institutions where there is a buyer, and food is not bought on contract. To serve dietetic meals in hospitals needs a reorganization of staff, for generally the cook is untrained, the steward has no experience and the housekeeping sister has had no training in general catering. All caterers ought to be cooks. Food should not be brought in by friends. The proper feeding of patients in hospitals is part of the treatment. A very weak spot is the delay between kitchen and ward and ward and patient. Meals in transit lose much of their value.

A Cardiff worker reported that school meals sometimes reach Miss Langley's figure. But the average for vitamin C in a large number of canteens throughout a year was 25 mgm. ascorbic acid a meal. It is almost impossible to get higher figures with the expenditure allowed and the equipment available. Children cannot, or will not, eat enough watercress to give 25 mgm. ascorbic acid—they take 8–10 gm. a meal instead of about 100 gm. One third of the children get no vitamin C at any other meal.

Dr. Magee (Ministry of Health) pointed out that Dr. Milligan of Glossop was using the 'Oslo' meal years before we ever heard of it in Britain. He questioned if there is much deficiency disease among children in Great Britain. When 5,000 children were investigated, no single case of scurvy was discovered; but riboflavin deficiency is sometimes observed. One reason for the poor diet in hospitals is that caterers

do not know the priorities they are entitled to. They should be able to serve 131 gm. protein a day, of which 78 gm. could be animal protein. Hospitals often underdraw their rations of meat, dried eggs and milk.

The general impression produced by all the discussions was that though an enormous amount is known about the way people should be fed, there are not the trained personnel, equipment, or space to do the work adequately.

The Society passed a resolution, moved by Sir Joseph Barcroft, recommending that the Committee of the Society investigate the possibility of carrying out direct calorimetry experiments.

## OBITUARIES

### Mr. W. L. Sclater

WILLIAM LUTLEY SCLATER was born on September 23, 1863, and died through enemy action in June. He was the eldest son of Dr. P. L. Sclater and was educated at Winchester, and afterwards at Keble College, Oxford, where he studied under Moseley and Hickson, taking his M.A. with first-class honours in natural science in 1885. In the following year he worked under Ray Lankester in London, and also made a short collecting trip to British Guiana, whence he brought back live specimens of *Peripatus*.

In 1887 he acted as demonstrator to Sedgwick at Cambridge, and in August was appointed deputy superintendent in the Indian Museum at Calcutta. There he remained until 1891 and, in addition to other work, prepared Part 2 of the "Catalogue of Mammalia in the Museum", also lists of the birds' eggs, snakes and Batrachia. Towards the end of 1891 Sclater returned to England and joined the staff of Eton College as one of the science masters. In the latter part of 1895 he was appointed director of the South African Museum at Cape Town; but before proceeding there he married on February 1 Charlotte Seymour, daughter of W. P. Mellen of Colorado Springs. A new wing had just been completed for the South African Museum, and Sclater removed and rearranged the collections and also reorganized the staff. He widened the scope of the Museum and started the *Annals of the South African Museum*. The planning and publication of the "Fauna of South Africa" was principally due to Sclater, who acted as editor and wrote the two volumes on mammals. He was responsible for Vols. 3 and 4 of the birds after Dr. Stark's death in Lady-smith. This work, although now out of date, is still of value to the student of the South African fauna.

In 1906 Sclater and his wife returned to England via Mombasa, Victoria Nyanza, Khartoum and Cairo, which was quite an undertaking in those days. Shortly after his return Sclater was invited by his wife's uncle, General W. J. Palmer, to develop and enlarge the museum recently established in connexion with Colorado College. After General Palmer died in 1909 Sclater gave up his post and returned to London, where he took up residence at 10 Sloane Court, and began his long connexion with the Bird Room of the British Museum. Besides continuing his studies on African birds and publishing important papers he became the recorder for the section of Aves of the *Zoological Record*. This he continued to the time of his death, and at different times was responsible for other sections, including Mam-

malia and Crustacea. From 1921 until 1937 he was general editor and introduced many important changes into the arrangement of the *Record*. In 1912 he published a "History of the Birds of Colorado".

After the retirement of Mr. Ogilvie Grant in 1918, Sclater was entrusted with the temporary care of the ornithological collections in the British Museum up to the appointment of Dr. P. R. Lowe in 1919. During that time he rearranged part of the collection and prepared a manuscript "Catalogue of the Birds of Prey".

The Sclaters travelled much on the Continent and in North Africa and in 1919 made a trip round the world, including visits to many of the principal museums in the United States, where they renewed many old friendships. On their return Sclater commenced his great work, the "Systema Avium Æthiopicarum", which was published in 1924. This book is indispensable to all students of African birds. He also edited from Sir Frederick Jackson's manuscript "The Birds of Kenya Colony and Uganda Protectorate" (1938).

Sclater succeeded his father as editor of the *Ibis* in 1913, and for seventeen years held that office. He was president of the British Ornithologists' Union from 1928 until 1933, and in 1930 was presented with the Salvin-Godman Gold Medal for his services to ornithology.

In addition to birds Sclater had many other interests, including family history, publishing in 1922 a delightful volume of an ancestress Eliza Draper, better known as 'Strene's Eliza'. At the time of his death he was honorary secretary of the Royal Geographical Society and had held that office since 1931. Owing to his long connexion with the *Zoological Record*, Sclater had a very wide knowledge of literature, which he readily placed at the disposal of others. This knowledge was not confined to modern works, for he was a recognized authority on the older writers. He was a great walker, and few knew the country around London better than he.

His death is a great loss to his many friends, and in the Museum we will miss seeing that tall, slightly stooping figure walking through the galleries on his way to and from the Bird Room.

N. B. KINNEAR.

### Dr. I. Markovič

It has recently been learned that Dr. Ivan Markovič, a former Czechoslovak Minister of Education and sometime editor of the Bratislava literary and scientific periodical, *Prudy*, died in a German concentration camp some months ago. Markovič was born at Myjava in Slovakia in 1888 and was in Russia at the outbreak of the War of 1914-18. He eventually became a member of the Czechoslovak National Council and held various diplomatic and Government posts after the formation of the Czechoslovak Republic in 1918.

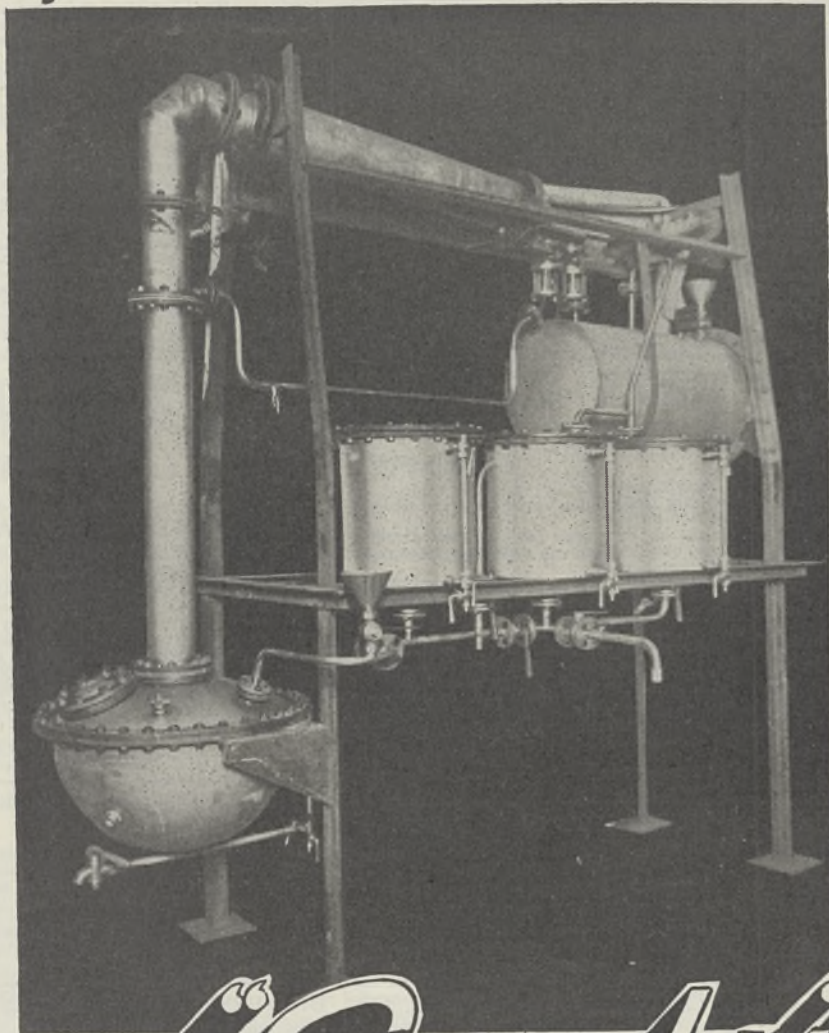
WE regret to announce the following deaths:

Prof. Carl Jakob, emeritus professor of pharmacology at Tübingen, aged eighty-seven.

Dr. L. E. Shore, O.B.E., formerly lecturer in physiology and junior bursar of St. John's College, Cambridge, on July 27, aged eighty-one.

Dr. J. N. Sugden, senior lecturer in inorganic chemistry at the Imperial College of Science and Technology, in July, by enemy action.

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### STOKES STUDENTSHIP

The Master and Fellows of Pembroke College, Cambridge, announce that the Stokes Studentship is vacant.

Candidates for the Studentship should send their applications, together with a birth certificate, a certificate as to personal character, and, if possible, seven copies of (1) a brief statement of their educational history, (2) a list of their published works, and (3) any testimonials (not exceeding four in number) which they may desire to submit, to the Master of Pembroke College, Cambridge, on or before November 15, 1944, marked on the outside "Stokes Studentship." If owing to service or other conditions a candidate cannot reasonably obtain seven copies of any documents he should give the reasons. One set of copies of their published works should also be sent.

The conditions under which the Studentship will be awarded are as follows:

1. The Studentship will be awarded without distinction of sex.

2. Preference will be given to graduates of the University of Cambridge.

3. Candidates must not be less than 23 or normally more than 30 years of age on Dec. 1, 1944, but on the present occasion an allowance will be made to candidates of more than 30 years of age equivalent to any time spent by them on work of national importance.

4. Candidates for the Studentship must have shown capacity for research in Mathematical or Experimental Physics or in subjects cognate thereto, such as Physical Chemistry or the study of Physical Laws in relation to Living Matter.

5. The student appointed will be expected to devote himself to research in Cambridge, unless he is permitted for special reasons and for a limited time to conduct his researches elsewhere. If he is now engaged on work of national importance he will not be expected to start work until he can be freed for this purpose.

6. The student will be allowed to give each term a course of lectures or demonstrations in the Department to which he is attached, but will not be permitted to undertake other work.

7. Normally the tenure in the first instance will be for a period of three years with a possibility of renewal for a further period not exceeding five years.

8. The value of the Studentship has been normally £400 to £450 a year, and the Board of Managers will be prepared to recommend the election of more than one student on similar terms if suitable applicants are forthcoming.

9. The student appointed, if a man, will be required to become a member of Pembroke College.

### EMSLIE HORNIMAN ANTHROPOLOGICAL SCHOLARSHIP FUND

The Trustees invite applications from British subjects for Emslie Horniman Anthropological Studentships.

The Studentships are open to university graduates and to others able to show that they are likely to profit by the study of Anthropology; they will normally be tenable for a maximum period of two years at any recognized university and may include a period of fieldwork.

The Studentship Grants will be determined according to the course of study pursued and the circumstances of each case. Cost of living, university dues, travelling and fieldwork expenses will be taken into consideration.

Applications must be received not later than September, 4, 1944.

Full particulars may be obtained from: The Secretary to the Trustees, Emslie Horniman Anthropological Scholarship Fund, Royal Anthropological Institute, 21 Bedford Square, W.C.1.

### UNIVERSITY OF MANCHESTER CHEMISTRY COURSES

A Prospectus containing full particulars of the LECTURES and LABORATORY COURSES qualifying for the Degrees in Chemistry will be forwarded on application to the Registrar. Applications for admission to the Research Laboratories should be made to the Director of the Chemical Laboratories. The Session Commences on Thursday, October 5.

### MINISTRY OF AIRCRAFT PRODUCTION

Applications are invited from persons possessing a Degree in Metallurgy, or recognized equivalent, for a senior post under the Aeronautical Inspection Directorate. Applicants should have an extensive knowledge of Metallic Materials, including manufacturing processes, with a specialized knowledge of the production of one of the following: Alloy Steels; Aluminium and its Alloys; Magnesium and its Alloys; and should have had experience in an executive grade in a firm or institution of standing.

The selected candidate will be responsible for the technical direction of inspection of all Metallic Materials, Ferrous and non-Ferrous, including the Alloys of Aluminium and Magnesium. He will be stationed at Harefield, Middlesex, but will be involved in considerable travelling.

Preference will be shown to qualified candidates between the age of 40 and 50 years. Salary £1,050 to £1,150, according to age, qualifications, and experience.

Applicants should write, quoting F.1155A, to the Ministry of Labour and National Service, Room 492, Alexandra House, Kingsway, London, W.C.2, for the necessary forms, which should be returned completed on or before August 25, 1944.

### THE WEST OF SCOTLAND AGRICULTURAL COLLEGE

The Governors invite applications for the following appointments:

1. Lecturer in Agricultural Zoology, including Entomology. Candidates should have a degree in Pure Science (Zoology principal subject). A veterinary qualification might be a recommendation.

Salary on the range £450 to £600, according to age, qualifications, and experience (plus appropriate war bonus).

2. Assistant Advisory Officer in Animal Husbandry. Applicants must have a Degree in Pure Science or in Agriculture and have experience of animal husbandry.

Salary ranges, according to age, qualifications, and experience (plus appropriate war bonus), are: Men £275 to £375; Women £220 to £300.

Particulars of the terms and conditions of appointment may be had from the undersigned, with whom applications are to be lodged not later than 25th current.

