than in Britain is at present the greatest contribution which can be made towards the control of the disease within the country.

A considerable proportion of the research effort at Pirbright has always been directed at improved methods of immunization against the disease. The period under review has seen a new bias on work on immunization. The development of live modified strain vaccines received a new impetus by the demonstration by Skinner in 1951 of the possibility of infecting unweaned mice and, in 1954, of passaging virus in day-old chicks and chick embryos. Serial transfers, repeated sometimes many hundreds of times, have the effect of reducing the capacity of the virus to produce visible signs of the disease in the cattle inoculated. By multiplying in the animal, however, the virus would stimulate the defence mechanism of the host and so produce a solid long-lasting immunity. Such vaccines are used in many other diseases; for example, in rinderpest, rabies, African horse sickness, blue tongue, and in yellow fever and also in smallpox in man. Workers developing such strains aim at the point at which the virus will 'infect' the animal but produce no clinical signs. The yellow fever vaccine inoculated in man is an example of a live virus vaccine which has reached this point. With most live vaccines, the ideal is not attained, and a compromise between slight infectivity in the sense of producing the clinical disease on one hand, and a capability which falls short of the maximum in producing immunity on the other, has to be accepted. This has been true in developing the strains in foot-and-mouth disease and the problem has been made more difficult by the demonstration that not all strains become attenuated or lose virulence at the same rate. On the other hand, there has been little indication of difficulty in some other ways; for example, there has been no restoration of virulence and no spread to normal animals in contact with those vaccinated. Limited experiments on pregnant animals have indicated no unfortunate sequelae, and young animals have been successfully vaccinated.

The variation in behaviour of viruses has made the development of suitable strains for each of the seven types of virus now known a complicated operation, especially when several different strains of one type have had to be developed to explore the possibilities of different methods of attenuation. Nevertheless, strains of six of the seven types have reached the point at which tests for non-infectivity in cattle have been sufficiently encouraging to warrant investigations on the immunity produced. These tests at Pirbright have now involved approximately 2,000 animals.

The qualified successes obtained under experimental conditions at Pirbright led to the next phase in

development of these strains. Since the step from the laboratory to field conditions might not be without risk, it was considered that first trials outside the laboratory should be conducted in areas where the disease was endemic. The Institute has had the willing and enthusiastic co-operation of the Governments of countries in South and East Africa in a series of trials. These experiments have indicated the potential usefulness of suitable strains in such animal populations while, at the same time, bringing to light many of the suspected difficulties inseparable from immunization of a mixed population with possible previous experience of the disease. Some of these experiments, notably those in South Africa, have involved tests of live attenuated vaccine on a scale which has not been undertaken with any other agent of this type, in respect of severe challenge with fully virulent material. Even under these conditions, 70 per cent protection was obtained and subsequent use of the vaccine in an infected area resulted in an incidence of less than 1 per cent on vaccinated farms, while, on unvaccinated farms, the incidence was between 60 and 70 per cent. These observations are essentially preliminary; many problems require investigation.

The problem of the use of inactivated vaccines has not been neglected. Frenkel-type vaccine in which virus is grown in culture of cattle tongue epithelium, adsorbed on aluminium hydroxide and inactivated with formalin and mild heat, has been a useful agent and will continue to play a most important part in the control of the disease as it has done in Europe and, to some extent, in South America. Extensive tests of this type of vaccine have been carried out at Pirbright and several large batches have been prepared and tested for safety and potency. Other possible sources of tissue in which virus may be grown, such as kidney, are being investigated, since kidneys present a more easily obtainable source of tissue than cattle tongue epithelium.

Foot-and-mouth disease must be considered as a world problem. Part of the work at Pirbright, therefore, has been directed towards the assessment of the world situation, particularly in regard to the prevalence of the disease and the distribution of the immunological types of virus. Earlier reports have referred to the discovery at Pirbright of four new types—*S.A.T.* 1, *S.A.T.* 2 and *S.A.T.* 3 from Africa, and Asia 1 in many countries in Asia. In the past twelve years considerable progress has been made in determining the broad outlines of type distribution. The international importance of this work was recognized when, in 1958, the Institute was nominated by the Food and Agriculture Organization of the United Nations to undertake the functions of World Reference Laboratory for Foot-and-Mouth Disease.

