"Infidel Mathematician", in another connexion Newton was not "faithless". Yet there is no doubt that the mechanistic concept of the universe exerted a certain fascination upon those who regarded it as a vast conglomeration of machine-like units. It was only natural that Berkeley, the devoted ecclesiastic, should look upon Newton with some concern. The eighteenth century could name Berkeley as a typical product, scarcely so Sir Isaac.

In 1718 Halley discovered the discrepancy—in relation to the catalogue of Hipparchus—in the position of Sirius and of two other stars. To deal with the 'ultimate' background involves successive approximation; but Berkeley almost certainly struck at the root of the problem in his insistence that "no *one* star should be regarded as more favoured than any other".

A following note brings to light the development of a 'descriptive' in contradistinction to an 'essentialist' concept in scientific theory, and shows how, in the fourteenth century, it was directed somewhat critically at Aristotelian physics.

Finally, a detailed treatment of Berkeley's "Querist", with its strong resemblance to the thought of the late Lord Keynes, rounds off a most valuable collection of essays. A brief outline of Berkeley's life forms a fitting conclusion.

In conformity with the opinion already expressed that it is well to see Berkeley's contributions as a whole (not only those which may be taken to add to the sum of human knowledge, and with which the special number of *The British Journal for the Philosophy of Science* was concerned), some account may now be offered of his more *ad hoc* inquiries. These are of necessity practical, and illustrate another facet of this complex character. First and foremost is his preoccupation with tar-water, first mentioned on February 8, 1741. The use of this he advocated unceasingly during the great epidemic in the south of Ireland as a remedy for smallpox. The prescription ran, "A heaped spoonful of rosin, powdered fine in a little broth". A year later, we find this concoction, or something very like it, being recommended as a tonic. Apparently Berkeley was content with the results as he observed them, and made no attempt to devise controlled experiments to support his action. Nevertheless, it was all of a piece with his overwhelming sense of solicitude for suffering, and in keeping with his disdain for "faith without works". With good reason has he been called a theological utilitarian.

His correspondence reveals numerous occasions when the temptation must have been tremendous to take sides in the burning questions which tore the Emerald Isle of his day into countless pitiful fragments; yet we read in the foreword to his "Passive Obedience" (1712) a determination "to preserve that cool and impartial temper which becomes every impartial inquirer after truth". Again, in his "Discourse to Magistrates", he maintains that prejudice is not necessarily false: it was the carelessness of free-thinkers to confuse prejudice with error.

All this needs to be supplemented by an appraisal of his efforts *pro bono publico*, for example, the grand scheme to found a university for the education of American Indians. In fact, for this project he obtained a substantial Parliamentary grant, which never came to fruition.

To-day, we have a likeness of Berkeley in the portrait by John Smibert in the National Portrait Gallery, London, reproduced as a frontispiece in the special number of *The British Journal for the Philosophy of Science*. A fairly recent cleaning has revealed the date 1728 in place of 1725. Mrs. W. S. Lewis, of Farmington, Connecticut, noticed not long since that the promontory in the background closely resembles Paradise Rock, Rhode Island, with a gentle slope down to the sea on the near side of the rock. This resemblance can be clearly seen in a snapshot which she took from near Berkeley's Farm and sent to the National Portrait Gallery. For these details I am indebted to the kindness of Mr. C. Kingsley Adams, director of the National Portrait Gallery.

Berkeley moved to Oxford in 1752, by then an exhausted man. His death occurred early in 1753, when, in the seclusion of Christ Church, he was laid to rest.

F. I. G. Rawlins

# THE INTERNATIONAL GEOPHYSICAL YEAR 1957–58

In 1882–83, many nations joined in a great international scientific enterprise, the International Polar Year, in which the geophysics of the polar regions—mainly the Arctic—was intensively studied, and expeditions set up polar meteorological, magnetic and auroral stations and operated them for twelve or thirteen months. In 1932–33 the jubilee of this First Polar Year was celebrated by a repetition and extension of the enterprise, and ionospheric observations were included in the programme.