A. J. WILSON,

6 Blythswood Square, Glasgow. Secretary.

### UNIVERSITY OF DURHAM MEDICAL SCHOOL, KING'S COLLEGE,

Newcastle upon Tyne

#### DEPARTMENT OF PHYSIOLOGY TEMPORARY LECTURER

#### IN THE DEPARTMENT OF PHYSIOLOGY

The Council invites applications for the post of Temporary Lecturer in Physiology. The appointment will be, in the first instance, for one year, but is renewable, and the successful candidate will be required to take up the duties on October 1, 1944. The salary, attached to the post will be between £350 and £450 per annum, according to qualifications and experience.

Applicants should possess a medical qualification or an Honours Degree in Physiology, and, preferably, should have had some experience of university teaching.

Four copies of the application, with copies of two recent testimonials, and the names of two persons to whom reference may be made, should reach the undersigned not later than Wednesday, August 16, 1944.

G. R. HANSON,

King's College, Newcastle upon Tyne, 2. Registrar.

### DUBLIN INSTITUTE FOR ADVANCED STUDIES

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The Council of the Dublin Institute for Advanced Studies are prepared to offer a number of Research Scholarships in Theoretical Physics of the annual value of £150-£250, according to the circumstances of the applicants. The research has to be carried out at the Institute.

Minimum academic requirements: familiarity with the Laws and Theories of Physics and with the Mathematical methods implied in them.

Applications, enclosing copies of any original work done by the applicant, should be sent so as to reach the Registrar of the Institute at the above address on or before September 1, 1944.

### KENT EDUCATION COMMITTEE

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Applications in the candidate's own handwriting, giving details of experience and qualifications, together with two recent testimonials, should be sent to the Principal, Senior Departments, Medway Technical College, Gillingham, Kent, not later than August 19, 1944.

### UNIVERSITY OF BIRMINGHAM LECTURER—DEPARTMENT OF PHYSIOLOGY

Applications are invited for a Lecturer in Physiology. Stipend at the rate of £350 to £450 per annum, according to qualifications and experience.

Qualifications: Hons. Physiology or Medical Degree.

Four copies of application, with testimonials, should be sent on or before September 5 to the undersigned.

C. G. BURTON,

The University, Birmingham, 8. Secretary.

### UNIVERSITY OF DURHAM KING'S COLLEGE, NEWCASTLE UPON TYNE

The Council of King's College invite applications for the post of TEMPORARY ADVISER in AGRICULTURAL ENTOMOLOGY. Salary will be at the rate of from £400 to £680 per annum, according to qualifications and experience. The appointment will date from October 1, 1944.

Further particulars may be obtained from the undersigned to whom four copies of applications, together with the names of three persons to whom reference may be made, should be sent not later than August 31, 1944.

G. R. HANSON,

Registrar of King's College.

### UNIVERSITY OF ABERDEEN ASSISTANT IN BOTANY

Salary £300 to £350, according to qualifications. Applications should be sent, not later than August 28, 1944, to the Secretary to the University, from whom further particulars may be obtained.

H. J. BUTCHART,

The University, Aberdeen. Secretary.

### UNIVERSITY OF MANCHESTER

Applications are invited for the post of ASSISTANT LECTURER IN ENGINEERING. Stipend £850 per annum. Duties to commence September 29, 1944.—Applications must be sent, if possible, by August 31, 1944, to the Registrar, the University, Manchester, 13, from whom further particulars may be obtained.

### UNIVERSITY OF MANCHESTER

Applications are invited for the post of ASSISTANT LECTURER IN BOTANY. Stipend £350 per annum. Duties to commence Sept. 29, 1944.—Applications must be sent not later than August 19, 1944, to the Registrar, The University, Manchester, 13, from whom further particulars may be obtained.

### THE UNIVERSITY OF SHEFFIELD

The Council are about to appoint a TEMPORARY ASSISTANT LECTURER IN MATHEMATICS at a basic salary of £300 per annum, plus substantial wartime allowances.

Further particulars may be obtained from the Registrar.

### UNIVERSITY COLLEGE OF SWANSEA

The Council proposes to appoint a Professor of Physics in succession to the late Prof. E. J. Evans. Further particulars may be obtained from the Registrar, University College, Singleton Park, Swansea.

Lever Brothers & Unilever Ltd. have a vacancy on their permanent staff for a Technical Assistant in their Patents Department in London. Applicants should have a university degree or its equivalent in chemical subjects and possess a sound knowledge of German. Previous experience of patent work is desirable but not essential.—Apply, Personnel Department, Unilever House, Blackfriars, E.C.4.

Applications are invited from persons of either sex with Chemical training and experience, including those demobilized from Forces, for technical positions, one of which involves laboratory work, on the London Staff of a well-known Chemical Company.—Full particulars to Box 226, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

University of London. The Senate invite applications for the University Readership in Physics tenable at King's College. Salary not less than £750.—Applications must be received, not later than first post on Sept. 6, 1944, by the Academic Registrar, University of London, S.W.7, from whom further particulars should be obtained.

Advertiser wishes to sell Klett Bio-Colorimeter, Hearson gas-heated incubator, small electric centrifuge, and other equipment which can be seen by appointment in West-End of London.—Box 223, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

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For Sale:—"Versalic" 1/12 immersion objective. Vernon Bench Lamp, 8-in. Argus objective, and Epilux Illuminator by Swift.—Lillicrap, 38 Hawkwood Road, Boscombe, Bournemouth.

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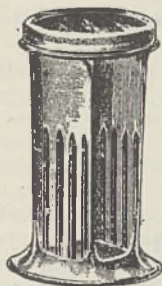
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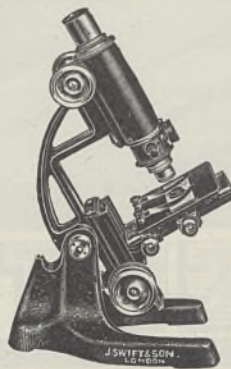


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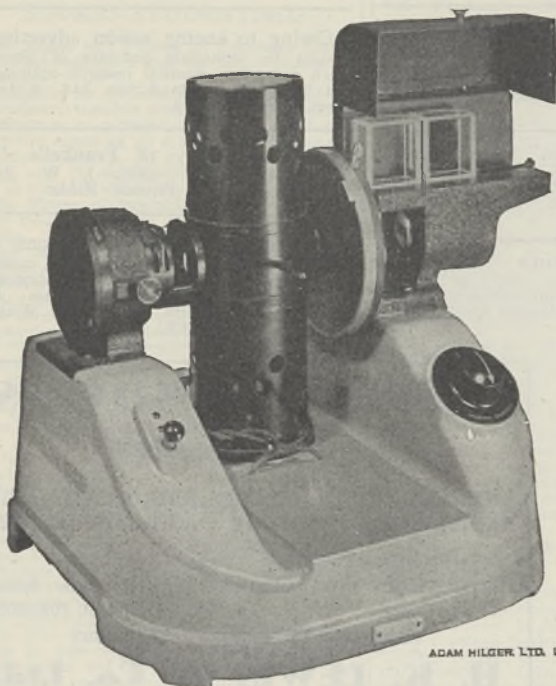
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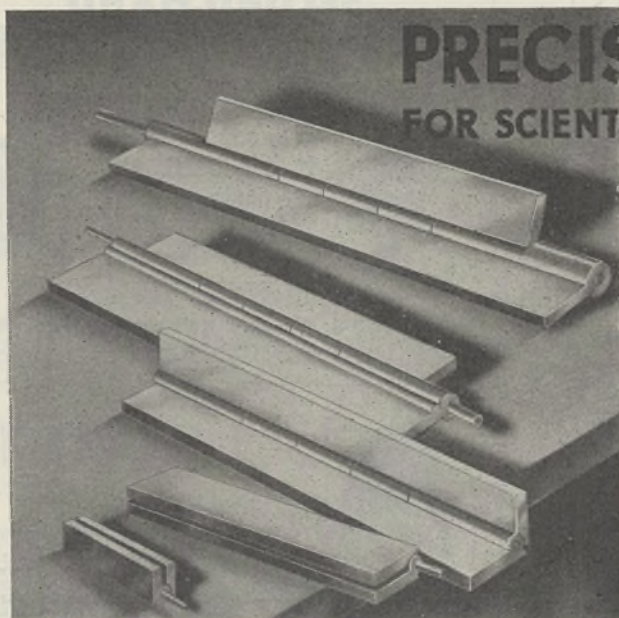
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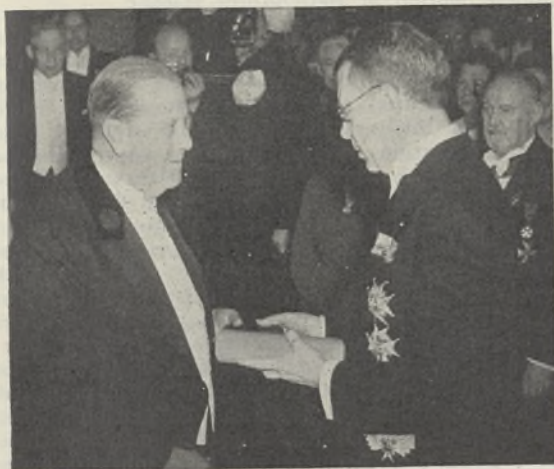
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Swedish Anthropological and Geographical Society:  
Award to Prof. L. von Post

THE highest distinction of the Swedish Anthropological and Geographical Society, the Vega Medal, has just been awarded to Prof. Lennart von Post, of Stockholm, for his outstanding contributions to the development and application of the methods of pollen analysis. It is Prof. von Post above all others who, by his clear vision and indomitable energy, both perfected and popularized the systematic analysis of the sub-fossil pollen content of lake- and peat-deposits. Speaking at the meeting when the award was made, Prof. von Post emphasized the manner in which pollen analysis studies from all parts of the world—Tierra del Fuego, New Zealand, North



PROF. LENNART VON POST (LEFT) RECEIVING THE VEGA MEDAL OF THE SWEDISH ANTHROPOLOGICAL AND GEOGRAPHICAL SOCIETY FROM THE CROWN PRINCE OF SWEDEN.

America, North China, as well as Europe—showed a similar post-glacial climatic drift, first of increasing temperatures, then through a period of severe heat and drought, and finally a recession to the climate of to-day. He visualized a forthcoming phase of international co-operation in pollen analysis work in systematically selected areas all over the world, by means of which we should resolve the general pattern of the cyclic climatic history of the world in the period since the last ice age. May Prof. von Post's vision be again rewarded by scientific advances comparable with those he has already accomplished.

## Co-operative Research in Industry

IN reply to a question from Lord Barnby in the House of Lords on August 1, Lord Templemore reaffirmed the great importance attached by the Government to co-operative research as a means of developing to the full the use of the industrial resources of Great Britain, a vigorous export trade and a higher standard of living. While the Cotton Industry Research Association, which receives a substantial contribution from the Cotton Board, set up under the Cotton Industry Act, is the only research association which is not supported solely by voluntary contributions or voluntary levies, apart from the Government grant, recently several industries, including the wool industry, have expressed themselves

in favour of statutory powers of one sort or another, including the collection of money for research by means of a levy on the whole industry, and research associations are now much more inclined to welcome an enabling bill. Lord Templemore said he was authorized to state that the Government will be prepared to consider sympathetically the introduction of enabling legislation for this purpose, if there is sufficient demand for it from industry, and that the matter will be discussed with industry in the coming months in connexion with post-war plans. The Government would also wish to be satisfied whether there are other proper objects connected with the furtherance of the export trade or of industry's efficiency generally for which a statutory power to collect money might be desirable.

## Human Factors in Industrial Output

IT is sometimes forgotten that output results from human activity and that therefore the amount will be dependent on many factors, of which it has been shown that the number of hours worked each week is one. There is abundant evidence that excessive hours result in diminished output. When, however, hours are relatively reasonable, can it be argued that a further reduction will increase the output? A recent report ("A Study of Variations in Output," By S. Wyatt and others. Emergency Report No. 5 of the Industrial Health Research Board. (London: H.M. Stationery Office, 1944.) 4*d.* net.) analyses some of the factors which had measurable effects on output. Study of the output records of a number of factories showed a striking variability. Some of the chief causes were: (a) changes in the type or design of the product; (b) mechanical difficulties and machine breakdown; (c) variations in the quantity and quality of the materials used; (d) progressive improvements in the methods or conditions of work; (e) changes in the type and lay-out of machines; (f) personal factors such as dissatisfaction with the methods or rate of payment, and occasional friction between the management and the workers.

The effects of the shorter hours of work were in most groups obscured by one or other of the above factors; but, when these were absent, reduction of hours from about an average of 60 to 55 a week for men, with a corresponding decrease for women, had a favourable result on the output. Absenteeism also tended to decrease as the weekly hours of work decreased. The results suggest that there is need for more research work to determine under what general or specific conditions changes of design, for example, have unfavourable effects on output, and the relative effectiveness of the chief causes of variations in output. Machines should be made for men, not men forcibly adapted to machines, which means careful physiological and psychological study.

## Research and Development in Scotland

A MEMORANDUM, "Chemical Research and Development in Scotland", by R. H. S. Robertson issued as *Bull.* No. 3 (March 1944) by the Scottish Reconstruction Committee urges the need for chemical and physical research and development in Scotland, stressing particularly housing research and research in relation to hydro-electricity, the lack of trained personnel in Scotland and the inadequacy of present facilities. The memorandum suggests the formation of a Scottish raw materials department under the Department of Scientific and Industrial Research,

with a wider field of activities than a development branch of the Geological Survey which would be restricted to the study of minerals, including peat. This department should co-ordinate every stage of development from survey to production and carry out the experimental work which existing organizations are not equipped to do, as well as serve as an institution for giving additional training to the technical men who will develop and eventually run the new industries. Apart from its references to seaweed and peat, the memorandum gives very little indication of what materials call for the creation of a new department to investigate Scottish resources. Neglect of those resources will be readily admitted, but it is not clear from this memorandum why their investigation and development could not be undertaken as part of the general national research effort—why, for example, separate Scottish research into housing is required.

#### Astronomy and the Struve Family

ON the occasion of the award of the 1944 Gold Medal of the Royal Astronomical Society to Prof. Otto Struve, the president of the Society, Prof. E. A. Milne, reviewed the astronomical work of the Struves, which has been recognized by four awards of the Gold Medal to the family in 118 years—once in each generation (*Mon. Not. Roy. Astr. Soc.*, 104, 112; 1944). Wilhelm Struve, founder of the Pulkovo Observatory, received the Gold Medal in 1826 for his work in discovering and measuring double stars. His son, an earlier Otto Struve, was awarded it in 1850 for a paper on "The Determination of the Constant of Precession with respect to the Proper Motion of the Solar System". The third medallist was Hermann Struve, uncle of the present holder, who gained the award in 1903 for his monumental work on the satellites of Saturn. This year's award goes to Prof. Otto Struve, director of the Yerkes and McDonald Observatories, and great-grandson of Wilhelm, for his observation and interpretation of the spectra of stars and nebulae. Prof. Milne reviewed this work in some detail, and pointed out that the present medallist has followed the family tradition in founding a new observatory, and has exceeded it in directing not merely one but simultaneously two great observatories. In his power of execution of new projects, in the width and generality of the problems he has selected and attacked, and in the brilliance of his solution of these problems, said Prof. Milne, Otto Struve has worthily carried the family fame in a new branch of astronomy to a new continent, and made good.

#### Telepathy in Psychoanalysis

DR. H. J. EHRENWALD, formerly of Prague, has directed attention to the possibility of telepathy in the psychoanalytic situation (*Brit. J. Med. Psych.*, 20, Pt. 1; 1944). It is well known to psychical researchers that since Freud mentioned this factor in his new series of introductory lectures, his pupils have obediently followed him and are themselves now at pains to discuss the question in relation to their own patients. In this paper, Dr. Ehrenwald extends these observations not only regarding telepathy from patient to analyst but also from analyst to patient. He mentions some of Freud's own cases, including the famous case of his patient, Mr. P., which Freud thought to be very suggestive, but which few psychical researchers would regard as

worthy of serious consideration. What is, however, of more interest in Dr. Ehrenwald's paper is his obvious anxiety to warn his colleagues of the possibility of telepathy occurring during sittings with their patients, and the implications which can be derived from it. From the point of view of the psychical researcher this attitude is somewhat diverting, since for so many years psychoanalysts have declined to learn what parapsychologists could have taught them and now, having become almost convinced through Freud's influence that telepathy exists, present examples of it which exhibit so many sources of error that it is clear that they still have little appreciation of the problems on which they write. If Dr. Ehrenwald's paper disturbs still further their complacency, it will have performed a useful service.

#### Chinese Journal of Agricultural Science

THE British Council made a very happy choice in selecting Dr. J. Needham for its scientific mission in China. He has been indefatigable in promoting scientific work in that part of the country which remains in Chinese hands and in his efforts to keep British scientific workers informed about Chinese work. Since the outbreak of the War, most of the scientific journals in China have been discontinued, and in consequence those keen spirits that still go on with their scientific studies have their difficulties increased by the lack of any means of publication. A new journal has now been started by the Ministry of Agriculture and Forestry at Chungking, and the first issue is to hand. Among other papers are two on inheritance in wheat. One on dwarfness deals with the complex ratios obtained in counts of the  $F_2$  progenies of the varietal crosses made in 1939; seven factors are assigned, of which three are complementary, three are duplicates of these and one is an inhibitor; the combinations necessary for dwarfness are discussed. The other paper is a mathematical discussion of Japanese data on the pentaploid hybrids of wheat. Trials are recorded of the Winogradsky Azotobacter plaque method for estimating potash and phosphate deficiencies in soils: this was found to be rapid and easily worked and seems likely to prove very valuable if its indications are borne out in practice. Other papers deal with the extraction of nicotine from tobacco leaves; the orange maggot (*Tetracus sp.*); and a possible vermicide plant, *Tripterium wilfordii*. The papers are in Chinese, but with summaries in English. We wish the new journal all success.

#### University of London

MR. T. H. Marshall has been appointed as from October 1 to the University chair of social institutions tenable at the London School of Economics. Since the beginning of the War he has worked in the Foreign Office Research Department, as head of the German Section since the autumn of 1940, and as deputy director since the spring of 1943.

Mrs. Barbara Wootton has been appointed as from October 1 to the University readership in social studies tenable at Bedford College. Since 1927 she has been director of studies for tutorial classes in the University and has acted as visiting lecturer in the Department of Social Studies at Bedford College for some years.

The title of professor of chemistry in the University has been conferred on Dr. E. E. Turner, in respect of the post held by him at Bedford College.



## LETTERS TO THE EDITORS

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

## Liver Ribonucleic Acid

It has previously been shown<sup>1</sup> that mammalian tissues contain, in addition to nuclear desoxyribonucleic acid (thymonucleic acid), appreciable amounts of pentose nucleic acid, which appears to be mainly a cytoplasmic constituent<sup>2</sup>. Liver tissue, for example, is known to contain both a desoxyribonucleic acid similar to the thymus nucleic acid<sup>3</sup> and a pentose nucleic acid<sup>1</sup>. The latter has now been isolated from the liver tissue of the sheep. The finely minced liver is dehydrated with ethanol and the nucleic acids extracted with 10 per cent sodium chloride. They are precipitated with ethanol, and the barium salts fractionated by the method used by Jorpes<sup>4</sup> for the pentose nucleic acid of the pancreas. The pentose nucleic acid is finally purified by precipitation from glacial acetic acid. The material so obtained is free from protein and from desoxyribonucleic acid. It is similar to yeast ribonucleic acid in its pentose content and in its absorption spectrum. Its contents of purine and easily hydrolysable phosphorus are consistent with a tetranucleotide structure with equimolecular amounts of purine and pyrimidine. It appears to differ, therefore, from the pentose nucleic acid of the pancreas, for which a pentanucleotide structure has been suggested<sup>4</sup>.

From the hydrolysis products obtained by the method of Bredereck and Richter<sup>5</sup>, we have prepared the pentose and identified it as ribose by the *p*-bromophenylhydrazone, which melted at 168–169°. This melting point showed no depression when the derivative was mixed with a sample of the *p*-bromophenylhydrazone prepared from pure *d*-ribose. The nucleic acid can therefore be correctly designated 'liver ribonucleic acid'. Gulland and Barker<sup>6</sup> have recently proved conclusively that the pentose of yeast ribonucleic acid is *d*-ribose, and have shown that small amounts of *l*-xylose are also present. The amounts of liver ribonucleic acid so far available have been too small to enable tests for xylose to be made.

Liver ribonucleic acid acts as a substrate for crystalline ribonuclease. When sections of liver tissue, fixed, embedded and mounted, are stained with toluidine blue, both nuclei and cytoplasm take up the stain. If the sections are treated with ribonuclease in the manner employed with other tissues<sup>7</sup>, and then with toluidine blue, the nuclei alone stain. The liver ribonucleic acid, therefore, probably occurs in the cytoplasm, in which it may be present in the form of phospholipin-ribonucleoprotein complexes in the particulate components (mitochondria<sup>8</sup>, secretory granules<sup>9</sup>, microsomes<sup>10</sup>). These complexes are known to contain a nucleic acid of the pentose type which is presumably identical with the ribonucleic acid which we have isolated.

In confirmation of the work of others<sup>11</sup>, we have found that the total nucleic acid concentration in the liver of the rat rises on fasting, although the liver weight relative to the body weight falls. Dry powders of rat livers from which acid-soluble and lipid phosphorus had been removed, contained  $554 \pm 10.7$  mgm. residual phosphorus per 100 gm. in the case of fed animals and  $583 \pm 20.5$  mgm. in the case of fasted animals. Of this residual phos-

phorus,  $75.3 \pm 2.33$  per cent in the fed animals and  $66.0 \pm 2.86$  per cent in the fasted animals was accounted for as ribonucleic acid phosphorus;  $17.6 \pm 0.59$  per cent in the fed animals and  $20.2 \pm 0.84$  per cent in the fasted animals was accounted for as desoxyribonucleic acid phosphorus. The fall in ribonucleic acid and the rise in desoxyribonucleic acid on fasting were both statistically significant. These results would be consistent with the disappearance from the cytoplasm of particulates containing ribonucleic acid, and with the loss in phospholipin and in nucleoprotein observed in the livers of rats fasted or placed on a protein-poor diet<sup>12</sup>.

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July 4.

<sup>1</sup> Davidson, J. N., and Waymouth, C., *Biochem. J.*, **38**, 39 (1944).

<sup>2</sup> Mirsky, A. E., "Advances in Enzymology", **3**, 1 (1943). Pollister, A. W., and Mirsky, A. E., *Nature*, **153**, 711 (1944).

<sup>3</sup> Greenstein, J. P., and Jenrette, W. V., *J. Nat. Cancer Inst.*, **1**, 91 (1940). Dounce, A. L., *J. Biol. Chem.*, **147**, 685 (1943).

<sup>4</sup> Jorpes, E., *Biochem. J.*, **23**, 2102 (1934).

<sup>5</sup> Bredereck, H., and Richter, C., *Ber. Deut. Chem. Ges.*, **71** (B), 718 (1938).

<sup>6</sup> Gulland, J. M., and Barker, G. R., *J. Chem. Soc.*, 625 (1943).

<sup>7</sup> Bracht, J., *C.R. Soc. Biol.*, **133**, 88, 90 (1940); *Arch. Biol.*, **51**, 151, 167 (1940). Gersh, I., and Bodian, D., *Biol. Symp.*, **10**, 163 (1943).

<sup>8</sup> Bensley, R. R., *Science*, **96**, 389 (1942). Hoerr, N. L., *Biol. Symp.*, **10**, 185 (1943).

<sup>9</sup> Claude, A., *Cold Spring Harbor Symp. Quant. Biol.*, **9**, 263 (1941).

<sup>10</sup> Claude, A., *Science*, **97**, 451 (1943).

<sup>11</sup> Kosterlitz, H. W., and Cramb, I. D., *J. Physiol.*, **102**, 18P (1943)

<sup>12</sup> Kosterlitz, H. W., *Nature* (see following communication).

## Effect of Dietary Protein on Liver Cytoplasm

It is well known that the protein content of the liver can be lowered by fasting or by feeding a low-protein diet and raised by feeding a high-protein diet. The question arises: Is the protein stored in the liver as is glycogen, or is it built into the structure of the cytoplasm? Since the evidence so far available on this point is equivocal, it was decided to correlate, under various nutritional conditions, the protein content of the liver with other cytoplasmic constituents, namely, phospholipin and nucleic acid.

In a previous communication<sup>1</sup> it was shown that fasting caused a loss in the protein as well as the phospholipin and nucleic acid contents of the livers of rats. Similar changes are obtained if the animals are placed either on a protein-free diet or given protein deficient in one or more essential amino-acids. On the other hand, a high protein diet causes an increase in the protein, phospholipin and nucleic acid contents of the liver. There is no change in the number of liver cell nuclei (Table 1).

If the protein content of the diet is varied, the relative concentrations of protein and phospholipin remain remarkably constant, while that of nucleic acid rises gradually with falling protein intake (Table 2). This latter fact is probably due to there being no, or only little, loss in nuclear material which, although in mass much smaller than cytoplasm, has a much higher concentration of nucleic acid than cytoplasm. This interpretation is supported by the recent findings<sup>2</sup> that the ratio of ribonucleic to desoxyribonucleic acid is lower in livers of fasted rats than in those of fed rats. The relative

TABLE 1.

Diet*	Liver			Liver nuclei per 100 × 10 <sup>-6</sup> gm. body weight
	Protein	Phospho- lipin mgm./100 gm. mean body weight	Nucleic acid	
Stock	607	118	46	599
20 per cent casein + 8 per cent yeast	621	114	49	590
8 per cent yeast	454	82	41	556
18 per cent gel- atin + 8 per cent yeast	495	96	44	544
60 per cent casein	701	120	51.5	546
85 per cent casein	770	124	55	603

\* Female hooded rats 4 months old were given 16 gm. of the diets daily for one week. The diets contained 2 per cent agar, 3 per cent salts, 10 per cent lard, 25 per cent sucrose and varying quantities of protein and starch. Vitamins A, D and E were given in the usual manner, and the vitamin B complex in the form of dried yeast or of a mixture of aneurin, riboflavin, pyridoxin, calcium pantothenate, nicotinic acid, inositol and choline chloride, supplemented by liver concentrate.

protein concentration shows a slight rise when the protein intake is above optimum requirements.

The constituents of liver cytoplasm which contain protein, phospholipin and nucleic acid are the chromophilic substance of the cytoplasm and the mitochondria<sup>2</sup>. A recalculation of Claude's results on rats' livers yields as approximate composition of the chromophilic substance (on a dry glyceride-free basis) 60 per cent protein, 33 per cent phospholipin and 7 per cent nucleic acid; and of the mitochondria 74 per cent protein, 15 per cent phospholipin and 8 per cent nucleic acid. The nucleic acid is ribonucleic acid<sup>2,3</sup>. The nuclei contain 22 per cent desoxyribonucleic acid<sup>4</sup>. Since the phospholipin content of the whole liver cell is considerably lower than that of the chromophilic particulates, it would appear that not only the relative concentration of the chromophilic lipoprotein-nucleic acid complex but also that of the interparticulate protein, which is almost free from phospholipin<sup>2</sup>, remain constant. In other words, the changes in the protein contents of the livers observed after fasting and diets low or high in protein are due to changes in the cytoplasm content of the liver. This phenomenon is of greater physiological and pathological significance than would be a simple storage of protein, in that many of the enzymatic activities of the liver cell are associated

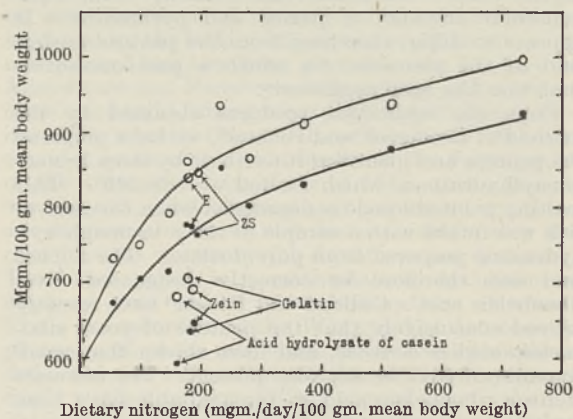
TABLE 2.