APPLIED GEOGRAPHY

THE application of geography to the study of a wide range of problems has made remarkable progress in recent years, partly during, and partly because of, the Second World War. Geography made a substantial contribution to the British War effort both in the planning of campaigns and in the re-organization of the nation's economy, and since the

War geographers have been active in the field of planning. Some of the fruits of these efforts can now be seen in the increase in the number of geographers who act as advisers in various fields, ranging from problems of conservation to aspects of medical geography: there is also the evidence of the results achieved by those who have been largely employed in the study of

the application of geography in Britain to national, regional and county affairs during recent years.

At the recent meeting of the British Association for the Advancement of Science a whole morning was devoted, largely by the geographers of Section E, to the planning problems of Britain and to those of East Anglia in particular. The future administrative organization of Norfolk and Suffolk is at the moment under review by the Boundary Commission, and during the course of the meeting geographers saw, in the field, the significance of the desire of the rapidly growing and increasingly industrialized city of Norwich to expand into its adjoining county areas. Others were shown the changing landscape of Thetford, where residential and industrial developments are designed to absorb part of the overspill of Greater London.

Among the speakers in the planning symposium were Mr. J. R. James, deputy chief planner, Ministry of Housing and Local Government, and the principal research officer of the Ministry, Dr. E. C. Willatts, who introduced a new map, at the scale of 10 miles to the inch, showing the major post-war developments in England and Wales that have resulted from, or are affecting, land planning¹. These developments, including the establishment of National Parks, the building of electrical and nuclear power stations, the construction of motorways, the creation of 'new towns' and the extension of other towns, are indicative of both the scale and scope of post-war changes. They show, too, how the regional geography of Britain is in process of being transformed by the technological revolution which, in its geographical aspects, was the subject of Prof. S. H. Beaver's presidential address to Section E².

In the siting of many of these new developments geographers have sometimes played a significant part. An assessment of the scope of geographical inquiry and of the fields in which geographers are capable of making important contributions was made by Prof. L. Dudley Stamp in a small book, published in 1960, *Applied Geography*³. Such a book could have had no better author than Prof. Stamp in view of his own great efforts in many of the fields of which he writes: these activities have included the Land Utilisation Survey of Britain, carried through under his direction during the 'thirties, a particularly difficult and trying period for British agriculture⁴; the investigations of the Scott Committee, of which he was vice-chairman, into the use of rural land in Great Britain⁵, and his later work as an adviser to the Minister of Agriculture on these problems; his initiative in establishing an organization for a World Land Use Survey under the auspices of the International Geographical Union⁶; and his work on the geographical background of many new developments overseas both within and outside the tropics.

Some of Prof. Stamp's topics have been further discussed by other geographers in the recently issued proceedings of the Anglo-Polish seminar held in Nieborów, Poland, in September 1959, and attended by twelve British and seventeen Polish geographers. The volume, *Problems of Applied Geography*, has been published in Warsaw by the Institute of Geography of the Polish Academy of Sciences, which organized the seminar in collaboration with the Institute of British Geographers, with the generous support of Unesco and of the British Council: limited supplies of the volume are available for sale in Britain⁷. The seminar, like that organized a year later for the exchange of views between American and Polish geographers⁸, included a series of papers—

six British and five Polish—which served as a basis for discussions between the delegations and was followed by a comprehensive tour of both agricultural and industrial areas of Poland.

While most of the six British papers have nothing strikingly original about them, they form a valuable and up-to-date summary of the special problems of Britain to-day as seen by a group of geographers. As with the Polish delegation, the British team emphasized the achievements and experience of the theory and practice of planning in its own country, while suggesting that many of its conclusions are of use to all concerned in the application of geography to the study of physical, social and economic problems in contemporary society. M. J. Wise's paper outlines the basic problems of national planning in Britain, including the optimum use of resources, the redevelopment of the older industrial areas, the restriction of the growth of conurbations, and the regulation of population movements; and A. A. L. Caesar shows how these problems vary between regions. H. C. K. Henderson describes the basis of the pre-war Land Utilisation Survey of Britain and indicates how its work has been used in the planning of agricultural land use. S. H. Beaver describes the reclamation of industrial waste-land for agricultural and other purposes, illustrating his paper by a series of carefully chosen examples: he shows that the area of land in Britain that cannot be reclaimed—less than 1,700 acres a year—is minute compared with the loss of agricultural land to urban development. It is this continuing urban encroachment on the countryside that A. E. Smailes in his paper on perhaps the most distinctive feature of British economy and society—the urbanization of Britain—sees as the crux of the physical planning problem of Britain to-day. Finally, K. C. Edwards, who, as president of the Institute of British Geographers, was leader of the delegation, discusses the 'new towns' of Britain, the results of which, he finds, though 'modest in scale and often despairingly slow in realization, at least encouraging'.

The Polish contributions have special value because so little information is easily available about modern Poland, certainly in English. They have been deliberately designed to match the British papers: thus the importance in Poland of regional planning, land use and urban geography are discussed by K. Dziewnowski, J. Kostrowicki and L. Kosiński respectively. The two other Polish essays are of a very different type, describing the preparation of a geomorphological and hydrographic map and an investigation of local climate: their inclusion in the symposium suggests that there is in Poland a greater appreciation of the significance of such detailed and specialized studies in practical affairs than has so far been the case in Great Britain, where research of this nature would, to most administrators and planners, seem not only academic but even irrelevant.

But what will strike readers of this volume most forcibly will be the fundamental contrasts between the British and Polish attitudes towards planning and between the nature and scope of the planning envisaged for the two countries. In Britain the problems are those of adjustment and reconciliation rather than those of development—the transformation of the population pattern and economic organization developed in one industrial age to what is required in another, and greatly different, age of new and rapidly advancing technology. Poland is concerned with the fundamental development problems that call for comprehensive and large-scale

regional planning as a basis for the reconstruction and expansion of the national economy; and Dziewonski's paper shows that the methods and results of geographical research in Poland have exerted very considerable influence on the methods and results of planning. For this there is not, and probably never will be, any exact British parallel, but Polish experience does heavily underline the diversity of the ways in which the work of geographers can be used for the nation's good, if they are given the opportunity and the encouragement.

International seminars of this type broaden the minds of those participating and at the same time help to create deeper understanding and friendship, while the circulation of the report of the proceedings will be of lasting value to all who are interested in applied geography and who are concerned that it

should have the closest possible connexion with life and society.

ROBERT W. STEEL

¹ The map prepared by the Ministry of Housing and Local Government is being published by H.M. Stationery Office.

² "Technology and Geography", to appear in *The Advancement of Science*, December 1961; and summary in *Nature*, 191, 986 (1961).

³ Stamp, L. Dudley, *Applied Geography* (1960).

⁴ See especially Stamp, L. Dudley, *The Land of Britain: Its Use and Misuse* (1948).

⁵ *Report of the Committee on Land Utilisation in Rural Areas* (Cmd. 6378) (H.M.S.O., London, 1942).

⁶ Four of the World Land Use Survey's reports have so far been published, the most recent being Niddrie, D. L., *Land Use and Population in Tobago* (Geographical Publications, Bude, 1961).

⁷ *Problems of Applied Geography*, Geographical Studies No. 25, Polish Academy of Sciences, Institute of Geography (Warszawa, 1961). Pp. 148, with photographs, maps and diagrams. Copies (price 25s.) can be obtained from the treasurer of the Institute of British Geographers, Dr. H. C. K. Henderson, Birkbeck College, Malet Street, London, W.C.1.

⁸ See Hartshorne, R., "The American-Polish Geographical Seminar and Excursion, 1960", *Geog. Rev.*, 51, 443 (1961).

GAS CHROMATOGRAPHY IN MEDICAL RESEARCH

THE Gas Chromatography Discussion Group of the Institute of Petroleum held an informal symposium on September 26, at the Royal College of Surgeons of England in London.

In welcoming the members of the Group, Prof. R. F. Woolmer, on behalf of the President and Council, explained that, apart from surgery, the College research and teaching also covered such associated fields as physiology, biochemistry, dental science and anaesthetics. It was appropriate that a symposium concerned mainly with the aspects of gas chromatography in medical research should be held at the College, as they believed in co-operation and a full exchange of ideas with other workers.

In the opening paper, