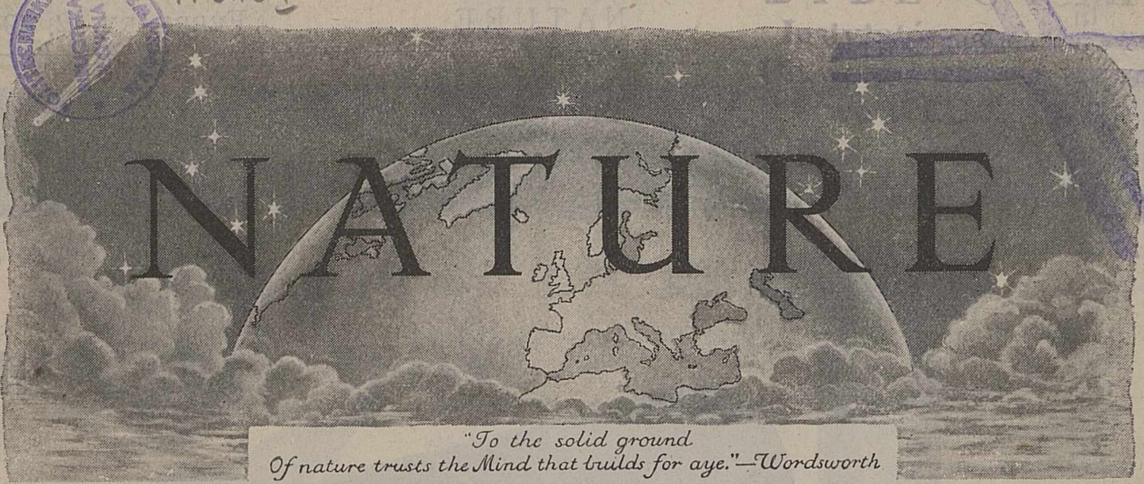

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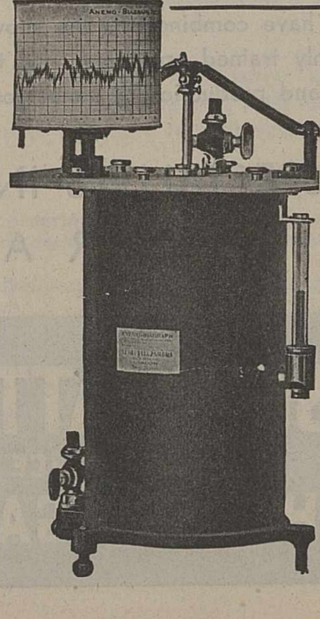

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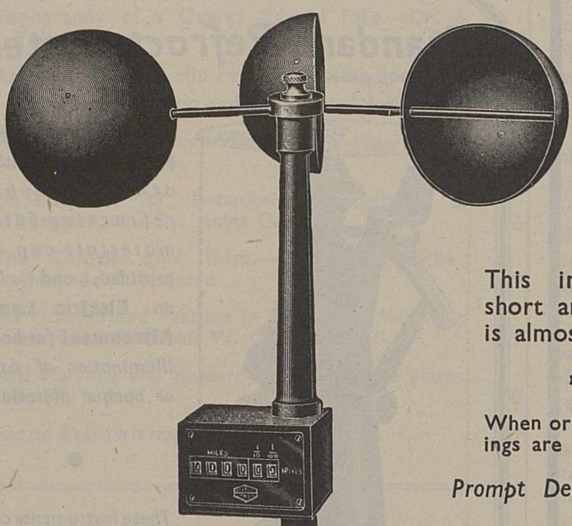

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THE ROYAL OBSERVATORY

THE announcement in the daily Press that the Admiralty has decided, in principle, that the Royal Observatory shall be moved from Greenwich to a new site, where conditions are more favourable for astronomical observations, will not have come as a surprise to those who have watched the trend of events in recent years. Rather is it a matter for surprise that the Observatory has been able to carry on for so long, under conditions of increasing difficulty, on its original site. Many observatories elsewhere have been compelled by similar circumstances to move. In the case of the Royal Observatory, the long associations with Greenwich, the advantages in fundamental astronomy of continuity of observation on the same site and with the same instruments, and its position on the prime meridian, have no doubt all played a part in postponing a decision the ultimate inevitability of which must long have been apparent.

The Royal Observatory was founded in 1675 by Charles II, to meet the needs of navigation. The problem of finding longitude at sea had then become urgent. The positions of the moon and stars were not known with sufficient accuracy to enable the method of lunar distances to be used. The Royal Warrant for the building of the Observatory states that "in order to the finding out of the longitude of places for perfecting navigation and astronomy, we have resolved to build a small Observatory within our park at Greenwich, upon the highest ground, at or near the place where the Castle stood". Sir Christopher Wren was appointed as architect and the Rev. John Flamsteed was appointed "our astronomical observator" and directed "to apply himself with the most exact care and diligence to the rectifying the tables of the motions of the heavens, and the places of the fixed stars, so as to find out the so-much-desired longitudes of places for the perfecting the art of navigation".

This branch of astronomy has continued to be the fundamental work of the Observatory throughout its long history. It provides the foundations upon which so much astronomy is built. The importance of the contribution made by Greenwich was stressed by the eminent American astronomer, Simon Newcomb :

"The most useful branch of astronomy has hitherto been that which, treating of the positions and motions of the heavenly bodies, is practically applied to the geographical positions on land and at sea. The Greenwich Observatory has . . . been so far the largest contributor in this direction as to give rise to the remark that, if this branch of astronomy were entirely lost, it could be reconstructed from the Greenwich observations alone."

When the need had arisen for general agreement about the choice of a zero or prime meridian from which longitudes should be measured, and a conference was called in Washington in 1883 by the State Department of the United States to consider the question, no alternative to the meridian through Greenwich was seriously considered. By an almost unanimous vote, the meridian through the centre of the transit instrument of the Greenwich Observatory was adopted as the prime meridian and as the basis for a zone time system. The choice of Greenwich was due to the close concern of the Observatory for more than two centuries with the practical needs of navigation.

The work of the Royal Observatory has not, however, been restricted to fundamental astronomy. In Airy's time meteorological, magnetic, solar and spectroscopic observations were added. Meteorological and magnetic observations were commenced in 1840. The Royal Observatory has the longest continuous series of magnetic observations and was the first observatory to employ photography, in order to obtain continuous records of the variations of the earth's magnetism. The magnetic observations were removed from Greenwich to Abinger, in Surrey, in 1923, consequent upon the electrification of the suburban system of the Southern Railway. The Solar Department, added in 1873, was a natural development arising out of the discovery that there were certain definite relationships between terrestrial magnetism and phenomena on the sun. In 1886, the 28-in. refractor was added to the Observatory's equipment, for visual spectroscopic observations and for double-star measurements. The application of photography to astronomy opened many new fields of work, and the Royal Observatory has taken a prominent part in the work of the Astrographic Catalogue, in the measurement of stellar parallaxes, in the determination of magnitudes and proper-motions of stars, in the measurement of colour temperatures and in other important investigations. A 26-in. photographic refractor, a 30-in. reflector and a 36-in. reflector have been added to the equipment of the Observatory at various times.

When the Royal Observatory was built, Greenwich was a fashionable village in the country, several miles from London. It was many years before the outward growth of London, with its accompanying pall of smoke, began to be troublesome. In 1824 Pond, then Astronomer Royal, erected an azimuth mark at Chingford for the new Troughton transit instrument. It must have been possible at that time to observe this mark with fair regularity; but it is many years since it has been visible from Greenwich even under the best conditions. The first note of concern about the future appears in the report of the Astronomer Royal (Sir William Christie) to the Board of Visitors of the Royal Observatory in 1906: "The continued efficiency of the Observatory is seriously threatened by the schemes for generating stations planted, or to be planted, in the immediate neighbourhood of the Observatory." The London County Council was then building a generating station exactly on the Greenwich meridian, half a mile from the Observatory and overshadowing the noble buildings of the Royal Naval College. That a public authority should have been allowed to commit such an act of vandalism is a reproach to the nation. The two chimneys, which stride the meridian, were indeed truncated to reduce the interference from smoke and heated gases with observations of circumpolar stars below the pole. Nevertheless, this generating station has been a source of continual trouble, discharging smoke and fumes and, with a northerly wind, showering grit over the Observatory, which has caused damage to pivots and other delicate parts of the instruments.

At the close of the War of 1914–18, there were still green fields and country lanes within an easy walk of Greenwich in the south-east direction. But since then London has stretched its tentacles well beyond Greenwich and, during the same period, there has been considerable industrial development in the vicinity of the River Thames. The deterioration of conditions for observation during the past twenty-five years has been marked and progressive, and has been referred to in the annual report of the Astronomer Royal on several occasions. The measurement with an Owens automatic filter of the pollution of the atmosphere by solid matter was commenced in 1934 and has shown that the pollution at Greenwich is not surpassed, on the average, at any reporting station in Great Britain. The difficulties were summarized in the Astronomer Royal's report for the year 1939.

The progressive decrease in the transparency of the atmosphere at Greenwich is shown by comparison between the Greenwich and Kew annual sunshine totals. From 1911 until 1920, Greenwich averaged sixty-four hours more sunshine than Kew; thereafter there was a rapid relative decrease in the Greenwich totals, so that during 1936–38 Kew averaged 159 hours more than Greenwich. This decrease in the amount of sunshine recorded at Greenwich in relation to the amount recorded at Kew is the result of loss of register at Greenwich when the sun is low, caused by atmospheric impurity.

A further trouble, first referred to in the report of the Astronomer Royal for 1937, was the brightness of the sky resulting from scattering of light from street lamps and illuminated advertisement signs; modern developments in street lighting, such as mercury vapour lamps and high-pressure gas, to meet insistent demands for better road illumination, have made the night sky at Greenwich (in peace-time) so bright that the Milky Way is never visible with the naked eye and long-exposure photography has become impossible. All types of observation, both visual and photographic, have been adversely affected; some, such as photometric observations, which require uniform transparency of the sky in different directions, can no longer be undertaken. New types of instrument, such as the Schmidt camera for the photography of faint stars, cannot be used at Greenwich because of the fogging of the plates.

It should not be necessary for a scientific establishment—even though it is the oldest in Great Britain—to stand out against public amenities. The astronomer requires a dark sky and a clean atmosphere; the public wants well-lit roads and puts up with a polluted atmosphere as the penalty of urbanization. The staff of the Royal Observatory has for many years been waging an unequal and losing struggle against progressively worsening conditions. It is not right that the reputation and prestige of the Royal Observatory should suffer by having to turn back from the van of progress in astronomy. The contributions that the Observatory has made to astronomical and nautical science in its long history, and the prestige that it has brought to the British nation, give it a right to ask for a new and a worthy home, where it will be free from the troubles that have so sorely beset it and where it may enter upon a new era of service to the community and of scientific achievement.

The Paris Observatory, faced with somewhat similar problems in a much less acute form, set up its large telescopes at Meudon and established a high-altitude station at the Pic du Midi. The possibility of keeping the meridian work and the time service at Greenwich and moving the rest of the work has evidently been considered and rejected. The meridian observations are handicapped and their accuracy is impaired by the difficulty of observing low north stars. The long-range programmes of observation, which should be undertaken by a great national observatory, require every member of the staff to observe, usually with more than one instrument; division into two branches would entail a serious loss of flexibility. The Observatory need not necessarily be tied to the prime meridian, which has been fixed by international agreement and will remain. The War has already necessitated the removal of the time service from Greenwich, and Greenwich time is now being provided by two time stations, neither of which is on the Greenwich meridian.

It is to be hoped that the original building, which Wren said that he built "a little for pompe", and the old buildings clustered around it will remain and that the historic instruments—including Halley's, Bradley's and Pond's transits, Bradley's zenith sector, with which aberration and nutation were discovered, the old quadrants, and, most famous perhaps of them all, the Airy transit circle—will be suitably displayed in them. They will become an object of pilgrimage not merely to astronomers but also to many visitors to Great Britain from all parts of the world.

Much of the work of the Royal Observatory has had to be removed elsewhere during the War, either for reasons of security or because of enemy action. The continuity of many programmes of observation has been broken. It is to be hoped that a new home will be made available as soon as conditions permit, so that the various branches of the Observatory can be brought together again and normal work resumed under more favourable conditions. It is understood that Treasury sanction will be required; but surely in a case such as this, to obtain it will be little more than a formality. The new home should be one befitting the long history and great traditions of the Royal Observatory. What could be more appropriate than that one of our large historic country houses, mellowed with age and rich in associations with the past, should form the nucleus of the new Observatory, the various telescopes being erected in the surrounding grounds? A fundamental need is for a neighbourhood not likely to be affected by the spread of industry, and it should not be impossible to find such a site.

A TURNING POINT IN EDUCATION

Education in Transition

A Sociological Study of the Impact of War on English Education, 1939–1943. By H. C. Dent. (International Library of Sociology and Social Reconstruction.) Pp. xi+244. (London: Kegan Paul and Co., Ltd., 1944.) 12*s*. 6*d*. net.

THE Education Bill now before Parliament is remarkable in many ways. The complete break it effects with the traditions of a century is enough to justify a description of it as revolutionary. Yet support for it is well-nigh unanimous, and criticisms offered during the second reading debate were confined to relatively minor points.

What is most remarkable about all this is that it should have been possible to introduce such a Bill at all, let alone to do so amid such general approval. It would have been inconceivable even as recently as three years ago.

Evidently some profoundly important change of outlook has occurred in Great Britain within a very short time. The new sense of educational needs is obviously a result of this deeper and wider change. It might well have happened eventually without the shock of total war. But the shock has certainly accelerated it and given it both sharper definition and, for the time being at least, a powerful backing of national conviction.

Essentially the change is towards a new conception of national destiny both in internal life and in external relations and responsibilities. It is British society as a whole which now tends to think so differently of itself. That the changed outlook should find expression first and most prominently in a liberally inspired plan of educational reconstruction is both natural and significant. The quickened sense of destiny and new life comes to its logical focus there, and Mr. Dent is well justified in the suggestion he offers in the sub-title of his book.

What is needed then, at such a turning point, is a backward glance with a critical eye over the past four years to mark out the route we have travelled. Mr. Dent is very favourably placed and unusually well qualified to perform this service, and he has discharged it with grasp and understanding in a timely and competent book. Though he writes with both warmth and insight he shows no tendency to dramatize the story. Yet the material itself is so intensely dramatic, passing as it does from the nerveless and sluggish Britain of the last decade to the sinewy and expectant Britain of to-day, that, in effect, it dramatizes itself.

The author tells his story in four stages, beginning with the mass-evacuation of children upon the outbreak of war. These are: disintegration, recuperation, adaptation and ferment. How strongly this suggests a five-act play of which the final act is still to be played! One could wish that something of this sense of drama on the great national scale might be communicated to those numerous critics of the Education Bill who see in it not at all the earnest of a great awakening but merely a failure to give full effect to some petty or short-sighted interest of their own.

Disintegration is, of course, the story of the disastrous consequences of hasty and ill-planned evacuation, planned it would seem by those who had little or no concern for educational consequences but were only eager to get the children away from the dangerareas. Yet this very bungling contributed in a most effective way to the awakening that was to take place. As Mr. Dent very truly observes: "It was a striking illustration of the sociological rule that the significance of an institution of society only becomes appreciated in a marginal situation".

The "it" here is the effect of evacuation in setting so many people thinking seriously about national education for the first time in their lives; the "marginal situation" is the shock of close contact between sections and classes of the population which had hitherto been almost totally ignorant of one another. Much was to happen as the result of this, the redeeming effect of what was otherwise so nearly disaster.

Recuperation followed through efforts from two main sources. One was the devoted work of an army of teachers and officials. To these Mr. Dent does ample justice. He does rather less than justice to the other, to the Board of Education itself. No doubt the Board, like so many other authorities, was lacking in grasp and foresight at the outset. But it had no free hand and was constantly being pushed aside or over-ruled. It is probably no accident that recuperation proceeded *pari passu* with recovery by the Board of its own proper controls and responsibilities.

Adaptation is a longer story. It became possible in the respite that was accorded us in 1941. The point that Mr. Dent makes with much force here amply justifies the title of the story. After mentioning the headings of the developments that occurred: war-time nurseries, school-meals, camp boarding schools, service of youth, pre-service training, youth registration, and several others, he comments: "Not a single one of these developments is wholly new. Powerful as has been the stimulus which total war has given to educational thought in this country, in the realm of educational practice it has as yet brought into being no absolutely new form or institution", though he believes that in the realm of theory we are now reaching new territory. The observation is just. What was working at this stage was the characteristic English 'hunch', inchoate thought revealing itself first in improvising action.

Then, very fruitfully, and again quite characteristically, follows the ferment, which has been going on so vigorously for the last year or two, expressing itself in a flood of books, pamphlets, brochures, articles and other forms of declaration. Mr. Dent gives an able analysis of this material, showing conclusively how the thinking, while almost invariably quite practical, was all the time deepening and widening and establishing ever firmer grasp.

So, in effect, the essential revolution had already taken place when the Board, seizing the happy moment, issued first its White Paper and then its draft Bill.

The full moral of the story has yet to be drawn. One important aspect of it is well stated by the Archbishop of Canterbury in a passage that Mr. Dent quotes: "The educational problem must never be separated from the social problem. It is all part of the great enterprise of civilization—the provision of a truly civilized society". But, as Mr. Dent so clearly sees, it is for the British people themselves to draw the full moral. The moment is big with fate. The Bill at its best, even when it has become an Act, offers no more than a great opportunity. We still have to learn new restraints and to subordinate the lesser to the larger interests if we are to make full and fruitful use of the instruments it places in our hands. FRED CLARKE.

SOCIAL PSYCHOLOGY IN A WAR FACTORY

War Factory

A Report by Mass Observation. Pp. 127. (London: Victor Gollancz, Ltd., 1943.) 4*s*. 6*d*. net.

WHAT'S in a name? More now than in Shakespeare's time. To attract notice, a label is necessary for any new movement, yet its later directions may be inaccurately described by the original title. It might shock some gentle English socialists to realize why there is a 'z' in Nazi, or organizers of O.C.T.U.s to discover an early meaning of 'cad'.

"War Factory" is "a Report by Mass Observation". Yet it is not by the masses, and Mr. J. B. Priestley would deny that it is of the masses. Perhaps because of this, it reads unusually well. Here is a workmanlike account of 'functional penetration' or 'participant observation'. This technique anticipated Mass Observation; a fact acknowledged with some back-hand swipes by Mr. Tom Harrisson in an interesting, splenetic preface. He shows gratifying signs of dropping a tiresome tendency to quote only work by the 'old firm'; yet it is still true that science, like a house, is built by superimposing stories, not by ballet-leaps deriving momentum from kicks at the work of predecessors. Mass Observation has still to work itself into the corpus of science. In this attempt, spinosity of style will accomplish merely punctate, superficial penetration.

"War Factory" is well written by a mother; a Cambridge graduate, less ambivalent towards social differences than many educated authors, with an ear almost untitillated by odd dialect and bad language. Any temptation to dazzle the B-class—as market-researchers put it—has been resisted.

The observations were made unobtrusively while the author worked in a small factory. Here only two managers knew that the workers (and themselves) were being studied. Part of the factory was an altered private house, situated neither in a large town nor in the north of England. It is hoped that the politically minded, on reading this, will not decide that the book can therefore be neglected; even these workers are God's creatures; and in the country, geographical and social differences significantly affect workers' attitudes.

Most of the employees described are young country girls with no industrial tradition, 'directed' to a new, chimneyless and socially 'rootless' factory. Character-sketches are given; they are salutary reading for machine-worshippers who ignore individual mental differences, though subject to the methodological criticism that such novelistic or journalistic efforts may cast as much psychological light upon the writer as upon the person described. Even in this little congeries—apparently it never grew into a community—there was marked social stratification. Girls in the machine and the assembly shops were regarded in very different lights. Nearly all, however, spoke of those who gave orders and did domestic work as 'they': and those who obeyed and were cared for solicitously as 'we'; a sobering thought for democrats.

The investigation was paid for by the firm observed; unlike the studies reported in "The Pub and the Public". This fact must be taken into account in appraising the result. The observer's criticism, however, was accepted sportingly and broadmindedly, in a constructive spirit. Indeed, the footnotes, by the works and labour managers, sometimes re-interpreting the writer's findings, but usually agreeing with them and accepting their practical implications, are some of the most encouraging parts of this book. Has the admirable "Western Electric attitude", which regards differences between the personality and temperament of workers, even in engineering shops, as suggesting scientific problems, spread at last from the United States to England ? North of the Trent we await the dawn.