Diet	Protein + phospholipin + nucleic acid mgm./100 gm. mean body weight	per cent		
		Protein	Phospho- lipin	Nucleic acid
Stock	771	78.8	15.2	5.95
Protein-free	583	77.8	15.3	6.85
5 per cent casein	672	78.5	14.9	6.6
10 " " "	705	78.6	15.0	6.3
15 " " "	714	78.7	14.8	6.5
20 " " "	776	78.7	14.9	6.3
25 " " "	852	79.5	14.6	6.1
30 " " "	801	80.0	13.9	6.05
40 " " "	880	80.4	13.7	5.85
60 " " "	877	80.6	13.7	5.8
85 " " "	923	80.6	13.4	5.9
24 hr. fast	638	78.1	15.5	6.35
48 " " "	586	78.1	15.2	6.6
24 " " after protein-free diet	612	77.9	14.9	7.2

with its cytoplasmic particulates<sup>2</sup>. It has also been found that the arginase activity of the liver is dependent on the quantity of dietary protein<sup>5</sup>. These facts are of importance in view of the damaging effects which low-protein diets have on liver function<sup>6</sup>.

Rats on a protein-free diet lose 15 per cent of their initial liver cytoplasm on the first day, 7 per cent on the second day, 5 per cent during the period from the second to the seventh day, and another 5 per cent during the second week. It appears that about 20-25 per cent of the liver cytoplasm of animals fed sufficient quantities of protein is very easily and rapidly lost, and it is suggested this fraction be called 'labile liver cytoplasm'. This term, however, is not meant to indicate a chemical distinction between the labile and the remaining cytoplasm.

The histological diagnosis of the loss of cytoplasm is complicated by the fact that the total weight of the liver may undergo considerable changes and is, at least so far, only possible in livers which have lost considerable quantities of their cytoplasm, namely, 20-25 per cent. However, the livers of the rats given the low protein diets remain almost constant in weight and show a diminution of their stainable cytoplasm and mitochondria. An apparent



EFFECT OF VARYING THE DIETARY PROTEIN ON THE CYTOPLASM CONTENT OF THE LIVER.

○—○, Non-glycogen non-lipin solids. ●—● Protein + phospholipin + nucleic acid. The dietary protein was casein except where specially marked, thus: E=diet containing 21.5 per cent egg albumin; gelatin=diet containing 18 per cent gelatin + 8 per cent yeast; zein=diet containing 18.5 per cent zein; ZS=diet containing 18.5 per cent zein supplemented with 2 per cent L-tryptophan and 5 per cent L(+) lysine dihydrochloride; acid hydrolysate of casein=diet containing 22.4 per cent acid hydrolysate of casein, deficient in tryptophane.

vacuolization takes place, probably due to the largely increased glycogen content of these livers. In fasted animals, due to a decrease in liver weight, there is chemically an increase in the concentration of cytoplasmic substance although the absolute quantity of cytoplasmic substance decreases. Histologically, small cells are found which stain intensely. These findings are in good agreement with those reported by Elman, Smith and Sachar<sup>7</sup>.

The changes in cytoplasmic substance may also be determined, with a high degree of approximation, by estimating the non-glycogen non-lipin solids. This method may lend itself to a rapid assessment of the biological values of proteins (see accompanying graph).

A grant for expenses from the Medical Research Council is gratefully acknowledged.

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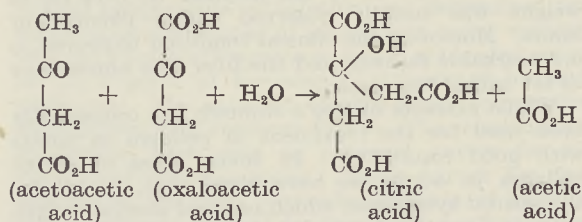
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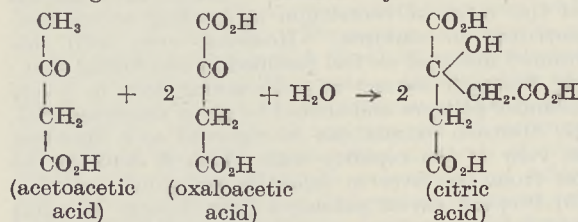
- <sup>1</sup> Kosterlitz, H. W., and Cramb, I. D., *J. Physiol.*, **102**, 18P (1943).
- <sup>2</sup> Bensley, R. R., *Science*, **96**, 389 (1942). Claude, A., *Biol. Symp.*, **10**, 111 (1943). Hoerr, N., *Biol. Symp.*, **10**, 185 (1943). Lazarow, A., *Biol. Symp.*, **10**, 9 (1943).
- <sup>3</sup> Davidson, J. N., and Waymouth, C., *Nature*, **152**, 47 (1943); *Nature* (see preceding communication).
- <sup>4</sup> Dounce, A. L., *J. Biol. Chem.*, **151**, 221 (1943).
- <sup>5</sup> Lightbody, H. D., and Kleinmann, A., *J. Biol. Chem.*, **129**, 71 (1939).
- <sup>6</sup> Miller, E. L., and Whipple, G. H., *Amer. J. Med. Sci.*, **199**, 204 (1940). Elman, R., and Heifetz, C. J., *J. Exp. Med.*, **73**, 417 (1941). Himsworth, H. P., and Glynn, L. E., *Lancet*, **1**, 457 (1944).
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### Metabolism of Acetoacetic Acid in Animal Tissues

BREUSCH<sup>1</sup> assumes that acetoacetic and oxaloacetic acids form citric acid in animal tissues according to the reaction:



Wieland and Rosenthal<sup>2</sup>, apparently independently, arrive at a similar view. They suggest that the following reaction occurs in kidney and heart:

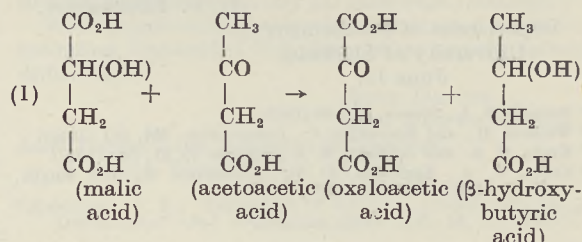


Both schemes are based on the observation that under certain conditions more citric acid is obtained from oxaloacetic and acetoacetic acids together than from oxaloacetic or acetoacetic acid alone. The importance of the schemes lies in the fact that they outline for the first time a mode of breakdown of acetoacetic acid in animal tissues, a problem which, in spite of many efforts, previous workers have failed to unravel.

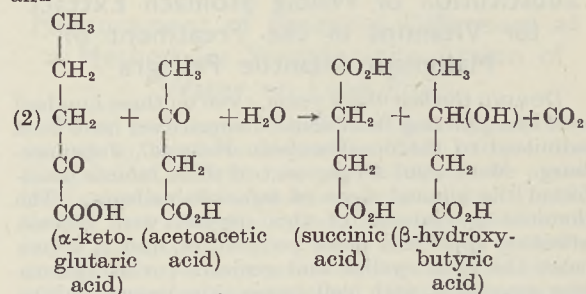
Experiments on sheep heart and sheep kidney, although they confirm the observation that acetoacetic acid can increase the yields of citric acid (or its breakdown products) in the presence of oxaloacetic acid, are incompatible with the above schemes. In both tissues the removal of acetoacetic acid is much accelerated by oxaloacetic acid (or its precursors). The effect is greater under anaerobic than under aerobic conditions. A detailed examination of the products of the anaerobic interaction between acetoacetic and oxaloacetic acids—involving the quantitative determination of acetoacetic, oxaloacetic,  $\beta$ -hydroxybutyric, citric, isocitric, *cis*-aconitic,  $\alpha$ -ketoglutaric,  $\alpha$ -hydroxyglutamic, succinic, fumaric, malic,

pyruvic and lactic acids—showed that the extra acetoacetic acid removed by interaction with oxaloacetic acid can be quantitatively recovered as  $\beta$ -hydroxybutyric acid.

The formation of  $\beta$ -hydroxybutyric acid is not due to a direct interaction between acetoacetic and oxaloacetic acids. Two substances arising in tissues from oxaloacetic acid—malic acid and  $\alpha$ -ketoglutaric acid—were found to react with acetoacetic acid. The two reactions are:

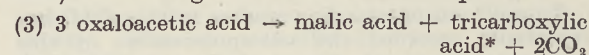


and

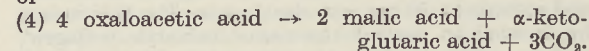


Reaction (2) has already been observed in other tissues by Krebs and Johnson<sup>3</sup> (1937).

Oxaloacetic acid, when added anaerobically to tissues, is in part reduced to malic acid<sup>4</sup>. The portion undergoing reduction varies, according to conditions, between 25 and 70 per cent. The remaining fraction enters oxidative conditions, the chief products of oxidation being, apart from carbon dioxide, citric acid (together with isocitric acid, *cis*-aconitic acid) and  $\alpha$ -ketoglutaric acid. For example<sup>4</sup>:



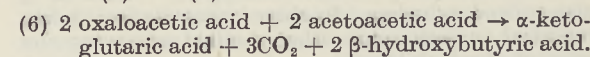
or



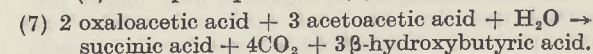
When reaction (1) is superimposed on (3) or (4) oxaloacetic acid is regenerated from malic acid and the reformed oxaloacetic acid will react again according to (3) or (4). The overall effect of (1) and (3) is

$$(5) \quad 2 \text{ oxaloacetic acid} + \text{acetoacetic acid} \rightarrow \text{tricarboxylic acid} + 2\text{CO}_2 + \beta\text{-hydroxybutyric acid};$$

and of (1) and (4)



If (2) is superimposed on (6) the overall effect is



In our experiments the increased yields of citric,  $\alpha$ -ketoglutaric and succinic acids were fully accounted for by the above schemes.

A study of the reactions of acetoacetic acid in the

\* 'Tricarboxylic acid' stands for the mixture of citric, isocitric and *cis*-aconitic acids, 'malic acid' for the mixture of malic and fumaric acids.

presence of oxygen does not indicate that there are other reactions between oxaloacetic and acetoacetic acids besides (1) and (2) in sheep heart muscle. Under the conditions of our experiments oxaloacetic acid had no effect on the *oxidative* breakdown of acetoacetic acid. The intermediate stages of this process must still be regarded as obscure.

Experimental details are to be published in the *Biochemical Journal*.

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<sup>1</sup> Breusch, F. L., *Science*, 97, 480 (1943).

<sup>2</sup> Wieland, H., and Rosenthal, C., *Liebigs Ann.*, 554, 241 (1943).

<sup>3</sup> Krebs, H. A., and Johnson, W. A., *Biochem. J.*, 31, 241 (1937).

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### Substitution of Whole Stomach Extract for Vitamins in the Treatment of Malignant Infantile Pellagra

DURING the last three years, close on three hundred children suffering from acute malnutrition have been admitted to the non-European Hospital, Johannesburg. More than 60 per cent of these infants manifested the clinical signs of infantile pellagra. The dominating features of this disease were oedema affecting upper and lower extremities, and in severe cases the face, eyelids and genitalia; this oedema was associated with pellagrous skin lesions on the legs, buttocks, back, arms and face, grey hair or alopecia, as well as patchy or diffuse dermal depigmentation. The stools were, as a rule, bulky, pale and foul-smelling, and contained much unsplit fat. The serum proteins, both albumen and globulin, were extremely low, a mild microcytic anaemia was common, and the liver, on biopsy and at post-mortem, was diffusely fatty. This severe form of malnutrition is apparently identical with that described by other investigators<sup>1,2,3,4</sup>.

Trowell<sup>5</sup>, an outstanding worker in this field, has repeatedly recorded the unresponsiveness of this disease to vitamin therapy, including nicotinic acid, and recorded a 90 per cent death-rate. For this reason he decided to discard the name 'infantile pellagra', and to call it 'malignant malnutrition'.

In our experience, not only has vitamin therapy failed to save the lives of more than 50 per cent of these children, but also in many instances we strongly suspected that vitamin therapy aggravated the disease and even hastened death. This opinion is substantiated by the sudden increase in oedema, as well as of fatty change in the liver, when vitamins were administered. Blood and serum transfusions also proved valueless. In these circumstances it was essential to seek some other method of saving the lives of these children.

We established, by an improved liver biopsy procedure, that the microscopic appearance of the liver is a most valuable method of assessing the severity of the condition and is certainly more reliable than the clinical picture or any of the laboratory findings. We therefore adopted the liver biopsy method as a routine procedure in gauging the condition of the child on admission and the effectiveness of our therapy. Twenty children were studied by this method. Of these, seven were treated with thiamin,

nicotinic acid or brewers' yeast administered either orally or parenterally; seven were given 5 c.c. of Abbott's crude liver extract intramuscularly twice daily for seven days, and the final group of six cases were treated with 10 gm. of ventriculin (Parke Davis) plus 10 c.c. of N/10 hydrochloric acid daily, in one dose, for five days.

All these cases had extremely fatty livers which, from our previous observations, indicated a very poor prognosis. Progress was assessed by the clinical condition, the weight curves (as an index of the gain or loss of oedema fluid) and weekly liver biopsies.

Only one child of the seven treated with vitamins survived. The oedema increased progressively, the fat in the liver became more extensive, the children became more apathetic and died within two weeks. Five of the seven children treated with liver extract lived. The recovery was slow, the oedema subsiding gradually. Even after four weeks the liver still contained appreciable amounts of fat.

The response to ventriculin therapy was most dramatic, since all the children survived, despite the fact that clinically and by liver biopsy they were as bad as the cases in the other two groups. A loss of oedema fluid shown by the decrease of 1-1½ lb. in weight was usually observed within twenty-four hours. Moreover, the clinical condition improved in a remarkable fashion, and the liver was almost free of fat within two weeks.

Whole extracts of hog's stomach has occasionally been used for the treatment of pellagra in adults with good results<sup>6,7,8</sup>. In seven cases of severe pellagra in adults we have found that, except for the mental symptoms, which respond slowly, ventriculin is a much more rapid and effective treatment than nicotinic acid or other vitamins.