On April 3, 1950, Dr. L. V. Berkner, at a small gathering of geophysicists at the then home of Prof. J. A. van Allen, Silver Springs, Maryland, U.S.A., proposed a second repetition after twenty-five instead of fifty years, in view of the rapid advances made since 1933 in scientific, especially ionospheric, techniques. Being favourably regarded, this proposal was formally brought before three international scientific bodies in the summer of 1950—the first to meet was the Mixed Commission on the Ionosphere (MCI), formed by the International Council of Scientific Unions (ICSU) under the sponsorship of the International Union for Scientific Radio (URSI) with the co-operation of the International Astronomical Union (IAU) and the International Union for Geodesy and Geophysics (UGGI). The Mixed Commission on the Ionosphere presented the proposal in some detail to the International Council of Scientific Unions, and recommended the formation of a committee to organize a third polar year in 1957–58. The proposals were later endorsed by the International Union for Scientific Radio and the International Astronomical Union in September 1950, and came before the Bureau of the International Council in January 1951; this commended them to its Executive Board, which met in October 1951 and decided to set up a 'special committee' for the purpose, under the direct auspices of the International Council (not a 'mixed commission' of several unions, sponsored by one of them). The choice of members delegated by the Executive Board to the Bureau was made by the latter at its next meeting in May 1952; four members were appointed, representing the International Astronomical Union, the International Unions for Geodesy and Geophysics and for Scientific Radio, and the International Geographical Union, respectively, with Col. E. Herbays, general secretary of the International Union for Scientific Radio, as convener. At the same time, the nations adhering

to the International Council were invited to form national committees to organize their participation in the new Polar Year; and through the Moscow Academy of Science, the co-operation of the U.S.S.R. was invited.

In the summer of 1952 the International Union of Scientific Radio set up its own committee to organize the ionospheric and radio parts of the enterprise, and the Mixed Commission on the Ionosphere discussed and made further proposals concerning it. By that time the view had developed among the unions concerned that the enterprise should deal as much with tropical and southern non-polar regions as with the Arctic and Antarctic, and this change was recognized by the Executive Board and General Assembly of the International Council of Scientific Unions meeting in October 1952, which decided to change the name to the International Geophysical Year (Année Géophysique Internationale, AGI), and also: (i) to charge the committee with the organization of a series of new determinations of longitude differences, an operation for which the International Union for Geodesy and Geophysics, supported by the International Union for Scientific Radio, had requested the formation of a new mixed commission of the International Council; (ii) to invite the other interested unions, like the International Union for Scientific Radio, to set up their own organizing committees, the Special Committee of the International Council (CSAGI) continuing with its very limited numbers; and (iii) to welcome the collaboration of the World Meteorological Organization (WMO) in the enterprise and to add a representative of that body to the Special Committee of the International Council.

In October 1952, a preliminary meeting of some of the members of the Special Committee of the International Council was held, and it was decided to renew the appeal (through Col. E. Herbays, who was elected provisional secretary) for the formation of national committees for the International Geophysical Year and the preparation of national plans; to hold its first full meeting in June or July 1953; to define the International Geophysical Year as extending from August 1957 to the end of 1958 (seventeen months); to propose to the International Council of Scientific Unions a moderate increase in its own membership, in view of the wide scope of the enterprise; and to seek financial support for the International Council from the United Nations Educational, Scientific and Cultural Organization, to provide for a secretariat for the International Geophysical Year from the beginning of 1955.

In March 1953 the Bureau of the International Council enlarged its Special Committee to include eleven representatives as follows: International Astronomical Union, N. E. Nørlund and M. Nicolet; International Union of Geodesy and Geophysics, J. Coulomb and P. Tardi; International Geographical Union, J. M. Wordie; International Union for Scientific Radio, L. V. Berkner and M. Boella; International Council of Scientific Unions, S. Chapman and E. Herbays; World Meteorological Organization, J. Van Mieghem and a second member to be appointed. The Special Committee of the International Council thus enlarged held its first meeting at Brussels during June 30–July 3, 1953; in place of MM. Nørlund and Tardi, MM. A. Danjon and G. Laclavère attended, and alternate representatives V. Laursen (secretary of the Association for Terrestrial Magnetism and Electricity of the International Union for Geodesy and Geophysics) and W. J. G. Beynon (secretary of the Mixed Commission of the Ionosphere) attended by invitation, making twelve representatives in all. (Later in July, N. E. Nørlund was succeeded on the committee by H. Spencer Jones, and A. Danjou was appointed formally as an alternative representative.)

On the first day (spent in administrative session), S. Chapman and L. V. Berkner were elected president and vice-president respectively, and M. Nicolet was elected general secretary from November 1; the period of appointment as provisional secretary of the original convener, E. Herbays, has now ended, and his valuable work for the International Geophysical Year and excellent arrangements for the meeting were warmly acknowledged. On the remaining three days, the Special Committee of the International Council met in open session with the participation of 'observers' delegated by several of the national committees for the International Geophysical Year, twenty-five people being present in all, drawn from thirteen countries. E. Herbays reported the formation of further union and national committees, from which twenty-six documents had been received, outlining union or national programmes and proposals. To consider these documents, eleven groups (partly overlapping) were formed from all those present, to deal with (i) meteorology, (ii) latitude and longitude determinations, (iii) geomagnetism, (iv) the ionosphere, (v) auroræ and airglow, (vi) solar activity, (vii) cosmic rays, (viii) glaciology, (ix) oceanography, (x) the choice and announcement of world days for specially intensive observation during the International Geophysical Year, and (xi) publication. These groups, in the work of which the help of the 'observers' was most valuable; each prepared a draft report and associated resolutions, and then, where desirable, held joint meetings to revise and complete their reports. With the aid of the Royal Meteorological Institute of Belgium, these reports and resolutions were typed and duplicated for consideration by the meeting as a whole; with some further modifications, the combined report and resolutions were adopted by the Special Committee of the International Council, to be a general preliminary guide to the unions and national committees. The committee, in conclusion, expressed its warm thanks for the hospitality it had received in many ways, from the Royal Belgian Academies (in whose Palace the meetings were held), from the Royal Meteorological Institute and its director, Prof. E. Lahaye, from Prof. J. Tison, and from Prof. V. Brien.

The scope of the International Geophysical Year is too wide to be indicated here even in outline; the Special Committee of the International Council recommended each national committee to take steps to inform the scientific and general public on the purpose of the International Geophysical Year and the plans for the enterprise. Here only a few major items will be mentioned.

The main meteorological problem to be attacked is that of the general circulation (and the associated thermodynamics), particularly above the troposphere; and special efforts are urged, and in part are assured, for the exploration of the atmosphere up to 30 km. height (at least on certain of the World Days), especially along the three meridians 10° E., 140° E. and 70° W.

These meridians were adopted also for special ionospheric and magnetic investigation. The World Days, on the average five per month, are to be fixed partly in advance (three per month) and partly

at short notice according to the existing solar activity and expected degree of magnetic and ionospheric quiet or disturbance; these disturbances are among the major problems to be examined further during the International Geophysical Year. A great improvement in auroral observation is to be aimed at, including aid from air pilots and meteorological officers, and also taking advantage of the new means of detection of daytime auroræ, and of auroræ behind clouds, by radio techniques. The latitude and longitude programme is intended to improve the accuracy of time determination and of star catalogues, and to extend our knowledge of the irregularities in the earth's rotation, of the relative displacements on the earth's surface and displacements of the vertical, and of the time of propagation of radio waves. Limited programmes on glaciology, climatology, oceanography and cosmic rays are also envisaged.

The Executive Board of the International Council of Scientific Unions, meeting in Strasbourg shortly after its special committee met in Brussels, provided funds for the secretariat of the Special Committee up to December 31, 1954, and enrolled it for the time being among its 'permanent services'. The International Union of Pure and Applied Physics (IUPAP), through its representatives, expressed an interest in the International Geophysical Year, particularly in regard to cosmic rays, and it seems not unlikely that it will become a participating union, form a union International Geophysical Year committee, and nominate a representative on the Special Committee of the International Council.