In this book there are no Zolaesque revelations, no 'front-page' stuff. Some newspaper men will be disappointed in this factory, for no men bite dogs. It offers no foundation for a glossy propaganda film or husky radio-postscript. We find just a detailed account of how a bunch of country girls worked, or didn't, in this comfortable, rather pleasant war-factory ; how they adapted themselves, or didn't, to the bench and the hostel ; how they solved the 'academic' problem of rest-pauses by just taking them when 'so disposed' ; how they displayed almost no interest in the War, except to speculate what they would do when it was over, thus puzzling tidy-minded 'scientific' thinkers, who regard the War as 'a stimulus', like a spur or a tot of rum. Now, this attitude will annoy people who, having delighted to design or make those lovely machines, cannot understand why girls should fail to play with them as enthusiastically, nine hours a day, for years. Yet why should they delight for ever merely in fiddling with bits and pieces, the function of which (often for necessary reasons) was unknown to them ? In peace-time, some of these girls would have been occupied, in sunshine and fresh air, with chickens, calves, even with their children. It is not recorded that they had been guided, by tests and psychological interviews, to different jobs, with some respect paid to their idiosyncrasies, as they would have been had they joined the Forces. Nor do we read of courses arranged by an Army Bureau of Current Affairs, or discussions in the British Way and Purpose. Yet incentive and motive are complex affairs, not easily to be packed into a pay-envelope.

The physical circumstances of the work seem to have been admirable. Though hours were long, the work was easy. There was good food, at which the amount of grumbling seems inversely related to the workers' degree of education and sophistication. Though some girls disliked being billeted upon inhospitable landladies, others were installed in an excellent hostel. But—and for the social psychologist this is perhaps the most interesting fact—in order that they might perform, as often as possible, a series of (to them) almost meaningless actions, everything else was done for them. They had no part nor lot in worries about food-rations or shopping ; sometimes on returning home they found that their family had ceased to consult them even about important matters like taking a lodger. When the day's work was over, often they did nothing but have supper and go to bed. They seldom listened to the radio, or read a newspaper, and when an illustrated daily paper came their way, they thumbed it listlessly, chattering about astrology, fashions and dress coupons. When they gossiped it was usually not about others in the factory but about people at the real place : home. They regarded the War as something to be endured, like a very heavy shower of rain, which for some inscrutable reason has not stopped, cannot go on for ever and cannot be affected by their efforts. Even grumbles were seldom directed towards anyone who could remedy the fault.

Yet it should be remembered that for them there were no smart uniforms, presumably no badge to show that they were doing important war work, no glamour, no public parades. The town into which they were herded did not want them, showing this positively and negatively ; for example, when the firm suggested the establishment of a British Restaurant there was no effective local co-operation. For their sisters, the Armed Forces may have provided many things of which these workers were deprived, including a stimulation of the intellect and discussion of their future as citizens and voters. In the life of these young workers, there is a background of aimlessness, irresponsibility and boredom ; all regarded as inevitable. This study, in conjunction with other field-work, emphasizes the decline in positive citizenship among such young people. The *laisser-faire* of leisure and its dangerous separation from work are immediately and primarily responsible for this. Here, under its modern orchestration, the social psychologist's ear discerns an old, mournful tune.

T. H. PEAR.

RECOGNITION OF THE STARS

Star Recognition

By Ft.-Lieut. Francis Chichester. Pp. 20+3 charts. (London : George Allen and Unwin, Ltd., 1943.) 7*s*. 6*d*. net.

THIS book supplies a lot of useful information for those engaged in air-navigation star-work, and follows the procedure adopted in the "Air Almanac", dividing the stars into three Lots : Lot 1 contains 22 main stars which are printed in capitals ; the 13 stars in Lot 2 are in italics, and Lot 3 contains 15 stars considered third class for air navigation ; but Benetnasch and Polaris are now included among the 24 main air navigation stars, Polaris, though only second magnitude, being considered much more valuable to the navigator than any other stars. Very full directions are supplied for the identification of the stars in various quarters of the heavens, and some space is also devoted to a description of the appearances of the navigational planets, Venus, Mars, Jupiter and Saturn, and to the method for recognizing them. On a Mercator's projection 390 stars are charted, and these include all the first-magnitude stars, nearly all the second-magnitude stars, 247 third-magnitude stars, and 8 fourth-magnitude stars (Polaris cannot be shown on a Mercator's projection and hence does not appear on the chart). A duplicate projection on which the stars are not named provides a useful test for the identification of stars—first-magnitude especially—and will show the student his weakness in star recognition.

Identification of the stars by means of the Mercator star chart and also by computed declination and sidereal hour angle is described, and an example of the application of the former method is given. At the end of the work there is a "Catalogue of First Magnitude Stars, given in Order of their S.H.A., with their Mean Positions for January 1943 in Terms of Dec., S.H.A., and R.A., with Annual Variations for the Middle of the Year".

This is a most useful book for air navigators. With the star charts, which fold up, it is enclosed in a glazed linen folder.

Radio-Technology

By B. F. Weller. Pp. viii+358. (London: Chapman and Hall, Ltd., 1943.) 21s. net.

THE author of this book is a practical radio-engineer, who has had some experience in teaching the subject; and he has endeavoured to provide an intermediate practical text-book suitable for students preparing for some of the recognized examinations in radio-communication. The reader is assumed to have a fundamental knowledge of electricity and magnetism, including the principles of alternating currents, and a mathematical ability normally associated with practical electrical engineering.

The scope of the work is approximately that of the terminal equipment—transmitters and receivers—required for radio-communication purposes. After an introductory chapter on alternating currents and resonant circuits, the general principles of the production of radio-frequency oscillations are described in Chapter 2. The properties of thermionic valves, from diodes to pentodes, are next dealt with, together with the circuit arrangements used for applying valves as rectifiers, amplifiers and oscillators.

This leads to a treatment of the principles of radio transmitters, and the k ying and modulation methods used for telegraphy and telephony. Two chapters are then devoted to the general principles of reception, and the supersonic heterodyne type of receiver now so widely used for radio-communication purposes. A chapter on the various types of modern aerial systems and their relevant characteristics concludes the book.

The treatment throughout is descriptive of the technological principles of the subject without reference to any specific equipment, and should thus prove valuable to the practical operating and installation engineer who desires to acquire a closer fundamental knowledge of the branch of engineering in which he is engaged.

The Manure Note Book

A Handy Guide for Manure Manufacturers and Merchants, Farmers, Agricultural Students and Horticulturalists. By John Stewart Remington. Pp. v+58. (London: Leonard Hill, Ltd., 1943.) 3s. 6d.

THE first chapter of this book is devoted to a brief account of the constitution of soils and the composition of plants. Then follow two short chapters on the origin and use of farmyard manure and fertilizers supplying nitrogen. Chapter 4 is headed "Phosphatic Manures", but after a description of the commoner phosphatic fertilizers, gives an account of the origin, characteristics and uses of potash manures and lime, the residual effects of manures and the manurial requirements of some of the common crops. A short chapter on manures for fruit trees is followed by a collection of manure recipes for a wide range of agricultural and horticultural crops and a number of conversion tables, and tables of equivalence relating to materials used in the manufacture of fertilizers. The last fifteen pages of the book are devoted to tables showing the percentage of any nutrient in a fertilizer mixture from the weight of the fertilizer salt supplying that nutrient which is included in each ton of the mixture.

The manure recipes and the manurial requirements of crops are dealt with from the pre-war point of view. No reference is made to the present restrictions on the use of fertilizers or to some of the more modern fertilizers. Some of the fertilizer recommendations are not in agreement with the results of recent experimental work, and the inclusion of sulphate of potash in a special turnip and mangold manure while kainite is used in a potato manure seems difficult to justify. The book is likely to be appreciated more by the manure manufacturer than the farmer. F. H.

The Natural Development of the Child

A Guide for Parents, Teachers, Students and Others. By Dr. Agatha H. Bowley. Second edition. Pp. xvi+184+30 plates. (Edinburgh: E. and S. Livingstone, 1943.) 8s. 6d. net.

THE appearance of a second edition of this work, little more than a year after it was originally issued, is itself sufficient tribute to the way it has been received. Dr. Bowley set out to help parents and teachers who need guidance about the emotional development of children. To do this she has not only read widely—each chapter ends with a list of references—but also has arranged various investigations at the school psychological departments with which she has been connected. Having collected the material, the author has not impaired the value of her work by the inclusion of technical descriptions; the book is intended for the non-specialist and in no part does it become too difficult for them. It is crammed with useful information for parents and teachers and, albeit inadvertently, shouts the need for more and more parents and teachers who are really fitted to guide young children towards maturity. "The Natural Development of the Child" continually raises the question as to whether the ability to produce a child is in itself sufficient justification for the parent to constitute himself or herself the most suitable guardian of the child. One also wonders if the ability to teach reading or writing or any of the 'ologies' should continue to be recognized as the main qualification required to help the child in its adjustment to life. T. H. H.

Map Reading and Avigation

An Introduction. By Richard M. Field and Harlan T. Stetson. Pp. xiii+129. (London: Chapman and Hall, Ltd., 1943.) 15s. net.

THE aim of this book is to provide an introduction to the subject for air cadets. The first half treats of map-reading from the point of view of the aviator, and is illustrated entirely from American maps, and even these, on account of censorship, have had to be chosen with discretion. The treatment is summary and omits some of the more familiar considerations generally embraced in the study of maps for surface travel. Particular attention is paid to the relation between aerial photographs, block diagrams and topographical surveys, and many well-devised exercises and problems are included. If space was a consideration, it is difficult to understand why a brief résumé of the physiographic region of the United States and Canada and a section on the moon should be included.

The second half of the book, and probably the most useful, is an introduction to air navigation for which the author uses a word of doubtful legitimacy, 'avigation'. This section is clear and lucid, and requires a minimum of mathematical skill. The relative merits of Mercator and the Lambert conformal projections are discussed. The diagrams are well drawn. A list of reference books and charts includes only United States publications. On the whole, it is a useful book and is admirably illustrated.

MEASURING THE DISTANCE OF THE SUN FROM THE EARTH*

By SIR HAROLD SPENCER JONES, F.R.S.
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THE distance of the sun from the earth or, speaking more correctly—for the distance is, of course, variable—the semi-major axis of the earth's orbit, is the most important constant in astronomy. It determines the scale not merely of the solar system but also of the whole universe. It enters into almost any calculation of distances and masses, of sizes and densities, either of planets or of their satellites or of the stars. Any error in its determination is multiplied and repeated in many different ways. The measurement of the sun's distance with the highest attainable accuracy is therefore of great importance in astronomy, and it is not surprising that vast amounts of time and labour have been devoted to it by astronomers in the course of centuries.

Many different methods are available for determining the sun's distance. They can be grouped into three main classes: geometrical methods, gravitational methods and methods involving the velocity of light. I shall deal primarily with the geometrical methods, those which depend upon direct measurement. But first I shall refer briefly to the other methods, which are indirect.

Gravitational Methods

The gravitational methods depend upon the fact that there is a theoretical relationship between the distance of the earth from the sun and the ratio of the mass of the earth to that of the sun. This relationship, which involves the length of the seconds pendulum and the length of the sidereal year, is known with great exactness; it is one of the best established results of celestial mechanics and is the principle on which the lunar theory is constructed.

Now the perturbing effect of the earth on the motion of a nearby planet, such as Mars or Venus, depends upon the ratio of the masses of the earth and the sun. If, then, by analysing the motion of the planet the perturbing effect of the earth is determined, we can infer the distance of the earth from the sun. But, on closer examination, it is found that the mass of the earth can not satisfactorily be determined from its action on the other planets, because the observations are affected by errors of a systematic nature, which it is impossible to control satisfactorily. When the errors of observation are of a purely random or accidental nature, increased precision in the quantity to be determined—in this case, the mass of the earth or the distance of the sun—can be obtained by increasing sufficiently the number of observations. But when, on the other hand, all the observations are affected in a similar way by a certain source of error, there is a limit to the precision attainable, and no increase in the number of observations will give a precision within this limit. The causes that limit the precision with which the mass of the earth can be derived from observations of Venus or Mars do not apply in the case of the minor planet Eros, which has an orbit of high eccentricity and a star-like image. The orbit of Eros has been determined with high accuracy and it is possible that the most accurate determination of the sun's distance will eventually be inferred from the mass of the earth derived from the perturbations produced by the earth in the motion of Eros. Time is on the side of this method, and as observations of the position of Eros accumulate the precision of the determination will increase.

Another gravitational method by which the mass of the earth and the distance of the sun can be derived is worth mentioning, because of its intrinsic interest. The orbits of the planets are subject to slow secular changes caused by the perturbing actions on each planet of the other planets. These secular changes can be deduced from the accumulated observations of the planets and compared with their theoretical expressions, which involve the masses of the planets; in this way the masses of the planets can be inferred. For many years a large and unexplained discordance in the motion of the perihelion of Mercury remained one of the outstanding problems of gravitational astronomy. This was at length satisfactorily accounted for by Einstein's generalized theory of relativity. But there was also another serious discordance: the mass of the earth derived in this way corresponded to a distance of the sun which was considerably greater than the distance derived by every other method. I have rediscussed these secular changes, introducing all the corrections required by the theory of relativity, and the discordance still remains. It arises almost entirely from a disagreement between the observed and theoretical motions of the node of the orbit of Venus. Observations of the transits of Venus and meridian observations of Venus show about the same discordance. This anomaly in the motion of the node of Venus has remained unaccounted for after the most exhaustive discussion. As the American astronomer, Simon Newcomb, said, "What adds to the embarrassment and prevents us from wholly discarding the suspicion that some disturbing cause has acted on the motion of Venus, or that some theoretical error has crept into the work, is that, of all the determinations of the Sun's distance, this is the one which seems the most free from doubt arising from possible undiscovered sources of error". Again, "Unknown actions and possible defects of theory aside, it seems to me that the value of the Sun's distance derived from this discussion is less open to doubt from any known cause than any determination that can be made". Yet determinations of the sun's distance by every other method suggest that the distance obtained in this way is seriously in error.

A third gravitational method is based on the determination of an inequality in the motion of the moon known as the parallactic inequality. The disturbing action of the sun on the moon is greater at new moon than at full moon because the moon is nearer the sun when new than when full. In consequence the time of first quarter is slightly retarded and that of last quarter is slightly accelerated. The parallactic inequality involves the sun's distance, and this can therefore be inferred when the parallactic inequality is determined from the analysis of the moon's motion. The determination of this inequality from meridian observations of the moon is peculiarly liable to systematic error, because observations have to be made on one limb of the moon when the inequality is positive and on the other limb when it is negative; any error in the adopted semi-diameter of the moon therefore enters almost to its full amount into the derived value of the inequality. It is better to use observations of occultations of stars by the moon. Near first quarter the stars dis-

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appear, as the moon moves eastwards relative to the stars, at the dark limb of the moon; these disappearances can be accurately observed. The stars reappear at the bright limb and, because they are likely to be lost in the glare of the moon at the instant of reappearance, the time of reappearance is almost certain to be late. Near last quarter, the stars disappear at the bright limb and may be lost in the limb glare before the instant of true occultation, so that the observed time of disappearance is likely to be early. They reappear at the dark limb and the instant of reappearance should be accurately observed, provided the observer is looking at the right spot. The systematic errors which may thus be introduced can be controlled by discarding observations at the bright limbs, except those of stars sufficiently bright to be seen readily at the limb. With proper precautions, a good determination of the sun's distance can be made from observations of occultations.

Velocity of Light

Of the methods involving the velocity of light the first is of historical interest only. In 1675 Römer had proved that light does not travel instantaneously, but with finite velocity. He found that the eclipses of Jupiter's satellites occurred later than they should when the earth was on the far side of its orbit from Jupiter, and earlier when the earth was on the near side of its orbit. The extreme difference in time, amounting to about 16½ minutes, represents the time required by light to travel across the diameter of the earth's orbit. As the velocity of light is now known with high precision, the distance of the sun can be inferred from observations of the times of eclipses of Jupiter's satellites. But this method does not permit of high accuracy.

A better method is provided by the phenomenon of aberration, discovered by James Bradley in 1728. Bradley had been puzzled by certain anomalies in his measurements of the positions of stars. The stars seemed to be pushed slightly out of their places, always towards the direction of the earth's motion. Bradley puzzled for a long time about the cause of these displacements; but at length he correctly explained them as due to the finite velocity of light. The direction in which a star is seen depends upon the motion of the earth and the finite speed of travel of light, and as the earth travels round its orbit in the course of a year, a star appears to describe a small ellipse in the sky. The displacements in the positions of the stars depend upon the ratio of the speeds with which the earth and light travel. This ratio is called the constant of aberration, and there are many ways in which it can be determined by astronomical observations. The velocity of light being known, the constant of aberration determines the speed of the earth. But the speed of the earth is related to the size of its orbit, for its orbital path is described in one year and, the speed being known, the size of the orbit and, consequently, the distance of the sun can be inferred.

It might be thought, therefore, that from the many determinations of the aberration of the stars, the distance of the sun could be found with very high precision. But the method proves to be attended with serious difficulties. The measurement of aberration depends essentially on the comparison of the apparent positions of stars obtained at intervals of about six months, when the earth is at opposite ends of its orbit. Moreover, the observations at one season must be made soon after sunset and at the other season shortly before sunrise. Thus all sorts of troublesome errors of a systematic nature, involved in seasonal and diurnal changes, are liable to enter. The errors bound up with seasonal climatic variations are among the most troublesome in astronomy, and it is practically impossible to eliminate them. For this reason it is preferable not to use the constant of aberration as a means of inferring the sun's distance, but to use the sun's distance, determined by other methods, to infer the constant of aberration.

Of the methods for finding the sun's distance that involve the velocity of light, the most promising is based on the measurement of the exact positions of the lines in the spectra of selected bright stars near the ecliptic. The motion of the earth towards or from a star alters the wave-lengths of the spectral lines, causing them to shift slightly to and fro. The shifts in the wave-lengths of the lines depend upon the velocity of the earth towards or away from the star. This again leads to a determination of the sun's distance. Some observations at the Cape by this method gave promising results, but long-continued observations on a number of bright stars, using a very large telescope and a spectrograph of high dispersion, are required in order to obtain an accurate result. The many demands on the observing time of powerful telescopes have prevented the method being given an adequate trial. A difficulty of the method is that any changes in the motion of the star itself—such as orbital motion or pulsations in its atmosphere—also give rise to displacements in the positions of its spectral lines and, unless these can be allowed for or are of a random nature, the accuracy of the result will be impaired. It is also necessary to take careful precautions that no displacements of instrumental origin, such as might be caused by instrumental flexure, can occur.

Direct Observation Methods

We come now to the determination of the sun's distance by direct observation. This type of method depends upon the measurements of angles. The process is essentially the same as that used by a surveyor in the measurement of the earth's surface by triangulation. He starts with an accurately measured base-line and determines the distance of a far point by measuring, from each end of the base-line in turn, the angle between the base-line and the direction to the far point. This enables him to calculate the distance of the point from each end of his base-line. In the case of the sun, the angle to be measured is what is called the horizontal parallax of the sun—or, more briefly, the solar parallax; it is the amount by which the sun at rising or setting is apparently moved—to an observer on the rotating earth—from its true place in the heavens. This angle of parallax (about 8·8″) is the angle subtended by the radius of the earth as seen from the sun. It is about equal to the diameter of a halfpenny as seen 2,000 ft. away. It will be understood that to determine this small angle with an accuracy of about one part in ten thousand is far from an easy matter.

The sun is a difficult object for accurate measurement under the best conditions; its large size and the effect of its heat on the instruments used limit the accuracy of the measurement. If the distance of the sun could not be determined otherwise than by direct observation of the sun, it would be a vain hope to expect an accurate answer. But, fortunately, this is not necessary. The laws governing the motions of the planets which were enunciated by Kepler in the year 1618 enable the relative distances of the planets in the solar system to be inferred with very great accuracy from the periodic times in which their orbits are described. The solar system can therefore be accurately drawn to plan; the scale of the plan is fixed when any one distance in it has been measured. The smaller the distance, the more favourable are the circumstances for accurate measurement, because the angle of parallax—from which the distance is inferred—is larger in relation to the errors of observation. From time to time, one or other of the planets in their unending journey round the sun comes sufficiently near the earth to enable the sun's distance to be measured with reasonable accuracy. The two planets which appeared to offer the best scope for measuring the sun's distance by direct observation were Mars and Venus. Venus comes closer to the earth than Mars does; its nearest distance is about 26 million miles, whereas Mars, when nearest, is 34½ million miles away. But Venus, when at its nearest, is between us and the sun. It then becomes lost to sight in the rays of the sun and it is only on the somewhat rare occasions when its path lies directly in front of the sun and it can be seen to transit across the sun's disk that measurements become possible. Four transits of Venus occur every 243 years, at successive intervals of 8, 105½, 8 and 121½ years. Five transits only have ever been observed, namely, the transits of December 4, 1639; June 6, 1761; June 3, 1769; December 9, 1874; and December 6, 1882. The next two will occur on June 8, 2004, and June 6, 2012. It was Halley who first suggested in 1679 that the transits of Venus would provide favourable opportunities for determining the sun's distance.