Owing to restriction of facilities, it has not been possible to conduct a more extensive investigation of the value of ventriculin in treating severe malnutrition in children. However, even with this limited material we feel justified in concluding that: (1) Stomach extract is a life-saving drug in severe infantile pellagra and should be given universal trial. (2) Stomach extract can be regarded as a lipotrope in view of the rapidity with which it depletes the fat from the liver in infantile and adult pellagra. (3) Biopsies reveal extensive liver damage in adult and infantile pellagra. (4) In view of the fact that both adult and infantile pellagra respond to a single form of therapy, there is no justification for regarding them as different diseases.

We wish to acknowledge our indebtedness to Dr. Selby for allowing us access to the children under his care.

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<sup>1</sup> Trowell, H. C., *Trans. Roy. Soc. Trop. Med. Hyg.*, 35, 13 (1941).

<sup>2</sup> Williams, C. D., *Arch. Dis. Child.*, 8, 423 (1933).

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## A Rapid Method of Estimating Moisture in Dehydrated Fish

THE determination of moisture in foods by extraction with alcohol has been limited by the lack of a rapid and accurate method of estimation of the resulting alcohol-water mixtures. Robertson<sup>1</sup> has recently shown that both dicyclohexyl and a mixture of seven volumes of 'Elaine' kerosene and one volume of Standard White Oil No. 7 (both products of the Standard Oil Co. of California) possess very critical temperatures of solution with water-alcohol mixtures. The critical temperature of solution is clearly demarcated by loss or appearance of turbidity with the paraffin mixture, but this is preceded by a hazy appearance with dicyclohexyl. As the method can be adjusted to give a range of up to 20° C. for a water content of 1 per cent in water-alcohol mixtures, the method appeared to be sufficiently critical for food analyses.

As neither dicyclohexyl nor the grades of paraffin mentioned by Robertson was available, a blend of Standard White Oils No. 5, No. 12, and liquid paraffin was used. This blend approximated to the physical characteristics of Standard White Oil No. 7. The critical temperature of solution was determined for water-alcohol mixtures of known low water content with (a) 7 parts of kerosene to 1 part of blended white oil, (b) 3 parts of kerosene to 1 part of blended white oil. The ratio of alcohol-water to paraffin mixture was kept constant at 2-4. The relationships so derived were used as reference curves for all subsequent determinations. These curves are not reproduced, as each particular mixture of paraffin has a different critical temperature of solution for the same amount of water.

The time required for extraction of water from any food by refluxing with absolute alcohol or with alcohol of low but known water content varies with the nature of the food. Extraction of water from 10 gm. dehydrated fish with 50 ml. of boiling alcohol reached equilibrium in 30 minutes. Only slightly less water was extracted in 15 minutes. The results obtained by the critical temperature of solution method and the more conventional methods of oven drying are compared in the accompanying table. The vacuum oven used was designed and constructed by workers at this Laboratory and gives quicker drying than the normal laboratory design.

WATER CONTENT OF DEHYDRATED FISH DETERMINED BY DIFFERENT METHODS.

Sample No.	Per cent loss in weight		
	Crit. temp. of sol. method	Vacuum oven 20 hr. at 70° C.	Oven drying at 100° C.
1	9.5	—	9.2 (6)*
2	5.7	5.8	6.0 (6½)
3	7.7	—	8.1 (9)
4	7.8	—	7.5 (7)
5	8.55	8.1	8.5 (8)
6	9.5	9.4	9.25 (6)

\* Hours of drying to give constant weight.

The results obtained by the three methods do not differ by more than 0.4 per cent except for sample 5, where there is a maximum difference of 0.45 per cent between the results obtained by vacuum oven drying and the critical temperature of solution method.

The samples determined were of four common South African fish of commercial importance with oil contents on a fresh-weight basis ranging from about 0.1 to 3.0 per cent.

The critical temperature of solution method can be recommended for rapid and accurate determination of the water content of dehydrated fish, since with this material there is rapid and complete extraction of water by alcohol and the necessary calibration curves need only be drawn up once for a single large consignment of kerosene and white oil. Where dicyclohexyl is obtainable, even this is not necessary, since the curve is given by Robertson<sup>1</sup>. It is necessary to take precautions to dry all glassware thoroughly.

Work is proceeding with other dehydrated products, including vegetables, but these latter present certain difficulties.

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Cape Town. May 16.

<sup>1</sup> Robertson, G. R., "Estimation of Water in Alcohol with Aid of Dicyclohexyl", *Ind. Engineering Chem. A.E.*, 15, 451 (1943).

## Measurement of Potential Difference as a Method for Studying the Action of Water on Lead Pipes

WHEN working a R.A.M.C. mobile hygiene laboratory in Northern Ireland in 1941, I found that a number of the water samples submitted for examination had a definite plumbo-solvent action. Thresh<sup>1</sup> showed that mere acidity or alkalinity was of minor importance, but the presence of lime with a silicate or organic acid, such as citric, lessened the action.

Nine samples attacked lead; they were mostly acid and very soft. The customary routine was followed, freshly scraped and old lead surfaces being immersed and the effects noted. Such comparative tests can give an approximately quantitative determination of the rate of attack. Thus water from the Glen River, Newcastle, was at pH 5.8 and gave a strong reaction for lead after 20 minutes with a fresh surface. The source, recognized as dangerous, is regularly treated with sodium silicate. The water was then at pH 8 and gave only a slight positive test for lead after an hour; the new surface tarnished rapidly. Water from Castlewellan Lake, at pH 7.3 and with ten parts per million temporary hardness and thirty permanent, gave a negative result after twenty minutes and showed less lead after one day than did the untreated river water after twenty minutes.

The diverse chemical factors affecting the action of water on lead appear to be summed up by a measurement of the difference of electrical potential between old and new lead surfaces immersed in the sample. Differences of a few millivolts were, however, found between various old surfaces. Accordingly, the gold electrode, supplied with the potentiometer provided in the mobile hygiene laboratory for pH determinations, was used in measuring the potential difference between gold and old or new lead surfaces.

Sample	Period of immersion	pH	Two min.		Ten-forty min.		About one day	
			Old	New	Old	New	Old	New
Distilled		6.0	617	725*	—	—	—	—
River		5.8	584	682	537	581	472	476-505†
River, with silicate		8.0	507	506	—	—	—	—
Lake		7.3	514	556	390	396	282	390

\* Obtained indirectly, 108 millivolts more than old surface.

† After stirring.

A few results are shown in the table, but pressure of routine work rendered it impossible to follow the changes at precisely regular intervals; the units are millivolts between gold and lead surfaces at about 12° C.

The treatment of the town supply with silicate is obviously very effective as the new surface is rapidly inactivated. Since the continuation of the work has had to be postponed, this outline of what appears to be a useful method is now presented; it is not mentioned in the 1942 edition of Thresh, Beale and Suckling's book "The Examination of Waters and Water Supplies".

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Thresh, J. C., *Analyst*, **47**, 457 and 500 (1922); **49**, 270 (1924).

### Active Nitrogen and $N_2^+$ ( $X'$ ) Ions

IN a recent paper<sup>1</sup> I put forward the hypothesis that active nitrogen is simply the positive ions of the nitrogen molecule,  $N_2^+$  ( $X'$ ) produced in the discharge tube. It was suggested that the excitation of the First Positive Bands—the characteristic active nitrogen spectrum—is due to the neutralization of  $N_2^+$  by a three-body collision, with the neutral  $N_2$  molecule as the third body, in the volume rather than on the surface of the discharge vessel. Thus,  $N_2^+$  ( $X'$ ) +  $e$  +  $N_2$  →  $N_2$  ( $B$  state) +  $N_2$  ( $A$  state). The energy relation is satisfied if the  $N_2^+$  molecule, on neutralization, drops to a vibration level in the neighbourhood of  $v' = 10$  of  $B^3\Pi$  state (9.26 eV.), and the neutral  $N_2$  molecule is raised to the  $A^3\Sigma$  state (6.14 eV.). It is now pointed out that the transition of  $N_2^+$  ( $X'$ ) to  $B^3\Pi$  ( $v' \approx 10$ ) on neutralization satisfies the Frank-Condon principle, namely, that the change in the nuclear distance (near turning point) is very small.

The remarkably long life of active nitrogen was attributed to the fact that the conditioning or special treatment of the walls of the discharge tube which is so essential for long life prevents recombination of the ions and the electrons taking place on the walls. The recombination thus being confined to the volume proceeds slowly by a three-body collision process, giving long life to the afterglow. In the present communication, certain properties of active nitrogen connected with the presence of ionization in the afterglow will be discussed, and it will be shown that they receive simple and satisfactory explanation on the above hypothesis.

The subject of ionization in active nitrogen has been studied by Constantinides<sup>2</sup> and in great detail by Lord Rayleigh<sup>3</sup>. Two of the experimental results of Rayleigh which have an important bearing on the present hypothesis are as follows:

(1) The ion density as computed from observation of ionization current flowing between two electrodes is less than the number of photons emitted per unit volume from the glowing gas (in the initial stage).

(2) Introduction of neutral  $N_2$  increases the ionization current and also the intensity of afterglow.

These experiments require careful consideration as otherwise they can easily be interpreted as invalidating the proposed hypothesis. For example, according to the proposed hypothesis, the density

of ions cannot be less than the number of photons emitted per unit volume. It will be shown, however, that the hypothesis not only offers a simple explanation of these apparently anomalous results but, in fact, is confirmed by them.

For explanation of (1) we recall that according to the hypothesis, the conditioning or treatment of the wall prevents the neutralization of electrons and positive ions on the glass surface. This, in other words, means that by some process—we do not as yet know how—the conditioned or treated wall prevents the electrons and positive ions from coming into contact with the surface. According to the hypothesis, therefore, ionization current between two electrodes (the surfaces of which, as in the experiment under consideration, are treated) will be extremely small compared to that which would otherwise be obtained if the electrode surfaces are normal and unconditioned. The ion density computed from currents carried by such electrodes would therefore be much smaller than the true ion density. It should be noted that even untreated metallic electrodes would not, as may at first sight be expected, yield better results. This is because such electrodes when immersed in active nitrogen become conditioned, as is evinced by the fact that they do not permit recombination on their surfaces. Perhaps metallic electrodes which can be warmed to 'poison' their surfaces would, if used, indicate the true ionization current.

These latter conclusions are based on another experiment by Lord Rayleigh<sup>4</sup>. It is found that a small piece of metal held in active nitrogen is ordinarily dark and is unaffected. If, however, it is warmed, or is not far from the direct discharge, it starts glowing presumably because active nitrogen begins to deliver energy to it. The obvious explanation of this experiment, on the basis of the present hypothesis, is that ordinarily no reaction takes place on the metal surface, because the metal immersed in active nitrogen becomes conditioned and prevents the access of ions and electrons to it. But if the conditioning is destroyed by any means (by warming or by putting the metal close to the discharge) then reaction on the surface starts and the released energy (15.58 eV. per electron and ion recombined) raises its temperature to a glow heat.

Increase of afterglow in experiment (2) is explained by the increase in the density of  $N_2$ , which causes an increase in the value of the recombination coefficient. The increase in the ionization current can be explained if it is assumed that the introduction of neutral  $N_2$  from outside temporarily 'poisons' the electrode surfaces so that ions and electrons flow to them with less obstruction.

No other hypothesis so far put forward gives any explanation of the occurrence of ions in active nitrogen, or of the fact that the afterglow and the ionization in it are not wholly independent.

Closer examination shows that the hypothesis gives similar simple explanations of various other phenomena observed in active nitrogen even to small details. These and the explanations of the phenomena mentioned above are being examined by Mr. J. S. Chatterjee (Ghose Research Scholar in physics). Mr. Chatterjee is also arranging certain crucial experimental tests for the hypothesis. These will form the subject matter of a future communication.

If the proposed hypothesis of active nitrogen be correct, then the proper subject of investigation now would be the study of the change which the conditioning or the treatment produces in the walls of the

discharge vessel and which prevents the surface recombination of  $N_2^+$  ions and electrons.

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<sup>1</sup> Mitra, *Science and Culture*, 9, 49 (1943-44).

<sup>2</sup> Constantinides, P. A., *Phys. Rev.*, 30, 96 (1927).

<sup>3</sup> Rayleigh, *Proc. Roy. Soc., A*, 180, 146 (1942). See also, 86, 61 (1911) and 87, 133 (1912).

<sup>4</sup> Rayleigh, *Proc. Roy. Soc., A*, 176, 17, 22 (1940).

## Derivation of Maxwellian Relaxation Times from Tensile Data

MAXWELL'S<sup>1</sup> relaxation time ( $t_r$ ) is defined as the ratio of viscosity ( $\eta$ ) to shear modulus ( $n$ ), and is derived from the expression  $-\delta(\log S)/\delta t$ , of which it is the reciprocal ( $S$  is the shear stress dissipating at constant strain).

It is well known that for fluids  $\eta = \tau/3$ , where  $\tau$  is the "coefficient of viscous traction" (Trouton<sup>2</sup>), and for elastic solids, that  $n = E/2(1 + \Pi)$ , where  $E$  is Young's modulus and  $\Pi$  is Poisson's ratio, which is  $\frac{1}{2}$  for fluids. But it is often overlooked that the latter expression is only applicable to small strains; there is also the question of isotropy, which will not be discussed here. Further, the validity of the former to flow conditions depends on the special nature of liquids (see especially Love<sup>3</sup>).

Now that the theory of elasticity is being increasingly applied to 'high-elastic' materials for which so-called 'moderate strains' may be of the order of several hundred per cent, it is important that the limitation of the  $2(1 + \Pi)$  expression should be more widely realized. A number of authors (Schofield and Scott Blair<sup>4</sup>, Kuhn<sup>5</sup>, Bennewitz and Rötgers<sup>6</sup>, Taylor<sup>7</sup>, Robinson, Ruggy and Slantz<sup>8</sup>, etc.) have derived relaxation times from tensile data for large strains using the  $2(1 + \Pi)$  expression. In some cases it is quite clear that it is only the order of magnitude of  $t_r$  that is significant: in others the limitations of the treatment are not made clear. The applicability of the expression does not depend only, as Simha<sup>9</sup> appears to suggest, on the constancy of  $\Pi$  or on the validity of Hooke's Law: in fact, the meaning of this latter criterion is liable to ambiguity where large strains are concerned. The essential point is that the original calculation of  $2(1 + \Pi)$  depends fundamentally on the deformations being small.

Fluid behaviour is defined in such a way that large strains must be expressed by the 'natural' formula

$$\int_{l_0}^l \frac{dl}{l} = \log_e l_0/l$$

(for a length increase from  $l_0$  to  $l$ ) and such strains are additive. The usual 'engineering' formula,  $l - l_0/l_0$ , is not additive for large strains and the 'extension ratio',  $l/l_0$ , which is much used in the theory of rubber structure (see Wall<sup>10</sup>, Treloar<sup>11</sup>, etc.), is multiplicative, being numerically equal to the anti-logarithm of the 'natural' strain. Some authors, such as Latschaw<sup>12</sup>, do not appear to be clear about this. The extension ratio has the advantage that it relates tensile to shear strains by a simple expression irrespective of strain magnitude<sup>3</sup>.

Modern 'high-elasticity' theory is based largely on the work of Kuhn<sup>5</sup> and that of Alexandrof and Lazurkin<sup>13</sup>, Lazurkin<sup>14</sup> and Gurevich and Kobeko<sup>15</sup>.

This latter school is concerned with what are called by the authors 'relaxation times' but, being quite different from those of Maxwell, are now generally known as 'orientation times'.

The orientation time is the time required for a strain to reach  $1 - 1/e$  of its equilibrium value under constant stress. Although said to apply only to super-cooled liquids, the materials concerned do not have that property of liquids which justifies the use of the classical expression relating tensile to shear conditions, since there is no unique rate of shear for any given stress. It is not clear whether orientation times refer to shear or to tensile-compressive strains. Alexandrof did compression tests whereas Gurevich and Kobeko used shearing conditions. The discrepancy does not appear to have been noted.

In fitting equations such as that of Nutting<sup>16</sup> which do not involve entities like viscosity and relaxation time, the empirical use of  $2(1 + \Pi)$  is justifiable; but this is scarcely the case in deriving values of  $\eta$  and  $t_r$ , unless it be made quite clear that the treatment may be only very approximate for large strains. For materials of high consistency, a relaxation time defined in terms of the dissipation of tensile stress and a coefficient of viscous traction would really be preferable to the more usual  $t_r$  and  $\eta$ .

I have been helped in the unravelling of this very confusing situation by so many friends that individual acknowledgment is impossible.

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June 23.

<sup>1</sup> Maxwell, J. C., *Phil. Mag.*, 35, 129 (1868).

<sup>2</sup> Trouton, F. T., *Proc. Roy. Soc., A*, 77, 426 (1906).

<sup>3</sup> Love, A. E. H., "A Treatise on the Mathematical Theory of Elasticity", 2nd ed. (Cambridge Univ. Press, 1906).

<sup>4</sup> Schofield, R. K., and Scott Blair, G. W., *Proc. Roy. Soc., A*, 141, 72 (1933).

<sup>5</sup> Kuhn, W., *Angew. Chem.*, 52, 289 (1939).

<sup>6</sup> Bennewitz, K., and Rötgers, H., *Phys. Z.*, 40, 416 (1939).

<sup>7</sup> Taylor, N. W., *J. Appl. Phys.*, 12, 753 (1941); *J. Phys. Chem.*, 47, 235 (1943).

<sup>8</sup> Robinson, H. A., Ruggy, R., and Slantz, E., *J. Appl. Phys.*, 15, 343 (1944).

<sup>9</sup> Simha, H., *J. Appl. Phys.*, 13, 201 (1942); *Ann. N.Y. Acad. Sci.*, 44, 297 (1943).

<sup>10</sup> Wall, F. T., *J. Chem. Phys.*, 10, 132, 485 (1942); 11, 67, 527 (1943).

<sup>11</sup> Treloar, L. R. G., *Trans. Farad. Soc.*, 39, 36, 241 (1943); 40, 59, 109 (1944).

<sup>12</sup> Latschaw, E., *J. Franklin Inst.*, 234, 63 (1942).

<sup>13</sup> Alexandrof, A. P., and Lazurkin, J. S., *Act. Physicochim. (U.S.S.R.)*, 12, 647 (1940).

<sup>14</sup> Lazurkin, J. S., *Act. Physicochim. (U.S.S.R.)*, 12, 669 (1940).

<sup>15</sup> Gurevich, G., and Kobeko, P., *Act. Physicochim. (U.S.S.R.)*, 12, 581 (1940).

<sup>16</sup> Nutting, P. G., *J. Franklin Inst.*, 191, 679 (1921); 235, 513 (1943) *J. Amer. Soc. Test. Mats.*, 21, 1162 (1921).

## Smoke and Rain

IN A paper published in 1929<sup>1</sup> the conclusion was drawn from observations made in two or three different ways that smoke discharged into the atmosphere tends to promote rainfall and to precipitate rain in highly moist air when, without smoke, it would not have fallen. One test was to compute the rainfall on each day of the week, and the result showed that on an average of thirty years, Sundays had rather less rain than weekdays by about 6 per cent, or more correctly, the average of weekdays had an excess over Sundays by this amount. As factories in Rochdale and neighbouring Lancashire towns do not work on Sundays there is then a general absence of smoke in the air, although

domestic smoke, which is of less importance, continues. The outpouring of factory smoke on working weekdays was considered to be the cause of the excess of rain on weekdays over Sundays.

Since the results of thirty years rainfall were published fifteen years have passed, and the rainfall for each day of the week for this later period has again been computed and has been combined with the previous thirty years so that a total of forty-five years is now available. The following are the average annual amounts of rain in inches for each day of the week (1) for the thirty years, 1898-1928, (2) for the forty-five years, 1898-1943:

	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.	Aver- age	Total
(1)	6.17	6.88	6.68	6.49	6.65	6.27	6.63	6.54	45.77
(2)	6.01	6.44	6.30	6.45	6.40	6.25	6.56	6.34	44.41

From this it is seen that the excess of rain on weekdays over Sundays, which was shown in the thirty years record, is again clearly in evidence in the longer record of forty-five years, a period long enough to make it improbable that the result is fortuitous.

It would not, however, have been surprising if the difference in rainfall between Sundays and weekdays had become less marked as time progressed, since electric power, supplied from a distant source, has in recent years replaced, to a considerable extent, steam power with its attendant pollution.

Unless there is a natural seven-day period in rainfall with its minimum occurring on Sundays, which may be ruled out, the conclusion is that the result found above is due to human agencies, and the most probable agency is smoke in the atmosphere.

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*Quart. J. Meteor. Soc.*, 55 (Oct. 1929).

### Scientific Research

In *Nature* of May 6, I find a very interesting and very hopeful discussion of the problems of scientific research in Britain. Yet it seems to me that there are some aspects of the matter which have not been sufficiently considered.

(1) The cultural value of research. It appears to be generally assumed that the purpose of science is almost wholly that of increasing material wealth. Surely it has also another purpose, perhaps no less important, that of enabling man to understand and appreciate the world he lives in. This cultural aspect, rightly understood, justifies scientific work which may have no significance or relation to material wealth. It is here that science is connected with literature, with poetry, with the emotional life of mankind.

(2) Certainly the remuneration of scientific workers should be increased, but it is difficult to say what that remuneration is in any given case. In the universities, men are paid primarily as teachers, and do what scientific work they can, or wish. But undoubtedly they are appointed to their positions partly on account of their scientific standing, and thus are indirectly paid. It is a curious circumstance that museums expect to get scientific workers to spend months or years in the study of their collections, without any thought of payment. On the contrary, they expect the workers to show gratitude for permission to study the collections, and they do show it, fully appreciating the work which has been

done, and the expense incurred, in assembling the materials.

(3) Provision must be made for adequate publication. Young men, entering upon a field of research, will not spend years on a revision or monograph which may never see the light. Not only should large and important works be published but also (as is customary) shorter papers to keep the scientific world aware of what is going on, and encourage co-operation. But still another sort of publication is needed. We need more small, well-illustrated books, written in simple language, to interest the general public in scientific work.

In all these matters, very considerable progress has been made in Great Britain, but when scientific work is under discussion they should not be overlooked.

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### Importance of Film Records

A NUMBER of amateurs are making films frequently of unique scientific interest. It may be that by patience an ornithologist has managed to secure some pictures of bird behaviour which may never be duplicated for a generation or more. It may be that a medical man has made a motion-picture record of a rare case-history or a film of a particular method of conducting an operation. It may be that an anthropologist has secured film records of fast disappearing tribal ceremonies or, in the case of our own country, a folk survival. Any worker in any field may indeed make a record which has more than a personal interest.

Most amateurs work on negative reversal stock if they are taking black and white pictures. No master negative, therefore, exists. The same is even more true of the colour films which amateurs are tending increasingly to use. The result is that each time the film is run through the projector, it depreciates slightly in quality. In the end it wears out, and people are thenceforth denied the knowledge which only this film can give.

To make a black and white negative from which prints can be taken or to make a master copy of a colour film from which other copies can be taken is relatively inexpensive; but nevertheless it is usually beyond the individual's pocket. In any event, is there any reason why he should make a special negative or copy to meet a hypothetical demand if other people do not share his views as to the importance of the topic?

So valuable film records are disappearing. Is there any means by which this may be prevented? Would learned societies, for example, be willing to set up special committees to appraise the value of any films submitted to them and, if they reach the requisite standard, would they be ready to put on one side sufficient funds to make a master copy for preservation? Can any of the big trusts be persuaded to interest themselves in making available something of the order of not more than £1,000 a year in order to set such a scheme going? Is there any point in this Institute convening a conference to obtain expressions of opinion?

OLIVER BELL.

The British Film Institute,  
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THE YEW TREE (*TAXUS BACCATA*)

By ALEXANDER L. HOWARD

"The warlike Yew by which more than the lance  
The strong arm'd English spirits conquer'd France."  
DRYDEN.

THIS romantic but rather sombre tree has for long ages been connected in simple country minds with superstitious stories of illness and death. All the old authorities on trees have lurid tales to tell of its poisonous effect on both man and beast, and it is therefore not surprising that the yew has never had a fair chance in England, but lived out its long life with little help or encouragement.

As long ago as 1662 John Evelyn wrote :

"Since the use of bows is laid aside among us, the propagation of this tree is quite forborne. But the neglect of it is to be deplored ; seeing that the barrenest grounds, and coldest of our mountains, might be profitably replenished with it."

Much has been written, and many reasons advanced for its invariable proximity to churches and graveyards. It has been suggested that this may have been partly to secure its continued cultivation on account of its value for bow-making, partly to safeguard cattle from its poisonous leaves, and partly because its rather sombre evergreen branches made of it a fitting symbol of death and immortality. The first of these cannot be accepted—the quality of the yew grown in England appears to have been inferior to that obtained from Spain, for Boulger says :

"It was to bows of Yew that we mainly owed the victories of Crecy and Poitiers ; and Edward IV enacted that every Englishman should have a bow of his own height. English Yew-wood, however, for this purpose, only fetched one-third the price of that which was imported."

Further, the greater number of, if not all, the yew trees by churches are living, nor have we any record of any being felled for bow-making. Mr. Teulon Porter also tells me that in past days the parson's revenue partly consisted of the licence to feed cattle in the churchyard, which negatives the second reason : we must accept the last as being the most probable.

Throughout the ages yew has been used as an emblem of death and burial, and this custom, which is even mentioned in ancient Greek and Roman records, has insensibly become a universal tradition, very ably expressed by Johns :

"Generation after generation might be gathered to their fathers, the Yew tree proclaiming to those who remained that all like the evergreen unchanging Yew were yet living in another world, the life which had been the object of their desire."

"Of all the trees in England,  
Oak, Elder, Elm and Thorn,  
The Yew alone burns lamps of peace  
For them that lie forlorn."

WALTER DE LA MARE (1873).

and

"My shroud of white, stuck all with Yew."  
SHAKESPEARE.

The yew has a short irregular bole, with strong-limbed branches somewhat resembling those of the hornbeam in habit of growth. These are densely covered with a dark green cluster of needle-like leaves spreading widely with a broad crown. Some

of the trees are brightened at intervals by clusters of golden or red berries, according to the variety.

It shares with the oak the claim to live the longest life of any tree grown in Great Britain, but Elwes thinks that its great age has been much exaggerated by many authors, particularly the great Swiss botanist De Candolle. Elwes refers his readers to Lowe, who proves "that the average rate of growth is about 1 foot of diameter in 60–70 years in both young and old trees". He also says that there is :

"abundant evidence to show that though old trees grow at intervals much more rapidly than young ones, they do not grow uniformly but have periods of comparative rest, and that the increase of girth is fastest when old trees have lost their heads and the stem is covered with young shoots.

No tree has such a remarkable faculty of covering up wounds or injuries by the growth of fresh wood from the outside, and even after the main stem is completely dead, fresh and entirely new stems may grow up around it and form a new tree around the dead one. For this reason most of the yews of very large size are mere shells, and even when no hollow can be seen from the outside, decay—which is often indicated by moisture running from holes in the trunk—has set in."

It is impossible in this article to enlarge upon this question of the age, about which many authorities have already written extensively, but after exhaustive inquiry into the history of a number of yew trees, and study of the growth of many that have been felled, I am inclined to the view that the ages claimed by tradition may be correct.

It is equally impossible to enumerate the many outstanding examples of yew trees which have been commented upon by all authorities since Evelyn's time, but some are specially worthy of mention. Elwes describes in his "Timbers of Great Britain and Ireland" trees at Midhurst :

"They consist of four avenues of yew trees forming a square of about 150 yards, together with a grove of yews at the upper end which average, as nearly as I could measure them, about 75 feet in height, but some probably exceed 80. These trees are for the most part sound and healthy, though little care has been taken of them, and some have fallen. They are remarkable not only for their great height, which exceeds that of any other yews on record in Europe, but on account of their freedom from large branches, many having clean boles of 20–30 feet, with a girth of 8–9 feet."

Mr. Thomas Roberts of Cowdray informs me that these avenues are in good healthy condition to-day (1944). Elwes also refers "to the largest pure yew-wood in England on the downs three miles west of Downton, Wilts, on the property of the Earl of Radnor" partially planted, and adds an account of "The Little Yews"—another wood near by, which contains much finer trees. He says :

"the Cherkley Court Yew Wood is the best in England. . . . The wood covers an area of 50 to 60 acres in a shallow valley forming part of the old Ashurst estate, about three miles from Leatherhead in Surrey, on the east side of the old pilgrims' road to Canterbury."

Another is at Castle Eden Dene in Durham.

With the knowledge we have of these outstanding plantations, which date from very early times, we conclude that there must have been a far greater interest in its cultivation than that which has obtained for the last three hundred years or even more. This view is supported by the fact that it amounted to almost a penal crime to make use of any yew wood

other than for bows prior to the year 1550. It is likely, therefore, that the demand was so great that the better quality was becoming scarce, and even at that early date it was found necessary to import supplies from Spain.

It appears also that at a very early date it became fashionable to plant yew walks. One such walk still flourishes to-day at Huntington Castle, Clonegal, Ireland, and regarding this Mr. Manning Robertson writes to me under date of June 27, 1944, as follows :

"This consists of 122 trees in a row : the row is some 360 feet long and there are 'return ends' making three sides of a rectangle. The largest tree is 41 feet high and 12 feet 9 inches girth at 5 feet from the ground. Many of the trees have interlaced and grown together—like Banyan trees. Little is known of the Walk's history, but it is almost certainly monastic, and tradition has given the age as 600 years : it is still in perfect condition."

Elwes mentions :

"a remarkably fine yew walk at Hatherop Castle, Gloucestershire . . . which is supposed to be about 300 years old, in which the trees average about 60 feet in height with a girth of 9 to 12 feet."

The importance of the yew as hedgerow has been recognized for many centuries. Its use for the partition of fields has been debarred because of the danger to animals. Although it is slow in growing to perfection, as protection for property it has been for long ages justly prized, and is not only very decorative but also presents a formidable barrier, impossible to climb and very difficult to destroy.

John Evelyn evidently felt strongly on the question of yew hedges, as he wrote :

"the Yew tree has been generally cultivated for the pleasure garden, to be clipped into the shape of beasts, birds, etc., or for hedges. Whoever is pleased with such figures can raise no tree more proper for the purpose, as the branches and the leaves may be clipped and fashioned into almost any form or shape. But as this method is justly exploded, and as everyone who has the least pretension to taste, must always prefer a tree in its natural growth to those monstrous figures, the Yew is now chiefly planted for wilderness quarters, and for hedges, for which service it is excellently well adapted."

With regard to its uses for timber, and quoting from "The Timbers of the World" :

"This useful and highly decorative wood is now little known or esteemed, although it presents qualities which deserve much better recognition. If the economic use of domestic woods were practised in this country as it has been in France and Germany, yew would have undoubtedly been brought into prominence. The colour is pale red, somewhat like cherry wood or pencil cedar : it has a beautiful smooth lustrous grain. Sometimes it is handsomely figured, and occasionally has a burr growth, the produce of which will compare favourably with amboyna, and has indeed actually been mistaken for it. The strength and elasticity of yew-wood has been known for centuries, particularly on account of its use for bows. . . . At Sir Mark Collet's house, near Sevenoaks, some handsome doors are made of yew. The stiles and rails are of the ordinary figured wood, and the panels of exceptionally fine figured burr. The colour has deepened with long exposure, assisted by careful polishing, and is now a rich red brown. Yew is particularly suited for chair-making, and some very fine specimens of considerable antiquity are to be found in many places. Elwes alludes to an extremely handsome arm-chair in Hornby Castle, the property of the Duke of Leeds. The date is about 1550. It is made of Yew, which adds to its rarity, for up to this time it was practically penal to employ yew-wood for

any other purpose than the manufacture of the national weapon ; in this instance the wood has become close, as hard as steel, and of a beautiful dark amber colour. The wood, though it is difficult to obtain, is also valued for brush-backs."

Yew is specially liable to the growth of 'burrs', which I have already mentioned. About thirty years ago an outstanding example was sent to me from the Caucasus, measuring more than seven feet in length, more than four feet in depth, and weighing nearly a ton. Purchased by an American, it was cut into veneer, yielding some of the finest specimens of yew burr ever seen.

It is difficult to decide whether this unique tree should be extensively cultivated ; but it is certain that as a tree it has many interesting and unusual qualities, and as timber it is a fine medium for decorative work of all kinds.

## THE UNIVERSITIES AND INDUSTRY

THE "Report on the Extension of Scientific Research in Manchester University, particularly in Relation to the Industries of its Area" (Manchester University Press, 1944, 1s.) which has been prepared by a committee of professors and industrialists, all of whom are members of the governing bodies of the University, to assist the University to make a considered estimate of the increase in income necessary to ensure that its science departments may undertake their proper responsibilities in the nation's economy, is of much more than local interest. In the first place, it amplifies some passages in the recent pamphlet of Sir Ernest Simon on the development of British universities, while at the same time it offers some measure of the value of the Joint Standing Council of members of the University of Manchester and the Manchester Chamber of Commerce which has been under discussion between the two bodies, as announced by Mr. A. H. S. Hinchliffe at the last of the series of meetings on "Science and Industry" arranged by the Chamber. Again, in its chapter on research and teaching, it puts concisely much of the argument advanced in the recent House of Commons debate, by the Parliamentary and Scientific Committee and elsewhere, and attempts to give concrete expression to the means by which those arguments may be given effect.

The statement includes detailed reports from the Chemistry and the Electro-Technics Departments, which have been chosen because of their relevance to some of the more important scientific industries of the area. The first of these reports comes from Dr. C. J. T. Cronshaw, Prof. A. R. Todd and Prof. M. Polanyi ; and the second is by Dr. A. P. M. Fleming and Prof. Willis Jackson. The broad conclusion reached is that the effective discharge of the functions of the science departments of the University of Manchester in the post-war period involves doubling the expenditure of the Departments as a whole. Even this would provide for no new developments outside existing departments, and the report proposes an increase of about 50 per cent in the first year, rising to 100 per cent in the fifth year after the War.

In its introductory survey of research and teaching, the statement emphasizes that the primary duty of the science departments must be research at the highest levels of which they are capable. The first step towards improving teaching standards in any

scientific department must be to increase the facilities for, and the volume and pace of, research. The expansion of research facilities in the science departments is thus placed first in order of importance; it comes before the expansion of student numbers, because the standard of a university depends on it.

Deprecating the distinction between 'pure' and 'applied' research, the statement prefers to speak of 'academic' and 'industrial' research, distinguishing the different modifying and conditioning factors which surround the same intellectual process. The outlook, approach and method of the research worker are the same whether he is in a university or in industry. Development work, which is the conversion of results of research into processes of economic production, depends for its success on men in industry who combine scientific knowledge with experience of practical problems in their particular field. The statement suggests that the flow into industry of men who have graduated in a strong science department, who have learned as postgraduates an outline of research technique, and who keep in touch with the work of academic laboratories, will reduce very materially the time-lag between research and development. The real and permanent link between university science departments and industry is in research.

Pursuing this argument, the chapter on post-war development in chemistry, from its review of the development of chemical industry in Germany, argues that a first-class scientific industry cannot be built up in the absence of first-class universities which are teaching science; while, on the other hand, such universities cannot long continue to function in the absence of an industry capable of exploiting scientific developments and willing to employ scientific staffs trained in them. The organic chemical industry in the past has been built up on coal and can continue to be based on coal in spite of the threat of the natural oil fields seeking new outlets for their new materials; and the statement urges that without an intensive research effort, both by industry and by the universities, comparable with that taking place in the United States, the organic chemical industry in Great Britain will falter and a great natural asset, coal, will be playing a lesser part in world development than is its due share. Besides the plans for an increased flow from the university of research chemists—representing in detail a department with an annual intake of fifty honours students and a total of some eighty research workers (including staff)—a flow from industry is recommended, such as the practice of releasing senior men in industry to pursue research in academic schools, for say two-year periods, and facilities for academic workers to visit other centres abroad for limited periods.

The following report, on post-war developments in electro-technics, similarly urges that what is particularly needed by the engineering schools is a scheme for the return, for limited periods, of selected men from industry. In the period between the two wars Great Britain lagged behind other industrial countries in the production for world consumption of those engineering goods and tools of production which result from the application of recent scientific and technical research and invention. This was a direct consequence of our inadequate research activity in the branches of science concerned, and in electrical engineering the effect was particularly marked on the telecommunications side. If, however, those university physicists and engineers who, either in their university departments or elsewhere, have contributed

so much to the war-effort, are given comparable research facilities in the post-war period, the intimate liaison between university scientific workers and their industrial colleagues which has been established will develop to the great benefit of both the universities and industry, and of the country as a whole. Collaboration between the engineering schools and industry is particularly desirable in the attack on the border-line subjects between pure science and engineering, especially in the study of the properties of materials in relation to their chemical composition and physical structure.

With regard to the Manchester Department of Electro-technics, an increase in the number of undergraduate students to an average of twenty to twenty-five a year is suggested, and accommodation for up to ten men in each of two postgraduate courses. Even if some of the postgraduate teaching is conducted by part-time specialist lecturers from the local industry, the scheme will involve doubling the present full-time staff, with a further supplement to the laboratory staff. On a rough estimate, a further £20,000, based on pre-war costs, spread over the five-year period, will be required to bring the laboratories into a condition to initiate the scheme.

The statement does not touch on the question of a School of Chemical Engineering in Manchester raised by Sir Ernest Simon in his pamphlet. The spirit and trend of the statement, however, suggest that the Joint Standing Council at present under consideration may not only stimulate further the contact between the University of Manchester and the industries of the north-west of England, but also facilitate inter-regional consultation with regard to the founding of new schools where they will best serve national needs and not merely local interests or prestige.

## DEVELOPMENT OF THE CARIBBEAN REGION

THE report of the West Indian Conference held at Barbados during March 21-30, 1944 (Colonial No. 187. H.M. Stationery Office, 1944. 6d. net), contains accounts of the findings of the six committees which considered the agenda of the Conference. One of these specifically considered the Caribbean Research Council and possibilities for its expansion. In addition to the existing Sectional Committee on Agriculture, Nutrition, Fisheries and Forestry, the establishment of four further sectional committees is recommended, for public health and medicine, for industries, for building and engineering research, and for social sciences. Creation of a statistical unit to serve all sectional committees is recommended; and also early consideration by the Research Council of legal and fiscal problems related to collaboration among the research institutions of the Caribbean, with the view of submitting proposals to the Anglo-American Caribbean Commission for possible consultation with the Governments concerned.

Three general points are emphasized by the committee considering the Caribbean Research Council. First is the importance of freedom of action and independence of thought for the Research Council and its technical experts in the sectional committees, within the terms of reference specified by the Anglo-American Caribbean Commission. The Research

Council should also provide that the programmes of work of the several sections are properly co-ordinated, and that the projected investigations of Caribbean problems are approached with the view of yielding early results. Secondly, the activities of the Caribbean Research Council and the implementation of its findings depend ultimately on an enlightened public opinion among the Caribbean peoples themselves, and therefore on an improvement of their educational standards. Thirdly, the Research Council should give due consideration to the related work of institutions outside the Caribbean area and to such international agencies as may be created in pursuance of proposals made by the Hot Springs Conference on Food and Agriculture.

The extent to which opinion in the Caribbean is becoming aware of the research needs of the area may be seen in a number of proposals made by delegates in the reports of the committees dealing with other items on the agenda of the Conference. The committees concerned with means for raising the nutritional level both included such proposals in their reports. That dealing with increased local food production urged that research in the development and adaptation of foods of high nutritional and protective value and in cognate matters should be intensified through the medium of the Caribbean Research Council, and the necessary personnel provided to undertake extended programmes of research. That concerned with expansion of fisheries, after endorsing the findings of the Fishery Committee of the Anglo-American Caribbean Commission meeting at St. Thomas last August, urges that its recommendations should be implemented without delay. The Fishery Experimental Station at Mayaguez, Puerto Rico, should be a centre for technological research and a bureau for the collection and dissemination of statistics and information as well as undertaking fundamental and biological research. The most pressing lines of research are, in technology, on the capture of fish and on its handling and preservation; in biology, biological research which is necessary for the intelligent development and conservation of the fisheries, including studies on dominant species of fish, fish histories, productivity and depletion, migrations, seasonal schooling and spawning, and environmental studies on contrasted types of fishing grounds. Besides research in oceanography, such as an ecological study of the environments in which fish live, long-term fundamental research will be necessary to provide background information for the intelligent management and development of the fisheries, and as an informed basis for measures of conservation. The establishment of a fishery research institute in the British West Indies will be necessary, and such a scheme should be co-ordinated with any plans for the establishment of a University of the West Indies, or it should be affiliated to the Imperial College of Tropical Agriculture. Fishery research institutes and experimental stations should frame their research policy in accordance with the practical needs of the industry and co-ordinate their programmes on a regional basis.

This sectional report also recommends that an exploratory fishery survey in the Bahamas and Caicos, investigations on fish handling and preservation and net preservation, under local conditions, and on the commercial possibilities of sharks, crawfish, conchs, turtle and shrimp should be undertaken without delay; and that the attention of the Caribbean Research Council should be directed to the necessity

for collecting and disseminating information on the commercial possibilities of sharks, the crawfish industry in the Bahamas, fresh and brackish water fish-culture and on sport fishing.

The report of the committee which considered the planning of public works for the improvement of agriculture, education, housing and public health includes a recommendation for the establishment of a Caribbean Planning Commission as part of the Anglo-American Caribbean Commission. It also recommends the institution for research on standardization of building units in various materials and the possibility of prefabricating such units in the Caribbean area, including the scientific pretreatment of lumber and standardized timber units against termite and rot at depots in each territory or group of islands.

The committee which considered industrial development recommends that the Government should help to create and to foster new industries and the development of existing industries which could survive without continued State assistance, either by undertaking research itself or by supporting approved investigations, the results of which should be made available at once to the whole area. Such research might include the erection of pilot plants at the public expense.

These and other recommendations of the sectional committees were adopted by the Conference, which further recommended that another session should be held within twelve months, and that the Anglo-American Caribbean Commission should consider the establishment of a permanent secretariat to handle the work of the Conference. Besides the emphasis thus laid on research, however, the Conference is of more than local interest as an example of Colonial regionalism in which an effective expression is given to the democratic spirit.

## POSSIBLE RELATION OF LINOLENIC ACID TO THE LONGEVITY AND GERMINATION OF PINE SEED

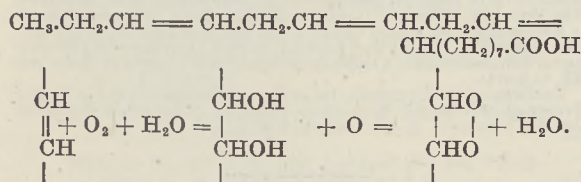
By DR. N. T. MIROV  
U.S. Forest Service

SEEDS of some pines, such as Jeffrey pine (*Pinus jeffreyi*), can be stored in air-tight jars at room temperature for a long time. Even after ten years of storage one may expect as much as 40 per cent of viable seed. When the seeds of Jeffrey pine are sown in a greenhouse they germinate rapidly and abundantly. Many other pines, as, for example, sugar pine (*Pinus lambertiana*), have short-lived seed. Under ordinary storage conditions sugar pine seeds lose their viability rapidly, and after five years of storage their germination is usually nil. At 5° C. the viability of sugar pine seed is maintained for a long time; in one case, after eight years of cold storage, germination amounted to 86 per cent of the original. Normally seeds of sugar pine sown in a greenhouse either fail to germinate completely or give a very small percentage of germination. When, however, the seeds are chilled in some moist medium for three months at 5° C., they germinate as well as those of Jeffrey pine. This prolonged period at a low temperature, necessary for germination of refractory seeds, can be designated as the period of incipient germination.

Food storage materials of seed of the two pines are composed chiefly of fatty oil (55.5 per cent in sugar pine seed and 50 per cent in Jeffrey pine seed), proteins and sugars. It is seen that more than one half of the reserve food material in seeds of both pines consists of oil, and that sugar pine has more of it than Jeffrey pine. Analyses have shown that the oil of sugar pine seed has an iodine value of 150.5 while the oil of Jeffrey pine seed has an iodine value of 136.4. There is thus a higher degree of unsaturation in the seed oil of sugar pine.

In ordinary storage the most unsaturated component of the pine seed oil—linolenic acid—disappears gradually in all seeds but more rapidly in sugar pine than in Jeffrey pine seed. In the seeds of both species stored at 5° C., on the contrary, no appreciable losses in linolenic acid were detected. When sugar pine seeds were chilled in moist sand for three months, only traces of linolenic acid were found at the end of that period. Prolonged storage at ordinary temperatures results in decrease of germination capacity of sugar pine seed, whereas chilling in moist sand results in an increase; yet in both cases linolenic acid disappears.

Although a possible role of unsaturated fatty acids and especially of linolenic acid in germination and longevity of oleaginous seed has received very little attention, its importance in biological oxidation has been emphasized by Meyerhof<sup>1</sup>. This author discussed at length Warburg's findings that "of all the unsaturated acids, linolenic acid alone with its three double linkages shows autoxidation with iron". During autoxidation the number of double bonds decreases and the reaction proceeds as follows:



Meyerhof distinguishes between the reaction *in vitro* where it stops on the conversion of linolenic acid into slightly oxidized products, and a reaction *in vivo* where it progresses as far as formation of carbon dioxide.

In stored seed where life processes are hindered, conditions perhaps are similar to those existing *in vitro*. Slightly oxidized products are formed and these are gradually polymerized into inactive substances. The degradation of the unsaturated acids, and especially of the linolenic acid, proceeds faster in sugar pine seed than in Jeffrey pine seed. During the incipient period of germination of sugar pine seed the conditions may be similar to a reaction *in vivo*. Here disappearance of linolenic acid is probably connected with respiration and also with transformation of fats into carbohydrates.

The final results in both cases are precisely the same, namely, disappearance of linolenic acid, but the course of oxidation is quite different. In one instance it possibly causes death of the seed, while in the other it probably represents the first stage of germination connected with the utilization of stored food materials.

Of course, variations in linolenic acid contents in the seed of the two pines do not explain yet why Jeffrey pine seed germinates well under ordinary conditions and sugar pine seed does not. The experi-

ments show that it might be connected with differences in the status of growth hormone in the seeds of the two species, but the discussion of this phase of germination is beyond the scope of this paper.

<sup>1</sup> Meyerhof, Otto, "Chemical Dynamics of Life Phenomena" (Philadelphia and London, J. B. Lippincott Co., 1924).

## ASSOCIATION OF UNIVERSITY PROFESSORS AND LECTURERS OF THE ALLIED COUNTRIES IN GREAT BRITAIN ANNUAL MEETING

THE fifth general meeting of the Association of University Professors and Lecturers of the Allied Countries in Great Britain was held in Cambridge during June 24 and 25, 1944. It was the annual meeting, a sequel to the annual meeting of 1943 held in Oxford, and a special significance was attached to it as a friendly gathering, as well as a business meeting, in view of the not unreasonable expectation that the members may have separated to their own countries before the next annual meeting falls due.

The morning of June 24 opened with meetings of Section IV (Student Affairs), chairman, Prof. R. D. Laurie (Great Britain); Section VIII (Modern Humanities), chairman, Prof. L. E. Genissieux (France); and Section IX (History), chairman, Dr. de Sturler (Belgium). Then all Sections met for a lecture on the history of the Cavendish Laboratory by Sir Lawrence Bragg. The afternoon followed the same pattern: meetings of Section II (Collaboration with International Bodies), chairman, Prof. J. Timmermans (Belgium); Section V (Law), chairman, Prof. B. Helczynski (Poland); Section VI (Science and Technology), chairman, Prof. A. Photiades (Greece); and Section VII (Economy), chairman, Prof. J. A. Veraart (Netherlands), and after tea in the gallery of Emmanuel College a lecture by Prof. G. M. Trevelyan on the history of the University of Cambridge.

On June 25 the General Assembly met, and was welcomed by the vice-chancellor, Dr. T. S. Hele, master of Emmanuel College.

The president of the Association, Prof. J. Timmermans, then gave his address, which was a résumé of the year's work and progress. He pointed out that it has been a period of consolidation but that also there have been new departures. The Executive Committee had found sufficient work to require a meeting each month, with two in May. An Education Conference was held in April on lines similar to that held in the spring of 1943, and the British Council again guaranteed a very considerable contribution towards defraying the cost of publishing the report. The Publicity Committee, under the chairmanship of Prof. Photiades, carried through the publication of *Communication*, addressed to members, of which three numbers have already appeared and of which some half-dozen are planned to be produced during twelve months. Prof. Timmermans reviewed the activities of members of the Executive Committee in relation to other organizations having similar interests, notably the Conference of Allied Ministers of Education, the London International Assembly, the British Association Committee on Post-War

University Education and the International Relations Committee of the Association of University Teachers. One of the most conspicuous developments of interest to the Association during the year was the events following the visit of the American education delegation. This delegation co-operated with the Conference of Allied Ministers of Education in producing a scheme for a United Nations Organisation for Educational and Cultural Reconstruction, which is now under consideration by the United Nations Governments. It is the hope of the Association that it will be able to establish useful contacts with this important Organisation.

Dr. Grayson N. Kefauver, who represents the United States Government in connexion with the development of the United Nations Organisation for Educational and Cultural Reconstruction, was present, and addressed the meeting. He explained the attitude of the United States and the purpose of the new Organization, and welcomed the suggestion of co-operation from the Association of Allied University Professors.

The reports of the various sections were then received by the Assembly, indicating that a considerable amount of work is in hand on a variety of topics. Arising therefrom it was resolved on the recommendation of Section IV that the Memorandum on Student Health which was printed in No. 1 of *Communication* be adopted.

The afternoon session was devoted to a discussion on the draft statutes of the proposed International Association. The importance of a thorough discussion was recognized by all, and it was felt undesirable to proceed to final decisions at this meeting as this was the first occasion on which the General Assembly had had an opportunity of expressing its views. The Executive Committee was asked to undertake some redrafting in the light of the discussion, for presentation to the next general meeting.

Prof. J. A. Veraart (Netherlands) was elected president for the session 1944-45. Other members of the Executive Committee were elected as follows: Belgium, Prof. J. Timmermans; Czechoslovakia, Prof. V. Klecanda; France, Prof. P. Vaucher; Great Britain, Prof. R. D. Laurie; Greece, Prof. A. Photiades; Netherlands, Prof. J. A. Veraart; Norway, Prof. A. Sommerfelt; Poland, Prof. B. Helczynski; U.S.A., Prof. A. L. Goodhart; Yugoslavia, Prof. S. Yovanovic.

## APPOINTMENTS VACANT

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

- LECTURER (temporary) IN PHYSIOLOGY—The Registrar, King's College, Newcastle-upon-Tyne 2 (August 16).  
 ASSISTANT MASTER to teach SCIENCE SUBJECTS to Junior Technical Classes and to Apprentice Day Classes in the Mill Street School of Building, Manchester—The Director of Education, Education Offices, Deansgate, Manchester 3 (August 16).  
 SENIOR TECHNICAL OFFICER on the staff of the Northamptonshire Institute of Agriculture, Moulton, Northampton—The Secretary for Education, County Education Offices, Northampton (August 18).  
 ASSISTANT LECTURER IN METALLURGY—The Registrar, The University, Leeds 2 (August 19).  
 ASSISTANT LECTURER IN BOTANY—The Registrar, The University, Manchester 13 (August 19).  
 ASSISTANT MASTER to teach MECHANICAL ENGINEERING SUBJECTS in the Stockton-on-Tees Technical School and Evening Institute—The Director of Education, Shire Hall, Durham (August 19).  
 SPEECH THERAPIST—The Director of Education, Town Hall, Ilkerton, Derbyshire (August 19).  
 AGRICULTURAL CHEMIST—The Principal, Agricultural Institute and Experimental Station, Kirton, Boston, Lincs. (August 19).  
 ASSISTANT PSYCHOLOGIST—The Chief Education Officer, 2 Cecil Road, Bristol 8 (August 21).  
 LECTURER (temporary) IN PHYSICS—The Registrar, University College, Southampton (August 21).

RESEARCH MANAGER to an Engineering Company in the Midlands (must possess an Honours Degree in either Engineering or Physics)—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. A521.XA) (August 21).

CIVIL ENGINEER by an Airways Corporation for Constructional Work in India and Burma—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. E.1069.XA) (August 21).

SPEECH THERAPIST—The School Medical Officer, County Hall, Chichester (August 23).

SENIOR POST under the Aeronautical Inspection Directorate (must possess a Degree in Metallurgy or recognized equivalent)—The Ministry of Labour and National Service, Room 432, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. F.1155A) (August 25).

ASSISTANT MASTER (Graduate) to teach PHYSICS and some MATHEMATICS in the Sheffield Technical School—The Director of Education, Education Office, Leopold Street, Sheffield 1 (August 26).

READERSHIP IN PHYSICAL ANTHROPOLOGY—The Registrar, University Registry, Oxford (August 31).

SECRETARY to the Editorial Board of the 'Transactions' (must hold a Degree in Physics, Metallurgy or Engineering of a British University, or an equivalent technical qualification)—The Secretary, Institute of Welding, 2 Buckingham Palace Gardens, London, S.W.1 (August 31).

CHIEF ELECTRICAL ENGINEER AND MANAGER—The Town Clerk, Town Hall, Chichester (August 31).

BOROUGH ELECTRICAL ENGINEER AND MANAGER—The Town Clerk, 4 Woodville Terrace, Gravesend, Kent (September 1).

UNIVERSITY CHAIR OF STATISTICS tenable at the London School of Economics—The Academic Registrar, University of London, South Kensington, London, S.W.7 (September 4).

CURATOR OF THE CITY MUSEUMS—The Town Clerk, Room 57, Civic Hall, Leeds 1 (endorsed 'Curator of the City Museums') (September 9).

CHAIR OF ELECTRICAL ENGINEERING—The Acting Registrar, The University, Leeds 2 (September 30).

CHAIR OF BIOLOGY in Victoria University College, Wellington, New Zealand—The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1 (September 30).

LIBRARIAN—The Librarian, Queen's University, Belfast (October 31).

CHAIR OF PSYCHOLOGY in the University of Sydney—The Secretary, Universities Bureau of the British Empire, c/o University College, Gower Street, London, W.C.1 (October 31).

ASSISTANT LECTURER (temporary) IN MATHEMATICS—The Registrar, The University, Sheffield.

ASSISTANT MASTER (Graduate) qualified to teach ENGINEERING SUBJECTS and MATHEMATICS—The Principal, Technical Institute, Beckenham Road, Beckenham, Kent.

TEACHER OF ENGINEERING SUBJECTS (must possess a Degree or equivalent qualification), and a TEACHER (man or woman) OF SCIENCE (with good qualifications in General Science or in Biology)—The Principal, Technical Institute, Darnley Road, Gravesend, Kent.

ENTOMOLOGICAL FIELD OFFICER by the Government of Aden—The Ministry of Labour and National Service, Appointments Department, Sardinia Street, Kingsway, London, W.C.2 (quoting Reference No. O.S.214).

TEACHER OF ENGINEERING, DRAWING and MECHANICS in the Junior Technical School for Boys—The Principal, Wimbledon Technical College, Gladstone Road, London, S.W.19.

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- National Institute of Economic and Social Research. Annual Report, 1943. Pp. 20. (London: National Institute of Economic and Social Research.) [187]  
 British Colliery Owners Research Association and British Coal Utilization Research Association. Report of Discussions on Determination of Particle Size in Sub-Sieve Range. Pp. 69. (London: British Colliery Owners Research Association, and British Coal Utilization Research Association.) [197]  
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- Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 174: Recent Advances in the Prevention and Treatment of Blowfly Strike in Sheep. Supplement to Report No. 2. By the Joint Blowfly Committee. Pp. 20. (Melbourne: Government Printer.) [147]  
 Smithsonian Institution. War Background Studies, No. 18: Peoples of India. By William H. Gilbert, Jr. (Publication 3767.) Pp. iv+86+21 plates. (Washington, D.C.: Smithsonian Institution.) [247]  
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- List of German Publications being reproduced in America by the Photo-Offset Process under authorization of the Alien Property Custodian in Washington. Pp. 12. (London: H. K. Lewis and Co., Ltd.)