By slow stages the Special Committee of the International Council has been constituted, and with the aid of the national committees for the International Geophysical Year set up at its invitation it has formulated an extensive co-ordinated programme the realization of which in large part may now confidently be expected. But the enterprise will not be fully successful unless all the major nations of scientific culture participate in it; for this reason, at the request of its Special Committee, the International Council of Scientific Unions has formally invited the renewal in this enterprise of the valuable and effective co-operation given by Russia to the first and second International Polar Years; and also has requested that the U.S.S.R. should co-operate in encouraging other nations to take part that have not yet agreed to do so.

SYDNEY CHAPMAN

## PRODUCTION OF ANTIBIOTICS AND THEIR USE IN INDUSTRY

A SYMPOSIUM on "Antibiotics—their Production and Use in Industry" was held by the Society for Applied Bacteriology at Oxford on July 7. The discussion was opened by Dr. A. Hirsch (Unilever, Ltd., Bedford), who pointed out the desirability for the continued study of polypeptide antibiotics. At the present time these antibiotics cannot be fully utilized because the necessary chemical knowledge and methods for their development appear to be lacking. In this respect, the peptide antibiotics resemble penicillin and other early antibiotics which were developed long after their first description. Most of the successful methods of protein chemistry concern compounds with a molecular weight of more than ten thousand, while paper-chromatographic methods are useful with compounds of a molecular weight of up to a thousand. The intervening gap is not adequately covered, and even counter-current studies are only of limited value because they rely on the hydrolysis of the very structures which ought to be the object of the study.

The rapidly bactericidal nature of the polypeptide antibiotics renders it unlikely that they act by competing with essential metabolites. Surface activity and consequent absorption of the antibiotics on the bacterial surface have been shown to occur in many cases, and the similarity to the antibacterial action of cationic detergents is very marked. This surface activity may not be the immediate cause of the death of the bacterial cell, but at least it enables the antibiotic to be effective in very minute amounts. Surface activity may also eventually permit of more specific action with smaller toxicity than would be possible with metabolic competitors. It was thought at one time that antibiotics effective against Gram-negative organisms would also be toxic, the structure of Gram-negative cells resembling animal tissues more closely than Gram-positive organisms. The polymyxin antibiotics are, however, selective against Gram-negative organisms, and their toxicity is no greater than that of some other polypeptide antibiotics.

The next speaker was Dr. T. S. Work (National Institute for Medical Research, Mill Hill). He discussed, from the point of view of the comparative biochemist, the reason for the selective action of the medicinally useful antibiotics. Penicillin is about ten thousand times more toxic to some micro-organisms than to animal tissues, and even chloromycetin is some hundreds of times more toxic to bacteria than tissues. The available evidence suggests that penicillin at any rate disrupts the protein metabolism of micro-organisms. This may explain the selective action of penicillin, because proteins are well known from immunological work to be the agents responsible for specificity. The study of the synthesis of protein may therefore give a clue to the selective action of the non-toxic antibiotics.

The synthesis of proteins is currently explained in two different ways. They may be built up, piece by piece, from amino-acids, or they may be formed as on a template, the whole molecule being 'stamped out' in a single operation. The latter explanation is largely favoured by geneticists, who regard the genes as the templates. Should this latter explanation be correct, this process might be difficult to investigate experimentally, and the first explanation offers the best hope to break the process down into small steps capable of study.

The nature of protein synthesis has been investigated in lactating animals injected with radioactive amino-acids. The amino-acids passed rapidly through the mammary barrier and were synthesized in the gland to casein and β-lactoglobulin. Immune globulin, however, was found to pass between the milk and the blood stream and was not synthesized in the mammary gland. After radioactive amino-acids were injected into the blood stream, samples of milk were taken and the casein from it mildly hydrolysed. Twelve separate fractions were collected from a column, and the radioactivity of these was found to be equally distributed. This was strongly suggestive evidence that the synthesis occurred by a template mechanism, since an unequal distribution of radioactivity would be anticipated if the protein was synthesized partly from pre-formed peptides and partly from individual amino-acids.