But the first scientific estimate of the distance of the sun was made from observations of Mars. The orbit of Mars is more elliptical than the orbit of the earth, so that the distance of Mars from the earth when in opposition, that is, with the earth directly between Mars and the sun, can range from 34½ million to 63 million miles. The favourable oppositions, when the distance is least, occur at intervals of fifteen or seventeen years, in August. Mars, when in opposition, crosses the meridian at midnight and is suitably placed for observation. A favourable opposition occurred in 1672. Observations to determine the sun's distance were planned by Giovanni Domenico Cassini, the first director of the Paris Observatory, then just completed. He sent an expedition to Cayenne to make observations of Mars, while corresponding observations were made at the Paris Observatory. Paris and Cayenne thus formed the ends of a base-line, and from the difference in the direction of Mars as seen from the two places the distance was to be inferred. The result of the observations was to place the sun at a distance of between 82 and 91 million miles, with a probable value of 86 million miles—a value that was accepted for about a century.

The determination of the distance of the sun by observations of Mars in this manner is liable to a very serious systematic error. At each station the position of Mars in the sky is determined with reference to adjacent stars. The effect of parallax is to displace Mars away from the zenith. Atmospheric refraction, on the other hand, displaces it towards the zenith; but as it displaces the stars also towards the zenith, its effects would be eliminated if Mars and the stars were refracted by the same amount. Refraction, however, is greater for blue than for red light, because of the dispersive power of the atmosphere. Because Mars is redder than the average star, it is displaced by refraction towards the zenith by an amount that is smaller than the average amount by which the adjacent stars are displaced. Hence, as compared with the stars, Mars will be effectively displaced away from the zenith. This differential displacement, caused by atmospheric dispersion, will be interpreted as the effect of parallax. The measured parallactic displacement will therefore be too great, and too large a value of the solar parallax, corresponding to too small a distance of the sun, will be inferred. The distance found in 1672 was, in fact, appreciably too small.

In 1877, Gill made an expedition to the Island of Ascension to make observations of Mars at a favourable opposition in order to determine the solar parallax by a method which Airy, the Astronomer Royal, had recommended. Its principle consists in substituting successive morning and evening observations from the same spot for simultaneous observations from two different spots, the rotation of the earth supplying the necessary difference in the points of view. Gill made his observations with an instrument termed a heliometer, which has an objective divided into two halves along a diameter. The two halves can be displaced relatively to one another, enabling the images of two objects, for example, Mars and a star, formed by the two halves separately, to be brought into coincidence. An accurate measure of the angular distance between the two objects can be inferred from the separation of the two halves of the objective required to give coincidence. Gill obtained a low value for the solar parallax, 8·78″, instead of the high value that would be expected. Newcomb, in collating various determinations of the solar parallax, rejected all those based on observations of Mars, with the exception of Gill's. He remarked: "It may be objected that it should be rejected for the same reason, since the colour of the planet would affect heliometer observations and meridian observations equally. I have, however, considered it free from the objections in question for two reasons. In the first place, the result is not too large, but is, on the contrary, the smallest of all the accurate measures. The principle that when a result is open to a strong suspicion of being affected by a cause which would cause it to deviate in one direction, it is logical to conclude *a posteriori* that the cause has not acted if the deviation is found to be in the other direction, may not be a perfectly sound one, but I have nevertheless acted upon it".

The explanation of Gill's low value of the parallax was not found until 1924 and is of some interest, as illustrating how systematic errors can enter into such observations and lead to erroneous results. In 1924 there was another favourable opposition of Mars, and I arranged a programme of observations at the Cape, which was shared by three observers, Dr. Halm, Mr. Wilkin and myself. These observations gave again a low value of the solar parallax, 8·76″, even lower than Gill's value. The same value was obtained from the observations of distances, position angles or right ascensions, so that the observations were internally consistent. When, however, the observations were grouped according to the observers, surprisingly large differences were obtained:

Halm	8·70″ ± 0·02″
Jones	8·77 ± 0·02
Wilkin	8·81 ± 0·02

The differences were much greater than the probable errors. Such a result had not been expected, because adequate precautions had been taken to guard against errors of 'personality'.

Now there was one, and only one, point on which the observers had differed. With the heliometer a series of graded wire-mesh screens are used, which can be placed at will over either half of the objective, so as to reduce the brightness of the object viewed. It was left to the judgment of each observer which screen should be used under any particular conditions of observation. Halm used the densest screen, even in cases where measurement would be possible with a more open one ; Wilkin showed great reluctance in using the dense screen, while I adopted an intermediate attitude, using the less dense screens for preference, but falling back on the densest screen whenever observations became at all difficult with the other screens. The presumption that the use of the densest screen gave the lowest value of the solar parallax could be checked in two ways : (*a*) under conditions of bad seeing, the image of a star becomes weak and diffused instead of appearing as a bright point of light, and it is then lost against the bright disk of Mars unless the densest screen is used to reduce sufficiently the brightness of Mars ; thus we may expect a smaller value of the solar parallax to result from the nights of bad seeing than from the nights of good seeing ; (*b*) for similar reasons, the densest screen had to be used more frequently when observing faint stars than when observing bright stars, so that again we may expect to find a smaller value of the parallax from observations of faint stars than from observations of bright stars. These expectations were confirmed and in each case the zenithal displacements required to account for the observed discrepancies were calculated. The results were as follows :

	Zenithal displacement From R.A.	Zenithal displacement From Dec.	Difference in solar parallax
Jones—mean	+0·02″	+0·04″	+0·01″
Halm— ,, ...	—0·13	—0·14	—0·06
Wilkin— ,, ...	+0·10	+0·10	+0·05
Bad—good seeing ..	—0·15	—0·16	—0·08
Faint—bright stars ..	—0·13	—0·12	—0·06

The agreement in each case in the zenithal displacements deduced from right ascensions and declinations separately demonstrates conclusively that the phenomenon has its maximum effect in the direction towards or from the zenith. Now it is a well-known fact that the sensibility of the human eye for colour depends on the intensity of the light source. The more the intensity of the light of Mars is diminished, the more sensitive does the observer become to the blue portion and the less sensitive to the red portion of its spectrum. With the densest screen the ruddy appearance of the planet was, in fact, completely lost. The conclusion is that the screens used for reducing the light of the planet show a tendency to enhance the susceptibility of the observer for the more refrangible portion of the planet's light and consequently displace the apparent disk towards the zenith as the result of atmospheric dispersion. Thus when observing with the heliometer, there is a tendency for too small a value of the solar parallax to be given by observations of Mars, contrary to what might have been expected.

Transits of Venus

Of all the methods of determining the solar parallax, the observation of the transits of Venus is the one that has raised the highest hopes, that has involved the largest expenditure of energy and resources and has proved the greatest failure. As viewed from remote parts of the earth, the track of Venus across the disk of the sun will be different, and the times of beginning and ending the transits will be different. The differences of path or of time can be translated into differences of space, and the distance of Venus and hence of the sun inferred. As Halley said, when emphasizing the advantages of the method, the times of beginning or ending the transit could be determined with accuracy "without any other instruments than telescopes and good common clocks, and without any other qualifications in the observer than fidelity and diligence, with a little skill in astronomy". So the astronomers of the eighteenth century were full of hope and of zeal as the two transits of 1761 and 1769 drew near. The principal Governments of Europe fitted out expeditions to various parts of the world, observers being scattered to many stations over the face of the earth. It is worthy of note that it was the transit of 1769 that gave Captain Cook his chance to establish his fame as a navigator. He took a party of observers in the *Endeavour* to Tahiti in the South Seas and, after the transit had been observed, completed his three-year voyage round the world. Mention may also be made of the ill fortune that befell the French astronomer Le Gentil. He had intended to observe the transit of 1761 at Pondicherry, but the war between the French and the English caused him to arrive too late. He decided to remain there for eight years to make certain of observing the transit of 1769, but clouds at the critical time prevented him from seeing anything. On his eventual return to France, he found that during his long absence he had been adjudged legally dead and all his property had been divided amongst his next-of-kin !

The results of these observations were disappointing in the extreme. Unexpected difficulties were encountered in determining the exact instants of contact between the dark disk of Venus and the bright disk of the sun. Instead of meeting and parting with a clean definiteness that had been looked for, they appeared to cling together, a black spot seeming to form between the edge of Venus and the edge of the sun, somewhat as a drop of ink clings to a pen which is slowly withdrawn from an inkpot. The results obtained by the various expeditions were very different and discordant, and the uncertainty in the sun's distance remained at several millions of miles.

As the transits of 1874 and 1882 approached, it was confidently expected that they would give a final answer to the question of the sun's distance. It was believed that the difficulties experienced in 1761 and 1769 would yield to the skill of forewarned preparations. More than a century had passed and not in vain. There had been during that time many improvements in instruments, in methods of observation and in technique. Photography was being developed as an aid to the astronomer and much was hoped from it ; though there might be difficulty in co-ordinating and interpreting visual observations, the camera could not lie and would be free from bias. The camera and the heliometers would both enable the position of the dark body of Venus seen against the bright background of the sun to be accurately determined, free from any peculiar phenomena, at the contacts. So the most intensive scheme of international cooperation that astronomy had yet seen was organized well in advance. Official commissions were appointed to consider the best methods of observations. Models were constructed to train the observers and to determine their personal equations. Special instruments were made to ensure uniformity in equipment and method. Great Britain, France, Germany, Italy, Russia, Holland and the United States co-operated and some four score stations were occupied, at a cost of nearly a quarter of a million pounds. Siberia, the Sandwich Islands, Kerguelen and the almost inaccessible St. Paul's and Campbell Islands were among the places to which expeditions were sent. The weather proved generally favourable; the well-organized arrangements proved equal to the test; the contacts were well observed and many photographs were obtained.

Yet the results proved a great disappointment. The 'black drop' again gave trouble, but not more than was expected. More troublesome was the illumination due to the atmosphere of Venus, which caused the planet to be illuminated with a ring of light; its power to mar observations by the distorting effect of refraction had not been foreseen. So uncertain were the instants of precise contact that observers, with identical equipment, and standing a few feet from one another, recorded times that differed by as much as a minute. Photography, on which such high hopes had been based, proved an almost total failure. The great campaign left the distance of the sun uncertain by about 1½ million miles.

Chastened but undaunted, preparations for the second transit were pushed ahead, in the hope that benefits could be obtained from the experience gained in 1874. Some countries withdrew on the ground that other methods of finding the sun's distance were more accurate and less costly. The arrangement of the observations was discussed by an international conference in Paris in 1881. Again there were many expeditions, the British parties being scattered from Queensland to Bermuda: visual and photographic observations were once more tried. The results were once more disappointing; the distance of the sun came out at 92½ million miles, but the diversity of results given by the different expeditions and by different methods of discussion showed that no great confidence could be placed in this value.

The Asteroids

But meanwhile other objects more suitable for observation than Mars or Venus had come within the range of celestial trigonometry. In the wide gap between the orbits of Mars and Jupiter there exists a swarm of tiny planets or asteroids circling round the sun. The first to be discovered was found on the night of January 1, 1801, by the Sicilian astronomer, Piazzi, and was named by him Ceres, after the tutelary deity of the island. About a couple of thousand of these small bodies are now known. Most of the asteroids are of little intrinsic interest, and the somewhat monotonous work of keeping track of them is carried on because from time to time one of them proves to be of special interest. In 1872, it was suggested by Galle that some of the asteroids might repay astronomers for much of their disinterested toil in keeping track of them, by aiding their efforts to determine the scale of the solar system. Some of them are sufficiently bright and come near enough to be of use for this purpose and, being small enough to appear like a star in the telescope, they have a distinct advantage over Mars or Venus, with their large disks. In 1888 and 1889, from observations of the three asteroids, Victoria, Iris and Sappho, Gill obtained a solar distance of 92,874,000 miles—undoubtedly the most accurate determination that had been made up to that time.

The 433rd asteroid to be discovered, found on August 14, 1898, and named Eros, proved to be of singular importance for measuring the sun's distance. It is a small body, only some 15 miles in diameter, with an orbit so elliptical that from time to time it comes within about 15 million miles of the earth. One such near approach had occurred in 1894, shortly before its discovery. Since then its nearest approaches have been in 1901, when its least distance was somewhat less than 30 million miles, and in 1931, when its least distance was only 16,200,000 miles, affording the most favourable opportunity that has ever occurred for determining the sun's distance. Extensive observations of Eros were obtained in 1901. But the observations were far more numerous in 1931; the circumstances were far more favourable at the latter date, and the great advances made during the present century in the applications of photography to precise astronomical measurements enabled greater accuracy to be obtained in the more recent observations. The results from the 1931 observations will therefore alone be referred to.

Observations of Eros in 1931

The observations were almost entirely photographic; the method used was to photograph Eros and the surrounding stars on the same plate and then, by careful measurement, to determine the exact position of Eros among the stars. A base-line can be obtained by using two different observatories and combining the observations to give the relative displacement of Eros as seen from the two ends of the base-line; or the base-line can be provided by the rotation of the earth, the observations at the same observatory in the evening and the following morning being combined. During the interval between the observations, both the earth and Eros have moved somewhat along their orbits round the sun. The displacement during this interval in the position of Eros as seen from the earth must be allowed for. This is not a matter of great difficulty when the paths of Eros and the earth round the sun are accurately known. Now it is usually stated that the path of a planet round the sun is an ellipse. This would be so if there were no other planets. But gravitation is a universal force. It is the gravitational pull of the sun that compels the earth to travel round the sun; but all the while each of the other planets of the solar system is also exerting a gravitational pull on the earth, which depends on the mutual distance between the earth and the planet, and the pull is continuously changing as the earth and the planet move. The effects of the gradually varying pulls of the other planets on the earth and on Eros must be determined and taken into account when calculating the paths of the earth and of Eros. This is a long and intricate task, which was undertaken by Dr. Witt, the discoverer of Eros.

As the positions of Eros had to be derived by reference to adjacent stars, it was necessary to determine specially the positions of a sufficient number of stars for this purpose. A selection of 900 stars, bright enough to observe with meridian instruments and lying in a narrow belt extending 1° on either side of the path of Eros, was made. These stars were sufficient in number to average ten or twelve on a plate, centred at any point on the path of Eros and covering the field of 2° × 2°, obtainable with instruments having a focal length up to about 12 ft. Their positions were determined at thirteen different observatories and combined into a definitive catalogue on a homogeneous system at the Rechen Institut, Berlin. But photographs with modern long-focus instruments cover a much smaller field, and the primary reference stars were too few in number to enable the positions of Eros to be derived from these photographs. A selection of some 6,000 fainter secondary reference stars was therefore made, the positions of which were obtained by photographic methods, using the primary stars as reference points. Special series of photographs were obtained for this purpose at the Greenwich, Bergedorf, Leipzig and Cape Observatories and combined into a definitive catalogue at Greenwich.

The path of Eros during the time when its parallax was large enough for observations to be worth while was in the form of a large arc across the sky, from north to south. It was at first only observable at northern observatories, but as it moved rapidly southwards it came within range of southern observatories, and eventually passed out of range of most of the northern observatories. Observations were obtained at some three dozen observatories, scattered over the world in all five continents. But the visual observations proved to be considerably inferior in accuracy to the photographic, and the derivation of the solar parallax was eventually based on photographic observations with thirty telescopes at twenty-four observatories in England, the U.S.S.R., Germany, Belgium, Czechoslovakia, Italy, Spain, Algiers, the United States, China, Japan, South Africa, Australia and the Argentine. 2,847 plates were measured and used.

The solar parallax can be derived from the observations in several ways. First, using the diurnal method, each instrument with which observations on several nights with a sufficient range in parallactic displacement were obtained will give a determination. Sixteen separate determinations were thus obtained, as shown in Table 1. The relative weights are based on the probable error of each determination. The weighted mean value is 8·7900″ ± 0·0013″.

TABLE 1. SOLAR PARALLAX: SEPARATE DETERMINATIONS FROM RIGHT ASCENSIONS.

Instrument	Parallax and p.e.	Relative weight
Cape 13-in.	8·7886″ ± 0·00165″	36·7
Cape 24-in.	8·7902 ± 0·00175	32·6
Cordoba	8·7928 ± 0·0024	16·4
Allegheny	8·8020 ± 0·0035	8·1
Van Vleck	8·7676 ± 0·0048	4·3
Dearborn	8·8070 ± 0·0061	2·7
Zô-Sè	8·7868 ± 0·0049	4·2
Union Obs.	8·7918 ± 0·0074	1·8
Lick	8·7887 ± 0·0080	1·6
Melbourne	8·7949 ± 0·0082	1·5
Greenwich 13-in. ..	8·7648 ± 0·0078	1·6
Greenwich 26-in. ..	8·7820 ± 0·0115	0·8
McCormick	8·7861 ± 0·0091	1·2
Washington	8·8160 ± 0·0101	1·0
Tokyo	8·7459 ± 0·0183	0·3
Catania	8·7865 ± 0·0336	0·1

The internal consistency of the results can be examined by subdividing the material in different ways. First, the three series with preponderating weight, on which the combined weighted mean value will largely depend, can be separated from the other thirteen series and the separate mean values compared. Secondly, those determinations based on primary star places can be compared with those based on secondary star places, to see whether there is any systematic effect connected with the brightness of the comparison stars. Thirdly, the results obtained with instruments designed for photographic observations can be compared with those obtained with visual instruments, used photographically by employing yellow sensitive plates and yellow filters. In each case there is a satisfactory accordance.

The results derived in this way are independent of systematic corrections required by individual instruments, but a considerable wastage of material is involved. Not only are unbalanced observations excluded (that is, where evening or morning observations, but not both, have been obtained), but also observations with other instruments the series of which were not sufficiently complete, have not been used at all. New solutions were therefore made, night by night, using all available material. 129 separate determinations of the solar parallax were thus obtained, with the weighted mean value 8·7875″ ± 0·0009″. The internal consistency was checked by dividing it into four groups of approximately equal weights; these gave values in close accordance.

An entirely independent determination of the parallax can be made by comparing observations at a northern and a southern observatory, the base-line being provided by the line joining the two observatories. This method uses observations in declination, instead of in right ascension. The results of a series of separate determinations are given in Table 2. The results are not entirely independent, because some of the material is used several times over, but they show the general consistency. Individual determinations were therefore made for each night on which sufficient observations at one or more northern and one or more southern observatories were obtained. Seventy-one separate determinations were thus made, giving a mean result of 8·7907″ ± 0·0011″. Dividing the material into three groups, concordant results were again obtained.

TABLE 2. SOLAR PARALLAX: SEPARATE DETERMINATIONS: N–S COMPARISONS

Instruments	Parallax and p.e.	No. of nights
Radcliffe: Cape 24-in.	8·7934″ ± 0·0026″	9
Greenwich 26-in.; Cape 24-in. ..	8·7935 ± 0·0040	9
Rad. + Gwh. 26-in.; Cape 24-in. + Yale	8·7908 ± 0·0026	13
Gwh. 13-in.; Cape 13-in.	8·8023 ± 0·0067	8
Dearborn; Cape 24-in.	8·7906 + 0·0033	28
V. Vleck; Cape 24-in. + Yale ..	8·7874 ± 0·0039	17
Algiers; Cape 13-in.	8·7886 ± 0·0028	49
Algiers; Cordoba	8·7865 ± 0·0033	30
Allegheny; Cape 24-in. + Yale ..	8·7840 ± 0·0037	22
Washington; Cape 24-in. + Yale ..	8·7870 ± 0·0058	14
McCormick; Cape 24-in. + Yale ..	8·7865 ± 0·0038	17
Lick; Cape 13-in.	8·7862 ± 0·0036	12
Lick; Cape 24-in.	8·7867 ± 0·0043	12
Lick; Cordoba	8·7909 ± 0·0086	9

Thus, summing up, the final results for the solar parallax from the Eros observations are:

R. A. Observations.

(*a*) Mean value from sixteen separate determinations, 8·7900″ ± 0·0013″.

(*b*) Value from all observations combined, 8·7875″ ± 0·0009″.

Dec. Observations.

(*c*) Value from all observations combined, 8·7907″ ± 0·0011″.

The three determinations are adequately represented by a value of the solar parallax of

8·790″ ± 0·001″;

corresponding to the sun's distance:

93,005,000 ± 9,000 miles.

The assigned probable error is based on the internal accordance of the observations. It is so small that the sun's distance is derived with an exactness adequate for all purposes unless there is some systematic error affecting all the observations. A possible source of such error is differential atmospheric dispersion, if the colour of Eros differs from the colour of the average star. We have already seen that such errors can be considerable in the case of Mars. A very careful and detailed investigation into this possibility has been made. We have seen that if Eros is redder than the average of the comparison stars, we may expect to obtain too large a value of the solar parallax. Now a number of determinations of the colour of Eros were made, and it was found that it was slightly, but only very slightly, redder than the average of the comparison stars. Thus, on this showing, we might expect our concluded value of the solar parallax to be a little too large.

But the matter is not quite so simple as that. All the observations were made with refracting telescopes, in which the light is collected by lenses; none of them was made with a reflector. The aberrations of lens systems play a not unimportant part in modifying our conclusions, which are strictly applicable only to a perfectly achromatic instrument, in conjunction with a photographic emulsion equally sensitive to all colours. Thus, for example, to consider but one way in which the conclusions are modified: if a refractor of the normal astrographic type is focused to give the sharpest images at its centre then, at the edge of the plate, the rays that are brought to a sharp focus are not those which are photographically most effective, but rays of a somewhat greater wave-length. If, in measures of colour, there are two stars of the same colour, one at the centre of the plate, the other at the edge, the latter will appear the redder. Now, because Eros is always photographed at the centre of the plate, this effect will counteract in whole or in part the small difference in colour between Eros and the comparison stars. There are many other factors concerned, but the outcome of the discussion is that, with so many different instruments employed, what at first sight appeared to be a troublesome systematic error tends to assume a random nature. In so far as any residual systematic effect remains, it should be revealed by a correlation between the determined values of the solar parallax night by night and the distance of Eros; for the atmospheric dispersion effects are independent of the distance of Eros, whereas the parallactic displacements are greater the nearer Eros is to the earth. An investigation of the correlation between the solar parallax and the distance of Eros was made for both the right ascension and the declination observations. The deduced effects, which were comparable with their probable errors in each case, were of opposite sign in the two co-ordinates. The conclusion is that the general effects arising from colour differences between Eros and the comparison stars are negligibly small. This is a fortunate circumstance, and one that could not have been foreseen. The conclusion is corroborated by the agreement, within the limits of their probable errors, between the mean values of the solar parallax derived from photographic and visual instruments. Colour effects with the visual instruments are only two-fifths as great as with the photographic instruments; the concordance of the results from the two types shows that the effects are negligible.

One hundred years ago the distance of the sun was uncertain to one part in twenty; gradually, the uncertainty was narrowed to one part in a hundred, and then to one part in a thousand; now it has been reduced to one part in ten thousand. In 1858, Sir John Herschel, referring to a new determination of the sun's distance, which had brought the sun nearer by 4 million miles, wrote: "The superficial reader (one of a class too numerous) may think it strange and discreditable to science to have erred by nearly 4 million miles in estimating the Sun's distance. But such may be reminded that the error in the Sun's parallax, on which the correction turns, corresponds to the apparent breadth of a human hair at 125 feet, or of a sovereign at 8 miles off". The uncertainty in our latest determination corresponds to the apparent breadth of a human hair at 10 miles, or of a halfpenny at 3,250 miles! Looked at in another way, a similar accuracy in measurement of the distance of the moon would set the moon only 100 yards nearer to or further from us than it really is.

The goal for which astronomers have so long been striving has at length been reached. The final word has been said on this historic problem for many years to come, and the fundamental distance in astronomy has been measured with all the accuracy that is needed.

THE RAPID TREATMENT OF SYPHILIS

By MAJOR JAMES MARSHALL, R.A.M.C.

RESEARCH into the problem of producing a safe and rapid method for the cure of syphilis has been given an added impetus during the war period, not only by an increase in the incidence of the disease, but also by the necessity for rapid rehabilitation of men who must be fit to move quickly and keep fit in conditions where continuous treatment may be impossible. The following account traces the evolution of the arsenical treatment of syphilis with special reference to intensive or massive arsenotherapy.

When Ehrlich, in September 1909, presented to Prof. Alt, for clinical trial, his preparation 'Ehrlich-Hata 606' he believed that he had discovered an immediately effective single-dose cure for syphilis. A year later Ehrlich, a little shaken, claimed that "606" in the original dosage was curative in 90 per cent of cases of syphilis. An accumulation of evidence in the form of relapsed cases soon showed, however, that the early high hopes could no longer be entertained. It is probable that a certain small percentage of cases of early syphilis are cured by one injection of "606"; but the difficulty of assessing cure makes the relative over-treatment of every case necessary in order to cover every eventuality.

In 1916 Pollitzer evolved a rapid treatment for early syphilis by three or four daily injections of arsphenamine, but here again early relapses proved the inadequacy of the scheme, and long-term investigation has shown that the end results of such treatment are very poor. Other like methods for the abortive treatment of early cases were found in time to be equally uncertain.

It finally became evident that the best prospect of cure was to be found in a treatment where a drug of the arsphenamine series was administered at the same time as a heavy metal preparation. Bismuth was found to be superior to mercury, and for the last twenty years has been the heavy metal of choice.

This combined scheme has proved highly successful and has stood the test of time, the most important test in the estimation of cure in syphilis. The great drawback is that, to be certain of effecting a cure, the patient must remain constantly under treatment for at least a year and sometimes longer. In principle the present-day British scheme in common use for cases of early syphilis aims at administering about forty injections of a drug of the arsphenamine series and the same number of injections of a bismuth preparation over a period of about one year (standard scheme). The number of injections and time of treatment is increased in some cases, but is rarely reduced. The spacing and arrangement of treatment varies, naturally, in different hands, and a variety of arsenicals is in use. Neoarsphenamine is still generally used in Britain, but arsenoxide is beginning to become more popular.

Arsenoxide, known to, but discarded by, Erhlich, is not an arsphenamine, and does not need to be broken down in the body to become spirochæticidal. It is rapidly excreted, and, in the opinion of many venereologists, must be injected at least twice weekly to achieve results comparable with those obtained with single weekly injections of an arsphenamine. If arsenoxide is used on the standard treatment scheme, the number of visits by a patient to doctor or clinic is doubled, and the rate of default from treatment rises accordingly. Arsenoxide has many advantages in other directions and these will be discussed later. It is believed by some American authorities to be, in proper dosage, the equal of '606', which has not yet been surpassed as a spirochæticidal agent. Some arsenoxide preparations for injection are known as 'Mapharside' or 'Mapharsen', 'Neohalarsine', and 'Chlorarsen'. Of these 'Mapharside' is the preparation which has so far been most used in intensive treatments.

Although the progress in cases of early syphilis treated by the standard scheme is very good (approaching 100 per cent cures) if treatment is faithfully followed, well under 50 per cent of patients, by reason of default, receive enough treatment to ensure a cure-rate of more than 80 per cent.

It is obvious, therefore, that any method which will give a high rate of cure in a short time will be of the greatest value to the patient and to the State.

No real approach to the rapid treatment of syphilis was made until it was shown by Hirshfeld, Hyman and Wanger that 'speed shock' following injection could be avoided by slow intravenous drip. By slow injection at a rate of 2 or 3 c.c. per minute, toxic substances could safely be introduced into animals in doses much greater than by a rapid method.

The first application of this discovery was made in 1934 at the Mount Sinai Hospital in New York City, when a number of patients with early syphilis were given 4 gm. or later 5 gm. of neoarsphenamine by a continuous intravenous drip over a period of five days. Results were very good.

Later a similar scheme was instituted in which 'Mapharside' was substituted for neoarsphenamine. The optimum dose of 'Mapharside' was discovered, by trial and error, to be 1,200 mgm. given at the rate of 240 mgm. a day, in 2,400 c.c. of 5 per cent dextrose solution. The results with 'Mapharside' were also very good, and severe toxic reactions, a grave drawback with neoarsphenamine, were much reduced. Neoarsphenamine is not now used in intensive treatment. A modification of this five-day scheme is the administration of 'Mapharside' in divided doses by syringe at intervals throughout the days.

About 85 per cent of cases treated with neoarsphenamine and 82 per cent of those treated with 'Mapharside' were clinically and serologically well after periods of from six months to six years.

Since these original experiments a number of other intensive methods of treatment have been tried in early syphilis, ranging in duration from one day to thirty days of arsenical treatment. The arsenical used has been arsenoxide, usually 'Mapharside', and in some schemes bismuth has also been used. One of the most promising schemes involves one daily injection of arsenoxide for twenty days, to give a total dosage of 1,200–1,800 mgm. of 'Mapharside'.

The most important complication of intensive arsenotherapy is hæmorrhagic encephalitis, and the higher the dosage of arsenic the more likely appears to be the risk. Some investigators have attempted to achieve good results on small doses (less than 1,200 mgm.) of arsenoxide by combining fever therapy with arsenotherapy. In one such investigation, fever was induced by intravenous injection of typhoid vaccines four times in a treatment period of eight days. The most widely publicized combined fever and arsenic treatment is the one-day scheme in which 'Mapharside' is administered in the course of a ten-hour session of high fever (hyperthermy) at 106° F. It is still much too early to judge the results of this form of treatment. A premature account of this method by Paul de Kruif in the *Readers Digest* of September 1942 caused a great deal of confusion and unfounded dissatisfaction in the lay mind. The enormous circulation of the *Readers Digest* gave medical men in America, and also in Britain to a smaller extent, a good deal of extra work to explain just why every case of syphilis could not be cured in one day.

All intensive treatment for early syphilis must still be considered as being experimental, because enough time has not yet elapsed to exclude all possibility of late relapse in the patients so far treated. Only in the earliest series is it possible to hazard a reasonably accurate estimate of the cure-rate.

Hæmorrhagic encephalitis gives a fatality-rate of 1 in 111 in the five-day treatment with neoarsphenamine and 1 in 300 in the five-day treatment with 'Mapharside'. The fatality-rate with 'Mapharside' is at least four times as high as the fatality-rate from all causes in a standard scheme of treatment. In the case of the other schemes of intensive treatment the true fatality-rate cannot yet be assessed, but it is reputed to be lower than in the five-day scheme. The calculated mortality in the case of the twenty-day scheme is about 1 in 400.

Peripheral neuritis was a common and often severe complication in the neoarsphenamine series, and is encountered in cases treated with 'Mapharside' but in very much smaller numbers and seldom in severe form. Most of the toxic effects of the arsenicals which are seen in the course of a standard treatment can also be encountered in intensive treatment. Secondary fever and toxico-dermal reaction is a fairly common complication of the twenty-day scheme, and occurs about the ninth day.

Research by Padget has shown that 60 per cent of patients who had received so little as 4–6 injections of arsphenamine were 'cured', that is, they remained well and were serologically negative after a significant lapse of time. A 'cure'-rate of 85 per cent was attained only by those patients who had more than twenty-one arsphenamine injections combined with a heavy metal. The prognosis in the case of patients who received irregular or haphazard treatment was worse than in the untreated. The number of patients in civilian clinic practice in Britain who remain under treatment long enough to fall into this last group is regrettably small. Either patient or doctor may be

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

INSTITUTE OF MEDICAL AND VETERINARY SCIENCE, ADELAIDE, SOUTH AUSTRALIA

Applications are invited from medical graduates for the office of Director of the Institute of Medical and Veterinary Science, Adelaide, South Australia, under the Council of the Institute of Medical and Veterinary Science. The successful applicant will be appointed by the Council of the University of Adelaide to be Keith Sheridan Professor of Experimental Medicine in the University of Adelaide.

The salary is £1,500 (one thousand five hundred pounds) per annum, payable in Australian currency. If a candidate from Great Britain, Canada, or America is appointed the salary will commence from the date of his embarkation, and a first class fare to South Australia will be provided, and, if he is married, for his wife also.

Provision for superannuation will be made on the lines of the Federated Superannuation system for British Universities, i.e., 10 per cent annually in addition to salary plus 5 per cent paid by the beneficiary, to be applied in payment of approved life assurance premiums.

The duties are the following:

1. As Director of the Institute of Medical and Veterinary Science he will be the principal executive officer of the Council of the Institute and will be responsible for the control and management of the Institute.
2. As Keith Sheridan Professor of Experimental Medicine, he will engage in the Institute in the active study and investigation of diseases of human beings and animals, and into problems connected with such diseases, and in postgraduate teaching and examining as directed from time to time.

The appointment in the first instance will be for a period of five years, subject to the Institute of Medical and Veterinary Science Act, 1937. A medical certificate of physical fitness is to be forwarded with the application.

Further particulars may be had from the Agent-General and Trade Commissioner for South Australia, South Australia House, Marble Arch, London, W.1, England, who has reports of the Institute, copies of the calendars of the University of Adelaide and copies of the Institute of Medical and Veterinary Science Act, 1937, and regulations.

Applications from medical graduates in Great Britain, the United States and Canada, including among other particulars the approximate date on which the candidate could begin work, should be sent to the Agent-General for South Australia at the above address before May 31, 1944.

(Signed) C. T. CH. DE CRESPIGNY,
Chairman of the Council, Institute of Medical and Veterinary Science.

STAFFORDSHIRE EDUCATION COMMITTEE

COUNTY TECHNICAL COLLEGE, WEDNESBURY

Applications are invited for the post of Lecturer in Engineering Science Subjects, vacant at Easter. Candidates should possess a degree, or equivalent qualifications, in Science or Engineering.

The post includes teaching duty in the Junior Technical School and Part-time Day and Evening classes in the College. Salary, Burnham Technical Scale plus War Bonus.

Applications giving age, qualifications, experience and other relevant details, together with copies of testimonials and names of referees should be sent not later than February 18, and addressed to the Principal at the College.

County Education Offices, Stafford. — F. A. HUGHES, Director of Education.

BEDFORD COLLEGE FOR WOMEN

(UNIVERSITY OF LONDON)

Applications are invited for the following post: LABORATORY ASSISTANT in the DEPARTMENT of BOTANY at Bedford College (at present evacuated to Cambridge, but returning to London in October). Applicants should have general experience of techniques employed in a biological laboratory and should be capable of making photographic records. Salary £200 p.a. rising to £250.

Last date for receiving applications, Saturday, February 26. For further particulars apply the Secretary, Springfield, Sidgwick Avenue, Cambridge.

IMPERIAL AGRICULTURAL RESEARCH INSTITUTE, GOVERNMENT OF INDIA

Applications are invited for the appointment of Director, Imperial Agricultural Research Institute, Government of India.

Candidates must be male British subjects or subjects of an Indian State and should possess a D.Sc. or M.Sc. degree in a science basic to agriculture, ability to plan, direct, and co-ordinate research, and administrative experience. Knowledge of Indian agriculture and its problems would be an asset.

Age not less than 40 years and preferably not more than 50 years.

Agreement for five years, renewable at discretion of Government. Salary 2,000 Rupees per month (approx. £1,800 per annum) rising by annual increments of 50 Rupees per month to 2,250 Rupees per month (approx. £2,025 per annum), plus, for appointee of non-Asiatic domicile, sterling overseas pay of £13 6s. 8d. per month. First class passage to India and home on termination of contract. Provident Fund.

Further particulars and forms of application may be obtained (on request by postcard) from: Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2, quoting O.N.F. 2080 A.

Last date for receipt of completed applications: March 1, 1944.

ESSEX EDUCATION COMMITTEE

SOUTH-EAST ESSEX TECHNICAL COLLEGE AND SCHOOL OF ART, LONGBRIDGE ROAD, DAGENHAM

Principal: N. M. H. Lightfoot, M.A., F.R.S.E.

APPLICATIONS are invited for the permanent post of Senior Lecturer in Mathematics. Duties to commence on April 1, 1944, or as soon as possible.

Candidates should possess high academic qualifications in Mathematics and have had some teaching experience. Research experience is also desirable.

Salary: Burnham (Provincial) Technical Scale, plus £40 per annum for post of special responsibility.

For further particulars and forms of application, apply (enclosing a stamped addressed envelope) to the Clerk to the Governors at the College, to whom applications must be sent not later than February 28, 1944.

County Offices, Chelmsford. — B. E. LAWRENCE, Chief Education Officer.

SUNDERLAND EDUCATION COMMITTEE

THE TECHNICAL COLLEGE

Principal: F. H. Reid, B.Sc., Wh. Ex., M.I.Mech.E.

APPLICATIONS are invited for the post of LECTURER in MATHEMATICS to commence duties as soon as possible after Easter, 1944.

Salary (Burnham Technical Scale) £234–£15–£480, plus War Bonus. The commencing salary will include an allowance for approved professional or industrial experience. After three years service an addition of £20 per annum will be made to the scale salary under Clause 5 (c) of the Burnham Report in respect of "special work of an advanced character."

Candidates must possess a good Honours Degree or its equivalent.

The standard of the full-time day course is that required for an Honours Degree in Science and Engineering, and for Higher National Diplomas.

Forms of Application and further particulars may be obtained from the Registrar, The Technical College, and APPLICATIONS must be returned to the undersigned not later than February 28, 1944.

Education Offices, 15 John Street, Sunderland. — W. THOMPSON, Director of Education.

BEDFORD COLLEGE FOR WOMEN

(UNIVERSITY OF LONDON)
REGENT'S PARK, N.W.1.

The Council of Bedford College invites applications for the following post, open to men and women equally, vacant as from October 1, 1944. LECTURER in the DEPARTMENT of GEOGRAPHY. Candidates must have an Honours or Special degree in Geography. Salary £350-£500. Initial salary may be higher than the minimum of scale if warranted by candidate's qualifications.

Last date for receiving applications March 1, 1944. For further particulars apply to the Secretary.

UNIVERSITY OF LONDON

GRANTS FOR RESEARCH

Applications are invited from members of the University for grants from the Central Research Fund for assisting specific projects of research and for the provision of special materials and apparatus. Application forms (which must be returned by March 31, 1944) and further particulars may be obtained from the Academic Registrar, University of London, at Richmond College, Richmond, Surrey.

UNIVERSITY OF READING

FACULTY OF AGRICULTURE AND HORTICULTURE

Applications are invited for the post of temporary Assistant Lecturer in Agricultural Chemistry. Salary £300 per annum.—Further particulars may be obtained from the Registrar.

Technical Librarian required. Good knowledge of science or engineering and experience of indexing and abstracting technical literature. Salary according to qualifications. Attractive superannuation scheme. Permanent headquarters London, temporarily Midlands.—Apply, stating salary required, to Box 153, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Organic Research Chemist permanently required by Company for pure research work on Chemotherapeutic problems. (Essential Works Order). Good salary and prospects of future advancement. Apply with details of career and any published work to Box 151, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Research Chemist, Ph.D., A.I.C., desires responsible industrial position, London area preferred. Eight years (laboratory and works) research, development, design, advisory and administrative experience in metallurgical and ceramic fields; speciality vitreous enamelling. Excellent references and extensive contacts. Available immediately.—Box 150, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

Microscope Super Ross Binocular. Movement every direction, Revolving Stage and Stand. Eight Objectives, 1-25th, 1-15th, 4-10ths, 1-5th, 1-10th, 1 in., 2 in., and 4 in. All accessories, including Camera Lucida, Micrometer, 2 sets eyepieces in glass-fronted cabinet, together with box of important slides. Suit Research Laboratory. Seen Art Depositories, 206 Upper Street, Islington, N.1. Canonbury 2141.

Leitz Microscope for Sale. 5 objectives (including 1-12 in. O.I.), 5 eyepieces. Recently cleaned. In perfect condition. Fitted cabinet. Price £65.—H. J. W., 70 Frankfurt Road, S.E.24.

Koristka 3 mm. apo. N.A. 1.4 £20. Koristka 1/15" semi-apo. N.A. 1.3, £10.—Hunt, 60 Woodhill Crescent, Kenton, Middx.

Artificial Ear, Ballantine Model 505. Required urgently for important development work.—Box 148, T. G. Scott & Son, Ltd., 9 Arundel Street, London, W.C.2.

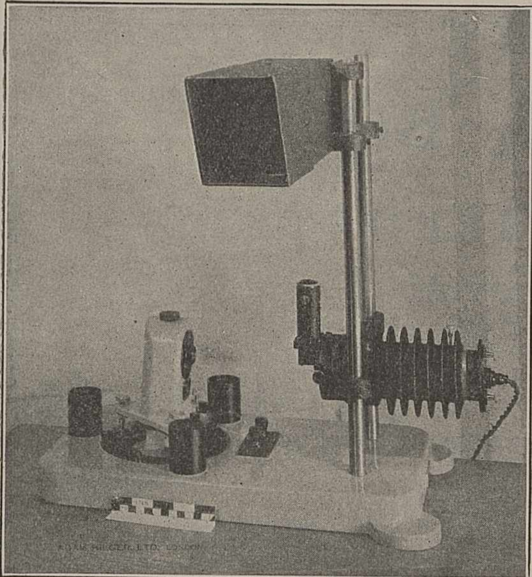
Reflecting Telescopes: 5¼" Mirrors of excellent quality £9 9s. Flat 7s. 6d.—Roland Lee, "Infield," Babell, Holywell, Flintshire.

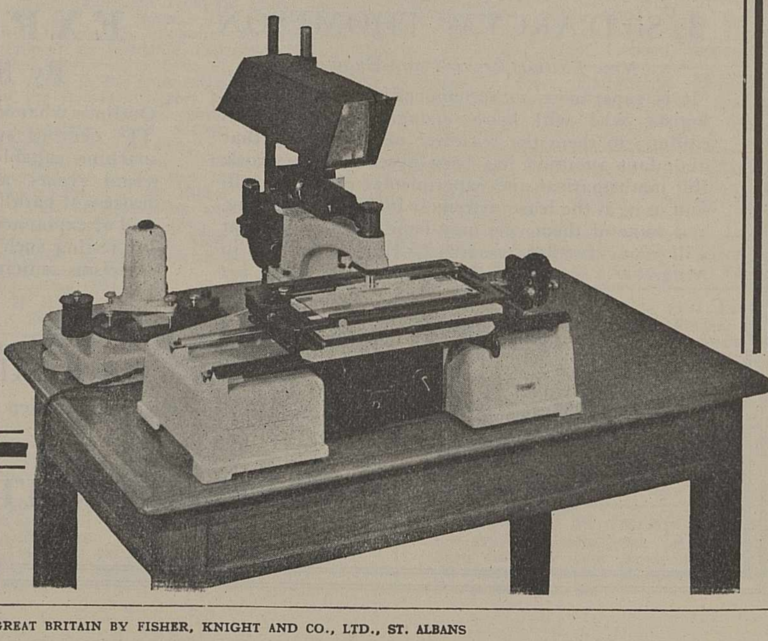
Quartz Condenser for Microscope wanted.—Baird, 39 Lothian Street, Edinburgh.

Translations of Scientific and Technical Papers from Danish, Dutch, French, German, Italian, Norwegian, Russian, Spanish and Swedish originals. Thirty-five years experience.—George Borrow, 6 St. Stephen's Grove, London, S.E.13.

Chemical, Physical, and Natural History Journals of every country urgently required. High prices paid. Please send particulars to The Scientific Book Supply Service, 5 Fetter Lane, London, E.C.4. (Phone: CEN 1294.)

Microscopes, of all descriptions, only a few available second-hand, perfect condition. Send details of your requirements enclosing 3d. stamp.—Chards, Microscope Specialists, Forest Hill, S.E. 23.





at fault, and the mechanism for the reclaiming of defaulters is not yet full enough in most areas.

It appears that intensive arsenotherapy offers in a short time as good, or even better, immediate results than the standard treatment scheme, but with a vastly increased risk of toxic effects and a risk of death four times as great. Between 95 and 98 per cent of patients complete treatment by intensive methods, and default is impossible in cases sent to hospital.

All the intensive treatment schemes so far detailed require the hospitalization of the patient. The risk of early muco-cutaneous relapse is about equal in the intensive and standard treatment schemes. Only early cases of syphilis can at present be treated by intensive methods, and the patients must be followed up for at least a year after treatment.

In the light of these limitations the application of intensive treatment must be restricted. An obvious use is in the case of key personnel in the Services, particularly the Navy and Merchant Marine. The benefits of returning a man to duty with no need for further treatment are obvious when it is remembered that many ships do not carry a doctor, and that haphazard treatment on standard lines may be worse than no treatment at all.

A potential use for intensive arsenotherapy might be in the case of persons who, notified under Regulation 33B, refuse to co-operate by placing themselves voluntarily under treatment when they are discovered to be infected with syphilis. This is naturally a hypothetical case and is open to criticism from both a legal and a medical point of view. Such persons, devoid of any sense of public duty, do however exist, and it would certainly be in the public interest to have them treated as rapidly as possible. In the United States such a policy is already in operation in at least one place.

A long-term policy in the public health aspects of syphilis must not be forgotten, for the sufferer from late effects such as general paralysis of the insane or cardiac disease may become a charge upon the State. We do not know what percentage of syphilitics treated by intensive methods may yet develop late phenomena. The aim in treatment is complete cure, and to accept any method which falls short of this, even if it offers immediate benefits in rapid and permanent surface sterilization in a high percentage of cases, may be to store up trouble for the future.

The aim in research into the treatment of syphilis is to discover a scheme which will occupy as short a time as possible, which will be free of dangerous toxic effects, give a high percentage of permanent 'cures', and can be used on out-patients. A clue has been given in the animal research work of Eagle and Hogan, who found that, within broad limits, the curative dose of 'Mapharside' with any one method of treatment was largely independent of the time period over which that treatment was given. Intravenous drip methods with 'Mapharside' were consistently less effective than repeated syringe injections over the same time periods. With regard to toxicity they found that on any schedule of injections the shorter the total treatment period the lower is the margin of safety. Assuming that these considerations apply in human syphilis, they have suggested a variety of possible schemes for trial. Patients are already being treated on the experimental lines suggested.

The treatment for early syphilis in the future may be a compromise between the present standard scheme and the intensive methods described above, and will probably last from four to ten weeks. The arsenical will almost certainly be an arsenoxide preparation injected by syringe at least three times a week, and bismuth will be used concurrently.

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OBITUARY

Dr. F. L. Pyman, F.R.S.

THE news of the death of Dr. Frank Lee Pyman on January 1 at the early age of sixty-one, after a prolonged illness, will have been received with deep regret by his many friends. Pyman was an outstanding personality in the chemical world of twentieth-century Britain, and his experimental work in medicinal chemistry has been a not inconsiderable factor in fostering the respect in which British medicinal chemistry is held to-day.

Pyman entered Owens College, Manchester, in 1899, and, after graduating in 1902, went to the Polytechnic at Zurich, where he had the good fortune to come under the influence of Bamberger, who was then at the zenith of his fame. The dissertation which followed was published in 1904, and Pyman was granted his doctorate at the University of Basle. In 1905, on his return to Great Britain, he obtained a post with T. E. Thorpe at the Government Laboratory, but stayed only a few months as he felt he had little flair for analytical chemistry.

Circumstances in another branch of chemistry were, however, propitious. The late Sir Henry Wellcome had for a decade pursued an enlightened policy of establishing laboratories for scientific research, and had allowed the results of such research to be published, a policy which, it is true to say, had ushered a new era into British pharmaceutical chemistry. In furthering this policy, Wellcome had in 1905 appointed Jowett, who had carried out noteworthy investigations under Power's directorship of the Wellcome Chemical Research Laboratories, as head of the new Experimental Department of the Wellcome Chemical Works at Dartford. Within a year, however, Jowett was raised to the position of works manager, and the vacancy thus created was filled by Pyman. This was indeed a fortunate choice, since, over the ensuing period of eight years, a succession of model papers issued from this laboratory under Pyman's name which stand comparison with any chemical work published in Great Britain during the same period. The subjects covered ranged from local anæsthetics, mydriatics and hypnotics to arsonic acids, *iso*quinoline alkaloids, glyoxalines and the alkaloids of jaborandi and ipecacuanha; they probably reached the height of experimental perfection in the syntheses of histamine and histidine, and in the elegant results obtained in the study of the Hofmann degradation of tetrahydroberberine methosalts.

In 1914 Power persuaded Wellcome to allow him to return to the United States, and it was but natural that Pyman should succeed to the directorship of the Wellcome Chemical Research Laboratories at Snow Hill, a position he held until early in 1919. The war years were strenuously devoted to the production of drugs hitherto made abroad and, in particular, the difficult problem of the salvarsans claimed much of Pyman's attention. In addition, the ipecacuanha alkaloids, so important in the treatment of dysentery, were made to reveal more of their secrets.

The war years were unsettling years; Pyman had long cherished the ambition of a professorial chair, and in 1919 this goal was realized when he accepted the post of professor of technological chemistry in the Municipal College of Technology, Manchester. He entered on his new teaching duties with zest; he was an excellent lecturer, and for eight years he directed the researches of numerous students, the main theme being the chemistry of the glyoxalines. As glyoxalines are cyclic amidines, Pyman extended his investigations into this field, and the amidines were the subject of constant research up to the time of his death. The full fruits of amidine chemistry in its application to therapeutics—in this Pyman was a pioneer in Great Britain—have still to be reaped.

In 1927 Pyman was appointed director of research to Boots Pure Drug Co., Ltd., at Nottingham, a position he occupied until his death. Administrative duties were now paramount, and he regretfully left the test-tube and allowed it to be wielded by others under his stimulating direction. During this period a return was made to the chemistry of glyoxalines, the glycerophosphates, and the *iso*quinoline alkaloids, but new departures took Pyman into the field of organic salts of bismuth, long-chain amines and amidines, purgatives and derivatives of harmine and harmaline; studies of all of which were enriched by his long and ripe experience.

In 1935 Pyman was fittingly awarded the Hanbury Medal of the Pharmaceutical Society for original research in the natural history and chemistry of drugs. He was chosen as president of Section B (Chemistry) of the British Association at Nottingham in 1937, and his address was devoted to an account of the extensive researches of his colleagues, on amœbicides in particular, and on antiseptics.

To the outside world, Pyman's published researches are a lasting memorial to his memory. His friends, colleagues and pupils will, in addition, remember him as an English gentleman, staunch and straight and in whom there was no guile. Widespread sympathy will be felt for his widow, his three sons and two daughters in their tragic bereavement.

HAROLD KING.

NEWS and VIEWS

Institution of Electrical Engineers

Faraday Medallist

THE Council of the Institution of Electrical Engineers has made the twenty-second award of the Faraday Medal to Dr. Irving Langmuir, associate-director of the Research Laboratory of the General Electric Company in Schenectady, N.Y., for his outstanding contributions to electrical science. Dr. Langmuir's investigations have ranged over an extremely broad field. His work on hard vacuum valves, thyratrons and gas-filled incandescent lamps is widely known. He has also worked on atomic hydrogen welding and carried out fundamental researches on oil films; this latter work led to clearer understanding of such diverse topics as thermionics, heterogeneous catalysis and surface tension. Dr. Langmuir was elected a foreign member of the Royal Society in 1935 (see NATURE, July 6, 1935, p. 14), and three years before he had been awarded a Nobel Prize for Chemistry. The Faraday Medal is awarded by the Council of the Institution of Electrical Engineers not more frequently than once a year, either for notable scientific or industrial achievement in electrical engineering or for conspicuous service rendered to the advancement of electrical science, without restriction as regards nationality, country of residence, or membership of the Institution.

Honorary Member

THE Council of the Institution of Electrical Engineers has elected Sir Ernest Thomas Fisk to be an honorary member of the Institution. This distinction has been conferred upon him in appreciation of the services he has rendered in Australasia in the field of radio-communications. Sir Ernest, who is a past-president of the Institution of Radio Engineers (Australia), was managing director from 1917, and has been chairman from 1937, of Amalgamated Wireless (Australia), and also chairman of several other companies concerned with wireless. Originally a member of the Marconi Company, he joined a special mission to the Arctic in 1909. He has generally pioneered radio in Australia, including direct wireless communication with Great Britain, having received the first direct wireless message from England to Australia in 1918. In 1940 Sir Ernest was appointed secretary of the Economic Cabinet in Australia, and Director of Economic Co-ordination.

Agricultural Education in Great Britain

THE Minister of Agriculture has announced the Government's plans concerning the future of agricultural education. So varied have been the reactions to the recommendations contained in the Luxmore Report that it was natural that the Government should require time to digest the different points of view before reaching a decision. Two matters have been determined. The first concerns the future of the provincial and county advisory services, which are to be unified into one national service for the whole country directly under the Minister of Agriculture, and financed entirely by the Exchequer. This is virtually one of the Luxmore proposals, though it should be noted it is the system which has governed county advisory work during the War. War Agricultural Executive Committees have assumed the full responsibility for this work, and the majority of county council staffs have been seconded to these committees, while considerable additions to technical staffs have been made direct. The provincial advisory service has always been financed by the Exchequer, but the new proposals will remove this work from the control of the provincial colleges and university departments of agriculture. One cannot see any serious drawbacks to these proposals and they will be endorsed by the majority of those engaged in this work at present.

The second proposal concerns the farm institutes. These are to be multiplied in number, but the provision of agricultural education at the farm institute level and below will remain a function of the local authority. In this sense the Government has wisely accepted the criticisms levelled against the Luxmore proposals. Discussions have proceeded as to the control which should operate in the case of the farm institutes, and as a piece of permanent machinery a joint advisory committee is to be set up by the Ministry of Agriculture and the Board of Education to advise on the general educational policy and methods of training at farm institutes, and in turn the institutes will be inspected by inspectors of the Board of Education and of the Ministry of Agriculture. It is a pleasing thought that the Government is now recognizing that steps must be taken at an early date to make available farm institute training, since it has been little short of a national catastrophe that the existing institutes were closed down at the beginning of the War and educational work at this level has practically ceased. The explanation is that staffs normally engaged in this work were diverted to the needs of food production; but since there has been a considerable influx of new blood into agricultural education work directly concerned with food production since the beginning of the War, it should now be possible to provide adequate staff for the re-opening of farm institutes at an early date. This will be in the best interests both of food production and the future of agriculture itself in Great Britain.

Social Security in the United States

In the discussions on social security in Great Britain, it has already been emphasized that, at least in part, social security is an international problem. Full employment, or the reasonably high level of employment pre-supposed in the Beveridge plan, depends on the general condition of world trade as well as on the social and economic policies pursued internally in Great Britain. For that reason alone the article on "Social Security Planning in the United States", contributed by Eveline M. Burns to *Agenda* of December 1943, is of general interest. It gives an appreciation of the general situation in the United States and of the lines of development and policy recommended in the Security, Work and Relief Policies Report of the National Resources Planning Board, the Wagner Bill proposing to set up a unified national system of social insurance, and the more recent report of the Planning Board on "Demobilization and Readjustment", which shows the complexity of the situation in the United States.

Any acceptable and realistic programme for the United States must take account of the great geographical diversity in living standards and real wage levels, and must be so devised as to operate within the limitations of a federal system of government in which the consciousness of State rights is very strong. Furthermore, many sections of the public still regard government action to assure the basic economic security of the individual with the gravest suspicion. Social security planning of the type envisaged by the National Resources Planning Board meets with strong opposition among those who believe that the job can be done by private enterprise. Moreover, there has been a surprising lack of public interest in the proposals of the report on demobilization and readjustment, with its emphasis on the vital importance of efforts to assure full employment and on the responsibility of the Federal Government to announce its vitally important policies as soon as possible for both economic and social reasons. The whole psychological attitude of Americans, and the present boom, tend to conceal the inadequacy of American social machinery for grappling with the problems of poverty and insecurity; and no great national ordeal comparable to the 'blitz' in Great Britain has strengthened the sense of communal responsibility and the desire to remedy some of the glaring social evils of the pre-war world.

Planetaria of the World

Mr. Roy K. Marshall has an article on the Planetarium in *Sky and Telescope* of November 1943, which announces the first public demonstrations in the Fels Planetarium of the Franklin Institute in Philadelphia. The remainder of the article is devoted to a historical survey of the planetaria which have been constructed at various times, starting with Archimedes, the story of whose machine for reproducing the motions of the planets is probably legendary. The first of such machines to be made, of the quality of which we can be certain, was constructed by Johannes van Ceulen de la Haye, in 1682, and it is still preserved in Leyden. The proper way to represent the heavens is to make a celestial globe so large that the observer can get inside it, and the most famous of these is the one constructed about 1758 by Roger Long, the first Lowndean professor of astronomy and geometry at Cambridge. It was about 18 ft. in diameter and thirty people could be accommodated on the platform inside it.

A list of known planetaria with dates and also the diameters of the domes is given. Of twenty-seven planetaria, twelve are installed in Germany, the largest, with a diameter of 98 ft., being at Düsseldorf, and the United States comes next in the list with a total of six. A short description of some of the instruments and also diagrams appear, and the subject will be continued in a later issue. It may be mentioned, though it is probably known to most readers already, that the name 'orrery', which is frequently applied to these instruments, is derived from the fourth Earl of Orrery (Charles Boyle), for whom John Rowley made an instrument. This was an improvement on the model made by George Graham for Prince Eugene shortly after 1700.

An Attack on Logical Positivism

The simple solution to philosophical problems, which those philosophers who describe themselves as logical positivists have propounded in the last ten years, are to-day coming under attack. In the issue of *Mind* of October 1943, Mr. John R. Reid, who, like many American philosophers, uses a rather elaborate and top-heavy nomenclature, in his article "Analytic Statements in Semiosis" strikes hard at the root of logical positivism by attacking its account of the distinction between analytic and synthetic statements. Briefly, according to the logical positivists, an analytical statement, for example, "Red is a colour", asserts no matter of fact, cannot be denied without self-contradiction, and needs no verification; whereas a synthetic statement, such as "What I see now is red", states matter of fact, can be denied without self-contradiction, and needs to be verified. An analytical statement needs no verification because it says nothing about anything; it merely illustrates our verbal habit. In saying "Red is a colour", I am merely illustrating the verbal habit we have of grouping the class of things we call *red* under a larger class which we call *coloured*. If, however, I say "What I now see is *red*", this is no question of verbal habits, but a matter of fact, and what makes it true or false is just what I *am* seeing now.

Mr. Reid argues that this is not the whole story, pleading that verification is needed even in the case of the analytic statement. What he says, reduced to very simple terms, is this: "Verbal habits are not known to me by any mysterious form of cognition. The analytic statement 'Red is a colour' must be verified by the same *sort* of process as the synthetic statement 'What I now see is red'. I must check how people do in fact use words such as *red* and *colour*. I must check just what my own use is (because it *is* my own use does not prevent me being ignorant about it) and what I intend my use to be. Rules of English change, and as they change, it may be expected that analytic statements will change with them." In Mr. Reid's view, then, both analytic and synthetic statements require to be verified, the former by the intentions and verbal habits of people, the latter by facts and natural laws. The point is one which was worth making though it may not reduce the structure of logical positivism to ruins.

Problems of Colonization

UNDER the title "Ideas Sobre Los Fundamentos Bioclimaticos Y Biogeographicos Para Una Colonizacion Europea", in *De Gœa, Anales de la Sociedad Argentina de Estudios Geográficos* (7, 99–111), Walter Knoche sets forth a number of important points to be observed if colonization is to be a success. As a general principle, it is laid down that woods and forests should be protected, as they are valuable in preserving the climate, to say nothing of their aesthetic value and their use to future generations in preventing the spread of steppe and desert. Problems relating to the acclimatization of European colonies in different latitudes are considered, and also the difference in the aptitude for acclimatization of European immigrants from southern Europe or from the Mediterranean countries in comparison with those from north-west and central Europe. It is interesting to know that in torrid zones no colonists from north and central Europe are found who have any real expectations for their descendants, but this does not apply to certain southern European colonists. The difficulties of acclimatization in torrid zones are discussed and also the effects of certain climatic conditions, such as ultra-violet light which acts very differently in regions of high altitude, in temperate zones, and in tropical countries. Very short waves produce erythema while those that are longer are responsible for the formation of pigment which, while it reflects some heat, also absorbs some and, as a consequence, there ensues hypertension of the sweat glands. The southern European is better protected against the solar radiation in torrid regions than is the northern European, though the latter is now able to acquire an artificial pigment by means of sun bathing or special heat rays. The principle laid down by the Incas is recommended: "Colonize in the valleys similar to those existing in the previous State, and other parts of the earth with temperature and conditions like those from which we came; if cold, select cold; if hot, select hot".

Bell Laboratories Photographic Department

PHOTOGRAPHY is a necessary part of research and development work, and there has been a Photographic Department at the Bell Laboratories, 463 West Street, New York, ever since the building was erected for the Western Electric Company at the close of the last century. Beginning with a single photographer and camera, it grew with the organization it served until in 1941 it required the full time of nine men, and included developing and printing quarters and a studio with cameras and other facilities that permitted it to turn out some 4,500 negatives and 63,000 prints each year. By this time the facilities were old and needed replacement. A careful study was therefore made of all needs and the most efficient production methods, and an entirely new lay-out was made, new equipment acquired, and all needed facilities provided to do the work most efficiently. This new lay-out was just about completed when war came, bringing with it intensified work, longer hours and increased personnel, and there is no doubt that the greatly augmented demands for photographic services of various types would have greatly exceeded the capacities of the old facilities. With the new quarters and equipment, a staff of fifteen is now producing at the rate of 14,000 negatives and nearly 200,000 prints a year. The new quarters are described and illustrated in an article by E. Van Horn (*Bell Lab. Rec.*, 22, No. 2; October 1943).

Conductor Sagging on Overhead Lines

Messrs. C. O. Boyse and N. G. Simpson recently read a paper in London on this subject before the Institution of Electrical Engineers, in which the first part reviews overhead-conductor sags and tensions and their calculation on single spans and on complete lines, using parabolic formulæ throughout. A standard procedure and standard methods of calculation are recommended. The second part of the paper deals with the determination, with respect to the conditions prevailing in Great Britain, of the wind and ice loads to be applied to conductors for design purposes, and the stresses so produced in the conductors. The use of the term 'factor of safety' applied to overhead conductors is criticized, and suggestions are offered for revision of the Overhead Line Regulations of the Electricity Commissioners. The loads transmitted to the supports are also considered. Erection sags for low-voltage distribution lines are recommended for general adoption.

Sheet Steels for Electrical Plant

A PAPER entitled "A Survey of Electrical Sheet Steels for Power Plant and the Factors Affecting their Magnetic Properties" (*J. Inst. Elect. Eng.*, **90**, Pt. II, No. 17; October 1943) by Mr. F. Brailsford discusses magnetic sheet materials used for electrical plant, and represents an attempt to stimulate the interest of electrical engineers and others in this class of sheet steels, in which progress in relation to the commercial materials has been relatively slow. After a short discussion of the historical development, the limitations imposed upon designers of electrical plant by the existing materials are referred to. This is followed by a brief outline of the physical basis of magnetic processes and by a discussion of the factors which affect the magnetic properties of electrical sheets. Finally, reference is made to future possibilities. The problems involved in the production of better electrical sheet steels concern not only the practical steel-maker and the electrical engineer but also, for their solution, the physicist, the chemist and the experimental metallurgist. There is a great demand in the electrical industry for better electrical steels, particularly for transformers.

Lepidopterous Larvæ in Stored Products

WAR conditions have made it essential to know the numerous kinds of caterpillars, as well as of other insects, affecting stored food in Great Britain. It was soon found that with few exceptions the available descriptions of these larvæ are quite inadequate for identification purposes. Being based mainly on colour it became necessary to use more precise methods. In a useful paper entitled "The Larvæ of the Lepidoptera associated with Stored Products" (*Bull. Entomol. Res.*, 163; Oct. 1943) by Dr. H. E. Hinton of the British Museum (Natural History), the chætotaxy and other structural features are relied upon for distinguishing the species. He deals with thirty-five species which include all the more important British kinds, together with seven which have not yet been recorded in Britain. In order properly to study the structure and chætotaxy of the larvæ it is necessary to preserve them in Pampel's fluid or alcohol or other preservative; dried specimens have, as a rule, too many of the critical setæ missing. Through the early researches of Dyar, Forbes and Fracker, and more recently of certain European workers, the classification of Lepidopterous larvæ has been placed on a relatively sound basis, although much still remains to be done.

Tuberculosis Survey in the Western Pacific

A GRANT of £28,600 has been made under the Colonial Development and Welfare Act to enable a tuberculosis survey to be made in Fiji. It is hoped to extend the survey to the British Solomon Islands Protectorate and the Gilbert and Ellice Islands Colony. The scheme will cover a preliminary survey only, mainly to determine the extent of the problem and the best means of dealing with it. A Government medical officer is undertaking preliminary work. A comprehensive scheme for the reorganization of the medical services of Fiji and the Western Pacific with assistance under the Act is contemplated, under which it is proposed to provide accommodation for four hundred cases throughout the area.

Road Research

A COMMITTEE of the Road Research Board of the Department of Scientific and Industrial Research has been appointed "to survey the field for research on the use of machinery in road construction and, if thought fit, to draw up a programme of research". The Committee is constituted as follows: Sir George Burt, Mr. R. M. Wynne Edwards, Mr. A. Floyd, Mr. W. Minty, Mr. W. P. Robinson, Dr. W. H. Glanville (director of road research), and Mr. G. Bird (secretary).

The Department has also arranged to resume and extend its researches on concrete roads as part of the programme of the Road Research Board. The new work, which will have as its general aim the improvement of the standard of construction in respect of durability of surface characteristics, will be undertaken in co-operation with the Cement and Concrete Association. The Ministry of War Transport is co-operating in both these schemes.

Earthquake in Turkey

YET another large earthquake has taken place in Anatolia. On the morning of February 1, a strong earthquake occurred to the north-west of Ankara. The epicentre was near the town of Gerede, which is 180 miles east of Istanbul and about 60 miles from the Black Sea. In Gerede itself about four fifths of the houses were destroyed, and here and in the province of Bolu (in which Gerede is situated) 310 people were killed. In the province of Changiri 517 were killed, mostly at Tcherkesh, while in Zonguldak Province 25 people lost their lives. The effects of the shock were widespread, and in the villages north-west of Ankara 103 deaths as a result of the earthquake are reported. Altogether at least 955 people were killed by the earthquake and its effects, and some thousand others were injured. Faulting occurred along the motor-road from Ankara through Gerede and Bolu to Ismid, and communications were cut between Istanbul and the Kandili Observatory on the eastern shore of the Bosphorus. Snowstorms have hampered relief work. Strong tremors were felt at Adabazar, Ismid, Haidar Pasha, Smyrna, Kaisarieh and Brusa. The shock was registered at Kew Observatory in England at 4.28 a.m., the maximum ground movement at 4·41 a.m. being greater than one millimetre. This is the fourth great earthquake, besides numerous others of smaller intensity, which has occurred since what was probably the greatest Turkish earthquake—that of Erzinjan in December 1939.

Announcements

SIR HAROLD SPENCER JONES, Astronomer Royal, has been elected an honorary member of the American Astronomical Society.

DR. WILLIAM CULLEN, the distinguished consulting chemical and metallurgical engineer, has been elected president of the Science Masters' Association in succession to Prof. Frederick Soddy.

PROF. E. K. RIDEAL, professor of colloid science in the University of Cambridge, will succeed Mr. Wallace P. Cohoe, a well-known American consulting chemist, as president of the Society of Chemical Industry, at the annual meeting of the Society to be held in July.

PROF. P. M. S. BLACKETT, Langworthy professor of physics at the University of Manchester, has been elected president of the Association of Scientific Workers as from February 1. During the War, Prof. Blackett is working for the Admiralty; he is widely known for his work on nuclear physics and cosmic rays.

THE Council of the Institution of Electrical Engineers having sanctioned the formation of a Wireless Group for Cambridge and District, a provisional committee has been approved, under the chairmanship of Mr. C. R. Stoner, with Mr. D. I. Lawson as secretary. The inaugural meeting will be held in the Engineering Laboratories of the University on February 17.

THE A. Cressy Morrison Prize Committee for 1943 of the New York Academy of Sciences has awarded prizes of two hundred dollars each to W. A. Ritchie, Rochester Museum of Arts and Sciences, Rochester, N.Y., for a paper on "The Pre-Iroquoian Occupations of New York State", and to A. Grobman, University of Rochester, Rochester, N.Y., for a paper on "The Distribution of the Salamanders of the Genus Plethodon in Eastern United States and Canada".

LETTERS TO THE EDITORS

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

Terminology of Nucleic Acids

So far as is known at present, nucleic acids are of two types, differentiation depending on the nature of the sugar which is present. In one type, the sugar is a pentose, and in those examples which have been sufficiently investigated, this pentose is *d*-ribose; the nitrogenous radicals are those of guanine, adenine, cytosine and uracil. In the other type, the sugar is a desoxypentose, and in those cases where examination has been adequate, this sugar is *d*-ribodesose, and the nitrogenous radicals are those of guanine, adenine, cytosine and thymine (5-methyl uracil). A convenient source of an acid of the former type is yeast, and the acid from that source became known as 'yeast nucleic acid'. Pentose nucleic acids were also thought to be peculiar to plants, and as a result the term 'plant nucleic acid' came into use, with an implication that all pentose nucleic acids from whatever source are identical; consequently the terms 'yeast nucleic acid' and 'plant nucleic acid' became synonymous. A satisfactory source of an acid of the second type is the thymus gland of animals, so that the acid from that source became known as 'thymonucleic acid'; and since it was believed that acids of this type were characteristic of animal tissues only, the term 'animal nucleic acid' came into vogue, with the implication that all nucleic acids of the desoxypentose type are identical. Thus the terms 'thymonucleic acid' and 'animal nucleic acid' became synonymous.

With the progress of knowledge it became clear that these generalizations were inaccurate, and it was suggested[1] that it is necessary to define a nucleic acid by referring both to its origin and its type. In this way alone, in the light of present information, is it possible to avoid future confusion, until such time as it can be stated with certainty either that two (or more) individual nucleic acids exist and that all examples of each are identical in chemical constitution, or that two (or more) types of nucleic acid exist and that each type comprises a number of examples of related but different constitutions.

Recently, however, Pollister and Mirsky[2] suggested that the names 'chromonucleic acid' and 'plasmonucleic acid' should be used by biologists to denote the nucleic acids called by chemists 'desoxyribose nucleic acid' and 'ribose nucleic acid' respectively. It seems to us that this suggestion has little to recommend it, and is, in fact, retrograde.

The adoption of these terms would be open to the objections based on constitutional reasons mentioned below, and their application to denote the two types of nucleic acid, pentose and desoxypentose, would not clarify the present situation, and would merely replace names based on chemical structure or biological source by other terms not wholly accurate because based on an incorrect statement of biological distribution. Thus, Pollister and Mirsky state that "it is now clear that desoxyribose nucleic acid is normally restricted to the chromatin of the cell nucleus", and that it is "now certain that the ribose nucleic acid, by contrast, is found either in the cell cytoplasm or in the plasmosome (nucleolus) of the cell nucleus". This statement is barely tenable at the present time without special emphasis of the word 'normally', since it is known, for example, that the viruses of psittacosis and vaccinia[3] contain desoxypentose nucleic acid and that the magnesium salt of ribonucleic acid forms part of the surface structure of Gram-positive organisms[4]. Who can predict what the future may bring in the way of other exceptions to Pollister and Mirsky's basis of definition?

Further, Pollister and Mirsky's proposed classification is founded on the recognition of certain chemical units detected only after the disintegration of complex molecules which occur in a considerable variety of biological sources. It ignores entirely in what ways those units may be joined together. There is at present no evidence to show whether the nucleotide components are united in the same mode and pattern in the different examples of each of the two types of nucleic acids, that is, that such examples have, in fact, identical chemical constitutions. The adoption by biologists of Pollister and Mirsky's proposed classification would obscure potential differences, which if they exist cannot fail to be significant.

It seems necessary, therefore, to reiterate the suggestion made more than five years ago that, until the position becomes clearer, a nucleic acid should be defined by reference to its origin and type (pentose or desoxypentose); closer specification of the type, for example, *d*-ribose or *d*-ribodesose, is to be welcomed when justified on sound chemical grounds.

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Department of Chemistry,
University College,
Nottingham. Jan. 10.

[1] Gulland, J. M., *J. Chem. Soc.*, 1722 (1938).
[2] Pollister, A. W., and Mirsky, A. E., NATURE, **152**, 692 (1943).
[3] Hoagland, C. L., Lavin, G. I., Smadel, J. E., and Rivers, T. M., *J. Expt. Med.*, **72**, 139 (1940).
[4] Henry, H., and Stacey, M., NATURE, **151**, 671 (1943).

Vitamin A Aldehyde

WITH reference to Dr. Morton's suggestion regarding the role of vitamin A aldehyde (axerophthal) in the chemical changes involved in photo-reception[1], it may be of interest to mention that we prepared this substance some eighteen months ago by Oppenauer oxidation of vitamin A alcohol with aluminium *iso*propoxide in the presence of acetaldehyde. The ultra-violet absorption spectrum of the aldehyde showed maxima at 350 and 368 mμ in *cyclo*hexane and a band at 657 mμ in the antimony trichloride reaction, and was characterized by the formation of a 2 : 4-dinitrophenylhydrazone, m.p. 207–209°. On Pondorff reduction, it regenerated vitamin A alcohol (abs. max. at 330 mμ in the ultra-violet and at 620 mμ in the antimony trichloride reaction) which was characterized by conversion into 'cyclized' vitamin A (abs. bands at 390, 370 and 350 mμ in the ultra-violet and at 620 mμ in the antimony trichloride reaction). On condensation with acetone in the presence of sodium ethoxide, the aldehyde furnished axerophthylideneacetone[2].

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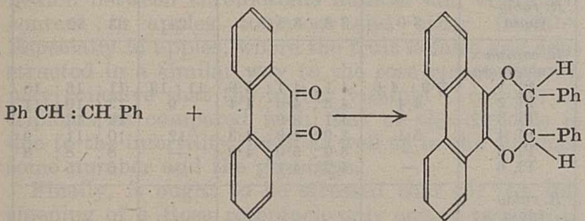
[1] NATURE, **153**, 69 (1944).
[2] Batty, Burawoy, Harper, Heilbron and Jones, *J. Chem. Soc.*, 135 (1938).

Reactions of Ethylenes with 1,2-Diketones in Sunlight

WE have found that ethylenes, for example, styrene, stilbene and triphenyl ethylene, react with 1,2-diketones when dissolved in benzene (thiophene-free) and exposed to sunlight. The experiments were carried out in 'Monax' glass tubes in an atmosphere of carbon dioxide. The reaction between phenanthraquinone and stilbene, which proceeds very rapidly, may be illustrated by the following scheme :



The nature of the product (m.p. about 260° with decomposition) is established by the fact that the photo-product is colourless (therefore no longer having the quinoid structure of phenanthraquinone) and when heated above the melting point, it decomposes into phenanthraquinone and stilbene. The action of concentrated sulphuric acid on it yields phenanthraquinone.

A full report describing the wide scope of the reactions mentioned in the title will be published soon.

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Topography of a Quartz Crystal Face

IN a recent communication[1] a brief description was given of a multiple-beam interference method which can reveal submicroscopic detail upon the surfaces of crystals, and some preliminary data for cleavage faces of mica and selenite were recorded. This method has now been applied to reveal the topographical features of a highly lustrous (100) face of a left-handed quartz crystal. Typical interference contours for this face are shown in Figs. 1 and 2. The particular pattern recorded in any exposure is determined by the angle of inclination between the interference surfaces, and the contour patterns, although superficially different, give the same interpretation of surface structure when this is taken into account.

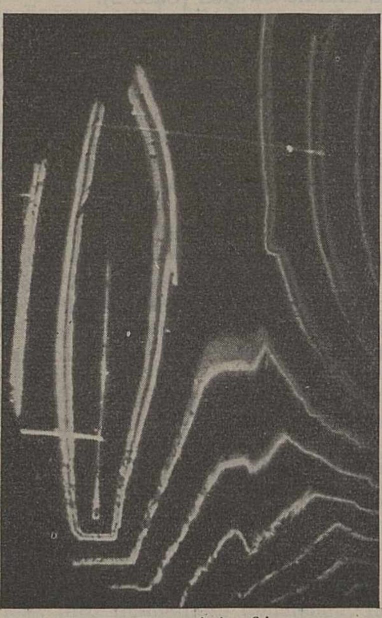

FIG. 1. Transmission fringes.

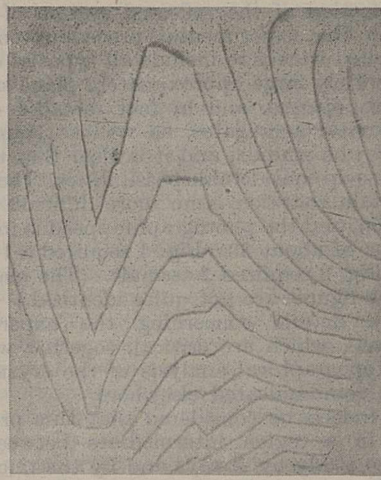

FIG. 2. Reflexion fringes.

Fig. 1 shows *transmission* fringes over the larger part of the (100) face, the optical conditions being such as to prevent the whole of the face being covered. Both green and yellow mercury fringes appear. Fig. 2 shows *reflexion* fringes of the same face (green only), with a different inclination between the interference surfaces. The fringes are remarkably sharp, particularly those in reflexion, and the precision is so high that faces with angles of no more than 1/50 of a minute of arc between their normals can be measured. This is true even for quite small facets, and, of course, far exceeds the Rayleigh diffraction limit of the goniometer.

The interference contours reveal considerable detail, and each kink and bend in the fringes has true topographical significance and can be interpreted accordingly. The patterns show the existence of a small number of large vicinal faces covering the entire (100) face. These are inclined to each other at very small angles varying from 0·50′ to 9·00′. Furthermore, the surfaces of these vicinal faces are in most cases slightly curved, with radii of curvature varying from 60 to 20 metres. In some cases the ridge formed by the junction of two vicinal faces has not a constant angle but exhibits considerable, but continuous, variation along the ridge length.

The visual markings characteristic of a (100) face in quartz, namely, fine striations, inverted V markings and small triangular patterns, each show their own influence upon the interference pattern, and their topographical features have been determined. The striations have been found to be either minute ridges or ruts, the height (depth) being only 100 A. (that is, 20 molecules). Both ridges and ruts have been observed. The inverted *V* markings reveal small discontinuities in level in their immediate neighbourhood, of the order of small fractions of a wave. The triangular markings are found to be small submicroscopic projections, which are tetrahedra, some 450 A. in height (that is, 90 molecules), and with vicinal face angles of the order of 2′ or 3′.

The perfection of the reflected system of fringes shows that the experimental procedure employed can be applied widely to include all types of crystals with moderately large approximately plane surfaces. Translucent, opaque, and in fact metallic crystals or even crystal aggregates, as well as transparent crystals, can be studied, and it is clear that the procedure opens up considerable possibilities. The optical adjustment in reflexion is no more difficult than in transmission, and the photographic speed is increased by a factor of about 30. Fig. 1 required a 1-minute exposure, Fig. 2 required 2 seconds. (The magnifications of the figures are not quite identical.)

Complete details concerning the experimental arrangements, which are critical, together with the complete topographical analysis of the crystal face, have been communicated elsewhere.

It may indeed be considered that this procedure functions in a region intermediate between that available to study by *X*-rays and by the microscope respectively.

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[1] NATURE, 152, 722 (1943).

Ascorbic Acid and Hip Fertility in Rosa Species

PREPARATIONS rich in vitamin C made from the flesh of ripe Rosa receptacles are now being produced on an industrial scale, in Sweden as well as in other countries. The systematic examination of native and cultivated species of Rosa has shown that considerable differences occur in their content of ascorbic acid. One of the present authors (J. S.) published in 1941 a paper on the results obtained at Kärnbolaget AB, Stockholm, up to that year. In that publication the chemical methods used were described in considerable detail, as was also the relation of ascorbic acid to yearly fluctuations, chromosome number and taxonomical position. Previously, Gustafsson[1,2] and Gustafsson and Håkansson[3] were engaged in genetical and cytological experiments on *canina* roses and undertook in 1942, with the financial support of Kärnbolaget AB, a population analysis of ascorbic acid in the roses of south Sweden. By this joint work a relation was discovered that seems to be of general importance, namely, the influence of hip fertility on the amount of ascorbic acid.

Successful cross-experiments were carried out in 1932 and 1934 between various *R. canina*, *rubiginosa* and *rugosa* biotypes. Especially the hybrid series *R. canina* II × *rubiginosa* and its reciprocal have proved interesting in several respects and have been carefully studied with regard to ascorbic acid content. With *R. canina* as mother the hybrids form large hips, rich in ascorbic acid ; but at the same time containing very few fruit, that is, they are largely infertile. Most of the reciprocal hybrids, with *R. rubiginosa* as mother, give late-ripening, bottle-shaped hips, having a low content of ascorbic acid, but being normally fertile with a high number of nuts per hip. These reciprocal differences made us assume that the infertility is responsible for the high content of ascorbic acid, or, in other words, that the fewer nuts per hip, the more ascorbic acid, within similar hybrid series and in related species. The proof of this assumption was afforded by a monosomic plant in the *R. rubiginosa* × *canina* II series (Pl. 34), this having a low fertility owing to the loss of one chromosome (34 instead of 35), but simultaneously a highly increased vitamin C content. The results are given in Table 1.

TABLE 1.

	Ascorbic acid as per cent dry matter of the flesh		Nut content as per cent of the hip weight	
	1941	1943	1941	1943
R. canina	1·9	2·7 ; 2·4	27	31 ; 32
R. rubiginosa	3·0	3·3 ; 3·4	24	33 ; 32
R. canina × *rubiginosa*				
Pl. 1	3·9 ; 4·6	4·1 ; 4·1 ; 3·9	11 ; 13	11 ; 16 ; 10
Pl. 2	4·4	4·3 ; 4·0 ; 4·4	9	13 ; 10 ; 11
Pl. 3	—	4·1 ; 3·9	—	12 ; 12
Pl. 4	5·1	3·9 ; 4·9 ; 4·3	12	10 ; 11 ; 9
Pl. 5	—	3·9 ; 5·0 ; 4·2	—	8 ; 8 ; 8
Pl. 6	—	4·2 ; 4·1	—	16 ; 15
R. rubiginosa × *canina*				
Pl. 1	2·2	—	44	—
Pl. 4	2·0	—	49	—
Pl. 21	—	2·8	—	35
Pl. 51	—	2·1	—	44
Pl. 34 ($2n=34$)	5·1	4·6 ; 4·2	21	27 ; 22

(The analyses of *R. canina* I × *rugosa* and *R. canina* II × *rugosa* run in the same direction, but so far the content of ascorbic acid in the *R. rugosa* parent has not been sufficiently determined to allow definite conclusions.)

This negative correlation of hip fertility and content of ascorbic acid was also demonstrated in three other sets of material.

In 1942 the ascorbic acid and the nut content were determined in 155 different spontaneous *R. canina* individuals, the hips of which were collected by Gustafsson and then immediately examined. Most of the shrubs belonged to the *R. eucanina* and *afzeliana* complexes (Case 1).

Similarly, a series of samples were taken by Schröderheim[4] from 41 different parcels delivered for industrial production in 1943 from various parts of south and middle Sweden (Case 2).

In these two cases the material was biologically heterogeneous. In order to examine the corresponding conditions in one and the same species, samples of 164 *R. rugosa* individuals grown at Närlunda, not far from Stockholm, were analysed. Owing to the heterozygosity of this species in Nature most of the individual shrubs probably represent different biotypes, but every one falls within the boundaries of the species (Case 3).

The *P*-values were determined by analysis of the co-variance[5,6]. The data obtained are given in Table 2. The regression is expressed in such a way that the coefficient, −0·037, to exemplify from Case 1, implies an *increase* by 0·037 per cent in ascorbic acid content for every 1 per cent *decrease* in fruit content.

TABLE 2.

	Average fruit content in per cent of hip weight	Average ascorbic acid in per cent dry matter of hip flesh	Corr. coeff.	Regr. coeff.	*P*
Case 1	34·76	2·82	−0·21	−0·037	0·01–0·001
Case 2	31·63	2·50	−0·75	−0·120	< 0·001
Case 3	20·82	3·50	−0·17	−0·032	0·02

Consequently, the fertility of the hips shows an obvious and significant influence on the amount of ascorbic acid. This fact in its turn may signify that the ascorbic acid (or some sort of precursor or derivative) takes direct part in the seed and nut development, so that it is stored up in the receptacles and not consumed if for some cause (genotypically or environmentally conditioned) the nuts are few in number and the ascorbic acid is not needed in metabolism.

These results point to a reconsideration of the connexion between chromosome number and vitamin C content in apples, tomatoes and other fruits[7,8]. Especially in apples, where the fruit is false and constructed in a similar way to the rose receptacle, we may conceive that the higher vitamin C content of triploids as compared with that of the diploids is due to the infertility itself, as well as to the chromosome number and the genotype.

Finally, it ought to be stressed that for the full ripening of a Rosa receptacle only one or two fruits are required. In fact, the above-mentioned *R. canina* ♀ × *rubiginosa* ♂ hybrids flower and fruit abundantly, although the number of fruits per hip is very low.

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Manganese Deficiency in Oats

E. S. TWYMAN[1] stresses the value of the water-culture technique used by Stout and Arnon[2] in investigations into the effects of traces of the heavy metals on plant growth. The demonstration of the rapidity with which grey-speck lesions can be produced in oat seedlings is, however, not new, and directs attention to the need to consider carefully the chemical background to all water-culture investigations. More than fifteen years ago it was shown[3,4] that, provided proper precautions were taken to exclude manganese from the culture solutions, grey-speck lesions invariably developed in oat plants in four weeks or less. Recent work by Arnon and Stout[5] on the effect of molybdenum on the growth of tomatoes has been confirmed by me[6] in regard to oats, so that the response obtained by Twyman to the group of seven elements (aluminium, molybdenum, titanium, vanadium, tungsten, nickel and cobalt) cannot be separated from the response known to be due to one of them.

In all critical water-culture investigations, it is necessary to consider carefully the chemistry of the elements under investigation, so as to appreciate the possible sources of contamination by them, the effective means for their removal, and specific tests to demonstrate their absence. Thus, in the case of investigations into manganese deficiency, it can be shown that water from a well-designed tinned-copper still and block tin condenser is entirely satisfactory, although such water would not be in the least suitable for investigations into the effects of copper and certain other heavy metals on plant-growth. For this, water redistilled from all-glass apparatus is essential. Water from a tinned-copper still has been found to contain 20–80 μgm. of copper per litre, depending on the condition of the tin coating of the still. In many cases high-grade analytical reagents can be shown to be free from manganese while other reagents, such as magnesium sulphate and iron salts, almost invariably require specially devised methods for their purification from the last traces of manganese. Fortunately, many of the methods for the removal of this element will, when properly carried out, also eliminate the last traces of copper, zinc and certain other heavy metals. Not all these methods will be equally effective for the removal of molybdenum, which exists as the molybdate ion in alkaline solutions, or for non-metallic elements such as boron. Incidentally, the diphenylthiocarbazone test does not detect either of these elements, and it is not correct to assume that methods suitable for the elimination of a particular element, or group of elements, will also ensure general purification of the reagents from all other important trace elements.

Traces of manganese and zinc are readily obtained by plants from many types of glass ordinarily used for culture vessels. In critical experiments involving these elements, it is therefore necessary to protect the surface with paraffin wax, or preferably to use vessels of 'Pyrex' glass. Many of the better quality resistant glasses do not yield significant traces of copper to plants growing in vessels made from them, hence they are quite suitable for such investigations.

In many experiments the amounts of the trace elements contained in the seed must not be overlooked for, after satisfactory control of all reagents and water has been obtained, these amounts become of prime importance. It is often necessary to select seed as low as possible in the element under investigation. The natural variation may be very considerable; I have noted a range of 10–75 mgm. of manganese per kgm. of dry matter and 0·9–11·3 mgm. of copper per kgm. for Algerian oats. Other investigators have also found considerable variation in seeds generally. Experiments recently carried out by me indicate that the relatively greater amounts of copper contained in rye grain account for the greater growth made by this plant when oats and rye are grown under identical conditions in nutrient solutions, either in the absence of copper or in the presence of amounts of the order of 1–2 μgm. per litre.

If adequate means of chemical control had been available to, or attempted by, the early investigators of the trace elements, to ensure the purity of the water and reagents used and the suitability of the glass of the culture vessels, it is reasonable to assume that the essential nature of manganese, boron, copper, zinc, and molybdenum would have been demonstrated many years sooner.

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Nov. 3.

[1] Twyman, NATURE, **152**, 216 (1943).
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[3] Samuel and Piper, *J. Agric. South Australia*, **31**, 696 and 789 (1928).
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[5] Arnon and Stout, *Plant Physiol.*, **14**, 599 (1938).
[6] Piper, *J. Aust. Inst. Agric. Sci.*, **6**, 162 (1940).

MR. PIPER has rather missed the point of my communication, which was to direct attention to the value of the Arnon technique, since this, so far as I was aware, had not until then been used in Great Britain. I exemplified this value by quoting some of my own experiments with oats. I certainly did not wish to suggest that there was anything new in producing the symptoms of grey-speck disease in water culture, and I had assumed that all those interested would be well acquainted with the work of Samuel and Piper, published some fifteen years ago, since it was this work which established the proof of the connexion between grey-speck disease and manganese deficiency.

With regard to the effect of molybdenum on the growth of oats, I would say that I have now been able to read Mr. Piper's paper which, probably owing to war conditions, had not reached me at the time of the publication of my earlier letter. There is now no doubt that molybdenum is an essential element for the growth of oats. It still remains to be proved, however, whether one or more of the other elements of Arnon's original *B*7 group (chromium, titanium, vanadium, tungsten, nickel and cobalt) were also responsible for at least part of the response obtained in the experiment reported in my communication.

I would like to take this opportunity of correcting an error made in my letter where I included aluminium among the seven elements of the *B*7 group; this should have been chromium. Thus for aluminium read chromium in Mr. Piper's letter in this issue.

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Development of Botanical Investigations at Rothamsted

IN an article in NATURE of July 24 entitled "Development of Botanical Investigations at Rothamsted", the following statement is made with reference to 'minor' elements and plant growth[1]:

"Stimulation with minute traces of elements was far more difficult to demonstrate, though some indication was obtained. Following up an accidental clue obtained in 1921, Dr. K. Warington proved conclusively that in the absence of a trace of boron, growth of broad beans was completely checked. . . ."

I am not sure what constitutes an "accidental clue" in scientific investigations, but as a matter of historical interest in the progress of our knowledge about the effects produced by minute quantities of boron on the growth of broad beans, attention might be directed to the following statement made by Dr. Warington in the introduction to her classical paper published in 1923[2].

"In some experiments carried out by Dr. J. Davidson at Rothamsted in 1920 in connection with the bean aphis, broad bean plants in water culture solution supplied with a small quantity of boric acid were strikingly superior to the rest of the series; accordingly, the present investigation was undertaken in order to determine more fully the action of boric acid on the broad bean and certain other plants."

The experiments referred to formed part of a wide programme of research, which aimed at finding out by means of controlled experiments with the black aphis on broad beans "whether changes can be introduced in the sap of the growing plant, so as to affect its suitability as food for the aphids, and at the same time not adversely affect the plant"[3].

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The British Elm Flora

THE view expressed by Howard in his interesting article on the elm tree[1], that there are but two species represented in the United Kingdom "with perhaps nine or more hybrids or varieties", is no longer accepted by botanists. It is true that the common or English elm and the wych elm are the most widely-spread species and both are undoubtedly native. The wych elm, the correct name for which is *Ulmus glabra* Huds., occurs throughout the country, but the common elm is concentrated in the south, thins out in northern England and is probably only planted in Scotland. This species is now known as *U. procera* Salisbury, the Linnean name *U. campestris* being a *nomen ambiguum*[2]. Its distribution in the country is quite natural, and so far it has been recorded from the Continent only as a planted tree; the evidence strongly favours the view that it is endemic, in spite of the misgivings of earlier writers.

The parts of England to the south and east of a line drawn from the Bristol Channel to the Humber has an unusually rich elm flora, including several species that appear to be endemic, though their status cannot be finally settled until a critical examination has been made of the elms of the neighbouring parts of the Continent. The Cornish elm, *U. stricta* Lindley, is abundant in Cornwall and Devon, thins out eastward into Dorset and is represented by a variety, the Goodyear elm, var. *Goodyeri* Melville[3], to the south of the New Forest, and by a further variety, the Wheatley or Jersey elm, var. *sarniensis* (Loud.) Moss, in the Channel Islands and possibly adjacent parts of France. The three varieties form a geographical series or topocline increasing in breadth of leaf from west to east[4]. In low-lying parts of the river valleys, from the Wash across to the Severn, is found the most distinctive and elegant of our endemic species, the Plot elm, *U. Plotii* Druce[5]. The Continental smooth-leaved elm, *U. carpinifolia* Gleditsch (*U. nitens* Moench), is doubtfully native, but we have instead the East Anglian elm, *U. diversifolia* Melville[6], having shoots with symmetrical leaves interspersed with others bearing the usual lop-sided leaves and another species with intergrading varieties extending across the Midlands and East Anglia. The latter awaits description, as does the small-leaved elm of East Anglia related to the Plot elm.

The Dutch elm, × *U. hollandica* Mill. var. *major* (Sm.) Rehd. and the Huntingdon elm, × *U. hollandica* var. *vegeta* (Loud.) Rehd., are widely planted; both are presumed to be hybrids of the wych elm with *U. carpinifolia* Gleditsch. There are numerous natural hybrids; the wych elm apparently hybridizes freely with all the other species except *U. procera*, which normally has finished flowering before the wych elm starts. It is probable that many of the hybrids are fertile, as intergrading series of hybrid forms connect the species. The intergrades are particularly numerous between *U. glabra* and *U. Plotii* and may be arranged in sequences on leaf shape characters[1]. Horwood's Midland elm, *U. elegantissima*, is a hybrid of this group.

There is a wide field for investigation in the physical properties and economic value of our native elms. Much of the ill-repute with which elm timber is regarded may be due to admixture of unsuitable hybrids. Without botanical assistance both forester and timber merchant may accept inferior hybrids as wych elm, since the habit of this species appears to be a dominant character. Field observations suggest that interaction or recombination of genes occurs in the hybrids, and may result in wood so brittle that branches half an inch in diameter break under slight pressure with a short fracture. On the other hand, it is probable that improved strains for timber production could be selected and this might be coupled with resistance to the Dutch elm disease, *Ceratostomella ulmi*. Of our native species, the wych elm is the most susceptible, but some of its hybrids are even less resistant, notably the Dutch elm and many of the heterogeneous forms hitherto imported as seedlings from the Continent. The Cornish elm, the English elm and the Plot elm all appear to be comparatively resistant.

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SURELY Dr. Melville is misquoting me. My statement was: "There are about twenty species, of which only two are prominent in the United Kingdom —the common elm (*Ulmus campestris*) and the wych elm (*Ulmus montana*)—with perhaps nine or more hybrids or varieties".

The article contributed by Dr. Melville, who has made a comprehensive study of the elm tree and has published many interesting articles in the *Journal of Botany* and that of the Linnean Society, recalls to my mind a conversation which took place about forty-two years ago between Henry John Elwes and Sir Hugh Beevor, one of whom at the time was president of the Royal English Arboricultural Society.

The subject was whether the elm was indigenous to Great Britain, and covered much the same ground as that traversed by Melville. It seems difficult to understand that those keen-eyed, closely observant men who came before and followed Evelyn would be likely to have been mistaken. The intelligent woodman clearly recognizes the difference between the common elm, the wych elm and the Dutch, the last-named of which assumes a quite different appearance in its habits from either of the others.

There is no doubt that the elm, with the exception of those sorts already mentioned, and possibly the Cornish elm, varies greatly, probably more than any other of our trees.

The regular planting and rearing of English elm has received little attention during the last two hundred years, and the greater majority of those trees that have established themselves have been self-sown. During this period a great many aliens have been introduced into Great Britain—American, Canadian, European, Japanese, etc. Is it possible that this has resulted in the development of hybrids ?

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An Undescribed Feature in the Drill (*Mandrillus leucophaeus*)

GLANDULAR modifications of the skin over the sternal region in primates have been described in the orang (Schultz) and in the Gelada. Something of the kind evidently exists in the drill (*Mandrillus leucophæus*) and possibly also, therefore, in the mandrill (*M. sphinx*), though full details cannot be given pending histological study of the part. No reference is made to such a structure by Sonntag.

My notice was first directed to the possibility of a sternal cutaneous modification in a male drill which has been in captivity under my observation for seven years. After passing the pubertal epoch at the approximate age of five years, he developed, upon the middle of his chest, between the nipples, a tuft-like patch of specialized hairs. These are longer, coarser, stiffer and of duskier colour than the general ventral covering of short, soft, whitish hairs. They project caudalwards and at times are slightly more upstanding than the hairs of the neighbouring areas.

This hairy tuft is the bas s of a very curious and extremely amusing behavioural pattern which is observed *only* when the animal is presented with pieces of fresh twig or bark derived from a mango tree (*Mangifera indica*). After smelling the twig, he rubs it in a vertical direction on his mouth and chin (maximum pressure being on the chin) and swiftly passes it thence to the sternal tuft, thrusting the chest forwards to meet it. This procedure is repeated many times in rapid succession. Each time a return is made from sternum to lips, profuse salivation takes place, until his beard is literally dribbling with saliva, much of which is transferred to the sternal tuft in the frenzied antics accompanying the act. The animal apparently realizes that this behaviour has an entertainment value, and this stimulates him to adopt the most inconceivable bodily postures in an endeavour to obtain the maximum number of contacts between the twig and his chest in the minimum time. The animal is quite rational in his other behaviour, so that I do not consider this to be merely a personal idiosyncrasy.

No adequate explanation can at present be offered for this behaviour ; but it is clearly initiated by the characteristic odour of the mango bark (the fruit has no similar effect). Some pleasurable sensation is evidently experienced either (*a*) from contact between the moistened bark and the sternal tuft, or (*b*) the twig serves to transfer a possible cutaneous secretion from a gland on the chest to the lips and nose, whereby pleasure is evoked by the taste or smell thereof, or (*c*) both.

There is no direct evidence of any sexual significance in the specialization here referred to, except that so far it has only been observed in an adult male. I have examined cadavers of two female drills (one juvenile and one sub-adult) and found no modification of the hair, and at any rate no macroscopic indication of a cutaneous gland in the intermammary area. The matter is being further investigated.

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Nov. 25.

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REGIONAL PLANNING AND RESEARCH IN THE UNITED STATES

IN the field of industrial research, the United States of America have always and with very good reason been held up as an impressive example; and a remarkable illustration of this truth now comes in a recent report on New England*. It is the more timely and interesting since it deals also with regional planning and location of industry in close relation to research.

New England comprises the six comparatively small States of Maine, Vermont, New Hampshire, Massachusetts, Connecticut and Rhode Island; accounting for only 2 per cent of the total land areas of the United States, but contributing 8·6 per cent to the country's manufacturing industry, and employing 12·1 per cent of the wage earners. There is no need at this time to describe in any detail the manifold industries and the spirit of enterprise and courageous and intelligent self-help which distinguishes its people: the point of main interest is the energy and vision with which New England is dealing with present and prospective problems of industry and social life, and its very faithful application of research methods to regional development.

Regional planning in this section of the United States may be said to date back to 1925, when the New England Council was established to co-ordinate economic interests and act in a broad sense as a research agency, both in the technical and the social aspect. It is democratically based on individual and corporate representation, and its one aim is to advance the economic and cultural welfare of the six States. One of its first actions was to set up a research committee, when Lincoln Filene—a great name in American industrial history—was appointed chairman. It initiated complete surveys of industry and technical research facilities, investigated cultural and recreational development, agricultural well-being, community growth, and in a word the whole field of communal and industrial activity.

In 1938 the president of the Council approached the Massachusetts Institute of Technology and asked the Institute to assist in the setting up of a New Products Committee. This assistance was readily forthcoming, and four sub-committees were soon afterwards established. (1) "Research Day" in New England, which aimed at setting apart one day at least in the year when all New Englanders should think about research and its vital importance to their welfare; become, in fact, research-minded. Meetings would be held, papers read, and speakers invited to tell the people in plain language some of the latest achievements of science. Special efforts would be made to interest the smaller firms, and discover means whereby they too should benefit from technological advance. (2) Natural Resources, to undertake complete surveys. (3) New Manufactures, mainly to study the various materials and products imported into New England, with the view of determining which of these could well be produced within the regional borders. Purchasing agents' associations were called in to help, and many new lines of industry were thus indicated, including fibre glass textiles and the like. At first sight it would seem that New England might benefit at the expense of other parts of the United States if this policy should be largely followed; but this is not necessarily the case, for manufacturers of these products in other parts would be invited and encouraged to establish branches in New England.

(4) Venture Capital. This sub-committee is of particular interest. As the name implies, its function is to finance the new ventures, and by skilful publicity, based on the many real advantages offered by New England to investors, to attract capital from outside and encourage those within the region to put their money into local industries rather than into safe gilt-edged securities. Hitherto brains and capital are said to have been the principal exports, but now it is earnestly sought to retain both at home for investment there. If other regional units of the United States follow the New England example, then there would be keen rivalry among them in attracting industrial enterprise, including capital, labour, research workers and management. Assuming that such competition is desirable if properly controlled and guided in the national interest, then it constitutes the real kernel in the location of industry problem.

Several interesting questions arise here of vital national and international importance as to the right kind of competition and its judicious balance with co-operation. It is obviously undesirable that one region within a country should gain at the expense of others, just as it is for one country to gain at the expense of others. These difficulties cannot be discussed fully here, but so far as New England is concerned, it is held that the most important part of the work of the Council is survey and research in order to ascertain quite definitely what are the determining factors involved in the question: Where shall we locate our business? In New England, in the Middle West, in some other part of the United States, or abroad? The last-named possibility should not be overlooked by taxation authorities, by labour leaders and others. It was indeed suggested early in the history of the Council that a permanent organization should be established to study industrial opportunities which offer the chance of major development, and assemble full and complete factual information on which industrial leaders could base a sound and intelligent judgment. Small firms would be welcomed equally with large.

Accordingly a Research Foundation was set up in 1941—the New England Industrial Research Foundation Incorp.—with a small operating staff and trustees of management. The seventeen founders were carefully selected to represent the most varied interests throughout the six States. Funds were readily forthcoming, and these, together with the fees payable to the Foundation for the various services it would render, were held to be ample to keep the establishment going. Its main function, as already implied, would be social and industrial research, in no wise competing with existing technical or scientific research institutions. Special care was exercised in the appointment of the first director, in March 1942, and the choice fell on Dr. Lawrence W. Bass, who has had wide experience both in the Mellon and in the Rockefeller Institutes. On the New England "Research Day" held in Boston during May 1942, Dr. Bass emphasized the need for technical excellence as the New England slogan, achieved through the sheer power of intelligence in manufacturing operations exercised through labour, management and research.

W. G. L. C.

* The McGraw-Hill Book Company, Inc., 1943. 25 cents. See also *Chem. and Metall. Industry* (Sept. 1943).

THE FOREST RESEARCH INSTITUTE, DEHRA DUN

In a Dispatch of the Governor-General in Council, India (dated Nov. 1, 1862), which merits a closer study than some parts of the Empire and Commonwealth appear to have given it, the formation of an Indian Forest Service with an inspector-general of forests at its head as adviser to the Governor-General was advocated, in order to check the excessive exploitment and waste of the forests of that country, which had been greatly intensified with the increased demand following the establishment of ordered rule, and to reserve and conserve selected forest areas. In sanctioning the proposals, the Secretary of State for India wrote that whereas capital expenditure might and would be justifiably spent in ameliorating ruined forests and in opening out inaccessible ones, he was assured that the work projected would result in a valuable forest estate accruing, which in due course, in addition to being of the greatest benefit to the people, would bring in an increasing revenue to the Government. This inspired prophecy was abundantly fulfilled.

Yet, something more than half a century later, so incalculable is the potential value of the great forest estate in India, that the Government of India wrote (to the Secretary of State), "the greater part of our Forest properties are undeveloped". The subject then in question was research and the Forest Research Institute at Dehra Dun. This was inaugurated in 1906, a research building erected and opened in 1912 and soon after came the War of 1914–18. Imports of many material products in common use in India came to an end, and the young Research Institute was called upon to investigate the possibility of replacing them with raw materials from the forests. The success achieved is common history. The second Dispatch, from which the above sentence is quoted, proceeds to point out that the existing research buildings were totally inadequate to the demands of the Institute and proposed, in addition to considerable increases of the research staff, the purchase of a site of 1,200 acres and the erection of a new Institute building, workshops, residencies, etc., at an estimated cost of close on a million pounds sterling. This great scheme was sanctioned by the Secretary of State, and the new Institute building was opened some seven years later by the Viceroy.

Once again war supervened ; and once again India was faced with a closure of imports and the necessity of falling back on her own resources. For the second time the Forest Research Institute, now immensely stronger, has proved able to give invaluable services.

A recent publication, "Forest Research in India and Burma, 1941–42. Part I. The Forest Research Institute" (Dehra Dun : Forest Research Institute, 1943. Pp. iv+151. 1*s*. 11*d*.), summarizes some of the work carried out. "Even more than last year," says the writer, "the work of the Institute has been dictated by War, in fact in certain sections and branches practically all work on ordinary programmes has been suspended to deal with war research. Whilst the branches dealing with Sylviculture, Botany, Mycology, Chemistry and Entomology have only dealt, in most cases, more or less indirectly with war problems, though their assistance has been solicited on occasion, the brunt of the work has fallen, as was the case during the last War, on the Utilization Branch, which throughout has had to devote its whole time to war work."

During the year this branch has been continuously evolving substitutes for which there was a shortage for one reason or another as a result of the War. In conjunction with the Mechanical Section, the Wood Working Section has devoted its energies entirely to the demands of India and the Army. Containers of many types down to the ordinary pail, and for a variety of purposes, were constructed of plywood, on the basis of researches at the Institute, and were afterwards manufactured at factories. The Wood Technology Section spent the year identifying timbers mostly for the Army, but was also concerned with the selection of the right type of timber for aircraft. It also trained in timber identification sixty men of the Ordnance and Military Engineers Services Departments. Ammunition boxes, walnut wood for rifles and other researches were undertaken by the Timber Testing Section ; while the Seasoning Section advised on the installation of kilns in various parts of India and also developed a simple hot-air kiln for quickly completing the seasoning of partially air-dried half-wroughts for such material as tool helves, shuttles, bobbins, picker-arms, etc. Unseasoned wood is useless for many of these purposes. The Adhesives for Plywood investigations have been already alluded to (Nature, Jan. 29, p. 144). The Paper Pulp Section continued to work throughout the year, guided to a large extent by the Advisory Committee of the Indian Paper Makers' Association, there being a general shortage of paper in the country.

Some interesting research in the Chemistry Branch, carried out owing to war shortage, included a simplified method of preparing ephedrine and its salts from Indian Ephedras. This has been started on a factory scale, so that ephedrine salts are now being produced to replace the imported article. Retorts have been installed, as a result of experimental work, for the large-scale distillation of chir (*Pinus longifolia*) tar ; the perfected process in these retorts will now yield products not only suitable for use in rope and rubber works but also for medicinal purposes. Tamarind seeds were shown to be a cheap source of pectin. A large amount of work was also carried out on charcoal for producer gas.

Truly has the great value and usefulness of her forests to India in times of stress, as in those of peace, justified the foresight of that Secretary of State in the distant days of 1862.

FORTHCOMING EVENTS

*(Meetings marked with an asterisk * are open to the public.)*

Saturday, February 12

Sheffield Metallurgical Association (at 198 West Street, Sheffield), at 2.30 p.m.—Dr. G. Jessop : "Some Electro-chemical Methods of Analysis".

Monday, February 14

Farmers' Club (at the Royal Empire Society, Craven Street, London, W.C.2), at 2.30 p.m.—Mr. A. P. McDougall : "Increasing the Cattle Population".

Illuminating Engineering Society (at the Royal Institution, Albemarle Street, London, W.1), at 5 p.m.—Dr. H. Buckley : "Some 18th Century Contributions to Photometry and Illuminating Engineering".

Royal Geographical Society (at Kensington Gore, London, S.W.7), at 5 p.m.—Major R. C. Farrow : "Surveys for Power in the Coast Range of British Columbia".

Society of Engineers (at the Geological Society, Burlington House, Piccadilly, London, W.1), at 5 p.m.—Mr. Frank Parfett : Presidential Address.

Association of Austrian Engineers, Chemists and Scientific Workers in Great Britain (at the Austrian Centre Swiss Cottage, 69 Eton Avenue, Hampstead, London, N.W.3), at 7.15 p.m.—Dr. E. Spencer : "Coal as a Source of Chemicals".

Tuesday, February 15

ROYAL SOCIETY OF ARTS (DOMINIONS AND COLONIES SECTION) (at John Adam Street, Adelphi, London, W.C.2), at 1.45 p.m.—Sir Bernard Bourdillon, G.C.M.G.: "Nigeria To-day".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5.15 p.m.—Dr. J. Ramsbottom: "Fungi and Modern Affairs", i. "Fungi as Food and Poison".*

INSTITUTION OF ELECTRICAL ENGINEERS (WIRELESS SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Discussion on "Recording and Reproduction of Sound" (to be opened by Dr. G. F. Dutton).

Wednesday, February 16

BRITISH PSYCHOLOGICAL SOCIETY (SOCIAL PSYCHOLOGY SECTION) (at Hastings Hall, Tavistock House, Tavistock Square, London, W.C.1), at 2 p.m.—Mr. H. J. Eysenck: "Three Methods for Studying National Differences in Sense of Humour"; Marie Jahoda: "Some Difficulties in Participant Observation"; Mr. Otto Friedmann: "Some Problems of Political Propaganda".

ROYAL SOCIETY OF MEDICINE (at 1 Wimpole Street, London, W.1), at 2 p.m.—Discussion on "The Limitations and Uses of the Comparative Method in Medicine", 3: "Nutrition and Endocrinology" (to be opened by Dr. H. H. Green and Dr. S. J. Folley).

NEWCOMEN SOCIETY (at the Royal Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Mr. Robert S. Nilssen: "The Pioneer Period of the Development of the Arithmometer from Pascal, 1642, Polenie, Leibnitz and others up to 1821, when the first Commercial Machine was Manufactured by Charles X. Thomas of Colmar".*

SOCIETY OF CHEMICAL INDUSTRY (MICROBIOLOGICAL PANEL OF THE FOOD GROUP) (at the Chemical Society, Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Dr. T. F. West: "The Pyrethrins and the Role of Pyrethrum in the Anti-Pest Measures".

GEOLOGICAL SOCIETY OF LONDON (at Burlington House, Piccadilly, London, W.1), at 3 p.m.—Scientific Papers.

ROYAL INSTITUTE OF CHEMISTRY (LONDON AND SOUTH-EASTERN COUNTIES SECTION) (at 30 Russell Square, London, W.C.1), at 5 p.m.—Dr. B. A. Southgate: "Recent Advances in Treatment of Sewage and Trade Waste Waters".

BRITISH INSTITUTION OF RADIO ENGINEERS (at the Institution of Structural Engineers, 11 Upper Belgrave Street, London, S.W.1), at 6.30 p.m.—Discussion on "Television Standards" (to be opened by Mr. L. H. Bedford and Mr. W. A. Beatty).

Thursday, February 17

CHEMICAL SOCIETY (at Burlington House, Piccadilly, London, W.1), at 2.30 p.m.—Dr. A. J. Ewins, F.R.S.: "Chemotherapy in Tropical Medicine".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 2.30 p.m.—Sir Lawrence Bragg, F.R.S.: "The Strategy and Tactics of Crystal Structure Analysis by X-Rays".*

KING'S COLLEGE (in the Department of Electrical Engineering, Strand, London, W.C.2), at 3 p.m.—Mr. N. V. Castling: "Electrical Switchgear".*

INSTITUTION OF ELECTRICAL ENGINEERS (CAMBRIDGE WIRELESS GROUP) (in the Engineering Laboratories, The University, Cambridge), at 8 p.m.—Inaugural meeting. Mr. T. E. Goldup: "The General Aspects of Radio Engineering Progress".*

Friday, February 18

ASSOCIATION OF APPLIED BIOLOGISTS (at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, London, W.C.1), at 11.30 a.m.—Annual General Meeting. At 12 noon—Discussion on "The Organisation of the Agricultural and Horticultural Advisory Services in Great Britain, with Special Reference to the Recommendations in the Luxmoore Report" (to be opened by Prof. W. B. Brierley).

INSTITUTION OF MECHANICAL ENGINEERS (at Storey's Gate, St. James's Park, London, S.W.1), at 5 p.m.—Annual General Meeting. Mr. H. A. Hepburn: "Fencing of Dangerous Parts of Machinery".

ROYAL INSTITUTION (at 21 Albemarle Street, London, W.1), at 5 p.m.—Miss Olga Tufnell: "The Wellcome-Marston Excavations at Lachish".*

ROYAL ANTHROPOLOGICAL INSTITUTE (at 21 Bedford Square, London, W.C.1), at 5 p.m.—Mr. R. T. D. Fitzgerald: "Nigeria and Reactions to the War".

INSTITUTION OF ELECTRICAL ENGINEERS (MEASUREMENTS SECTION, joint meeting with the TRANSMISSION SECTION) (at Savoy Place, Victoria Embankment, London, W.C.2), at 5.30 p.m.—Mr. L. B. S. Golds and Mr. C. L. Lipman: "A Modern Earth-Fault Relay Equipment for Use on Systems protected by Petersen Coils".

Saturday, February 19

BRITISH ASSOCIATION OF CHEMISTS (at the Café Royal, Regent Street, London, W.1), at 2.30 p.m.—Twenty-sixth Annual General Meeting.

APPOINTMENTS VACANT

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

ENGINEERING LECTURER (Ref. No. C.1997A), MATHEMATICS LECTURER (Ref. No. A.422A), PHYSICS LECTURER (Ref. No. A.423A), ASSISTANT MATHEMATICS AND PHYSICS LECTURER (Ref. No. A.424A), ENGINEERING INSTRUCTOR (Ref. No. O/N.391), and a DEMONSTRATOR to assist lecturers in class work generally (Ref. No. O/N.392), for the Technical School of a Government Department located in Surrey—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2 (quoting the appropriate Ref. No.) (February 16).

MASTER FOR MATHEMATICS AND SCIENCE in the Junior Technical School—The Clerk to the Governors, North-East Essex Technical College and School of Art, Colchester (February 17).

MASTER OR MISTRESS TO TEACH BIOLOGY and assist with some ELEMENTARY SCIENCE OR MATHEMATICS—Mr. E. B. Stockdale, Education Office, Mexborough, Yorks. (February 19).

WATER ENGINEER AND MANAGER of the Corporation of Dundee Water Department—The Town Clerk, City Chambers, Dundee (February 19).

TEACHER OF ELECTRICAL ENGINEERING SUBJECTS, and a TEACHER OF MECHANICAL ENGINEERING SUBJECTS, at the Smethwick Municipal College—The Chief Education Officer, Education Offices, 215 High Street, Smethwick 41 (February 21).

CHAIR OF BOTANY tenable at King's College, and CHAIR OF BOTANY tenable at Birkbeck College—The Academic Registrar, University of London, c/o Richmond College, Richmond, Surrey (February 21).

ASSISTANT ENGINEER for the Sudan Government Railways—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. E.783A) (February 23).

FIRST-CLASS MECHANICAL AND ELECTRICAL ENGINEER to act in the capacity of Plant Manager or Works Engineer (headquarters in the London area)—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C.2 (quoting Reference No. C.2025XA) (February 23).

LECTURER IN CHEMISTRY FOR MEDICAL STUDENTS—The Acting Secretary, University Court, Glasgow (February 25).

DIRECTOR OF THE IMPERIAL AGRICULTURAL RESEARCH INSTITUTE, Government of India—The Ministry of Labour and National Service, Central (Technical and Scientific) Register, Advertising Section, Alexandra House, Kingsway, London, W.C. (quoting Reference No. O.N.F. 2080A) (March 1).

UNIVERSITY CHAIR OF ANATOMY tenable at St. Mary's Hospital Medical School—The Academic Registrar, University of London, c/o Richmond College, Richmond, Surrey (March 20).

PROFESSORSHIP OF ENGINEERING SCIENCE—The Registrar, University Registry, Oxford (April 30).

DIRECTOR OF THE INSTITUTE OF MEDICAL AND VETERINARY SCIENCE, Adelaide—The Agent-General and Trade Commissioner for South Australia, South Australia House, Marble Arch, London, W.1 (May 31).

LECTURER IN PHYSICS (man or woman, honours graduate)—The Secretary, Woolwich Polytechnic, Woolwich, London, S.E.18.

WORKS MANAGER for Heavy Engineering firm in West Scotland—The Ministry of Labour and National Service, Appointments Office, 52 Robertson Street, Glasgow, C2 (quoting Reference No. 1105).

ASSISTANT MASTER FOR ENGINEERING SUBJECTS—The Principal, Technical Institute, Gravesend.

LECTURER IN GARDENING for Edgehill and Bingley Training Colleges—The Principals, at the Training College, Bingley, Yorks.

ASSISTANT LECTURER (temporary) in AGRICULTURAL CHEMISTRY—The Registrar, The University, Reading.

REPORTS and other PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

The Reform of the Calendar: a Measure of Social Security. By Colonel Clifford Allchin Gill. Pp. 36. (Reigate: Ancient House Bookshop.) 1s. [121

Scottish Education Department. Training for Citizenship: a Report of the Advisory Council on Education in Scotland. (Cmd. 6495.) Pp. 28. (Edinburgh and London: H.M. Stationery Office.) 6d. net. [121

Amgueddfa Genedlaethol Cymru: National Museum of Wales. Thirty-sixth Annual Report, 1942–43, presented by the Council to the Court of Governors on 22nd October 1943. Pp. 32. (Cardiff: National Museum of Wales.) [121

Empire Cotton Growing Corporation. A Review of the Work of the Experiment Stations, Seasons 1939–40 to 1941–42. By W. Nowell. Pp. iii+30. (London: Empire Cotton Growing Corporation.) 2s. [141

A New System of English Naming for British Macrolepidoptera By Beowulf A. Cooper and A. F. O'Farrell. Pp. 24. (London: Amateur Entomologists' Society.) 2s. 6d. [171

Colonial Office: Advisory Committee on Education in the Colonies. Mass Education in African Society. (Colonial No. 186.) Pp. 64. (London: H.M. Stationery Office.) 1s. net. [171

Other Countries

Commonwealth of Australia: Council for Scientific and Industrial Research. Bulletin No. 165: Potato Virus X.; Mixtures of Strains and the Leaf Area and Yield of Infected Potatoes. By Dr. J. G. Bald. Pp. 32. (Melbourne: Government Printer.) [61

Twenty-fifth Annual Report of the National Research Council of Canada, 1941–42. (N.R.C. No. 1089.) Pp. 33. (Ottawa: National Research Council of Canada.) [121

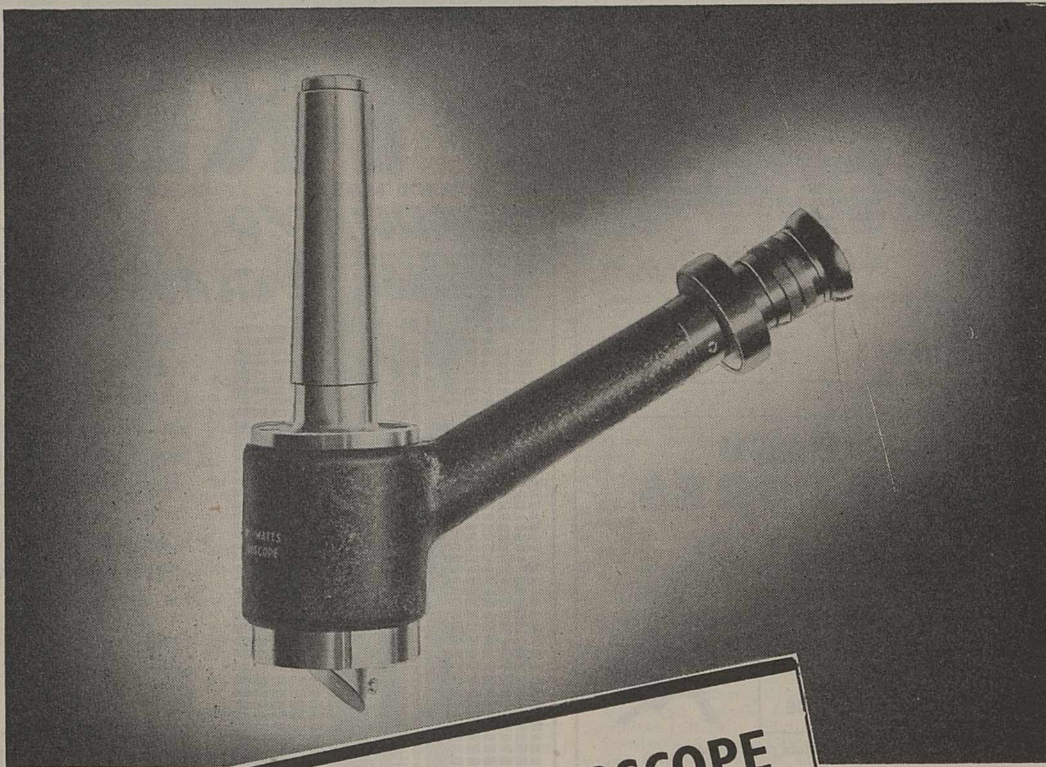
Harvard Meteorological Studies. No. 7: Filter Measurements of Solar Radiation at Blue Hill Observatory. By Edmund Schulman. Pp. 68. (Milton, Mass.: Blue Hill Observatory.) 90 cents. [141

Thomas Jefferson and the Scientific Trends of his Time. By Charles A. Browne. (Chronica Botanica Reprints, No. 1.) Pp. 64. (Waltham, Mass.: Chronica Botanica Co.; London: Wm. Dawson and Sons, Ltd.) [141

Catalogues

Sotheran's Price Current of Literature, No. 872: Annotated Catalogue of Works on Medicine, Surgery and Pharmacology. (Medical Series, No. 4.) Pp. 76. (London: Henry Sotheran, Ltd.)

Ogal Drum-reading Plunger-type Colorimeter. Pp. 60. (Salisbury: The Tintometer, Ltd.)



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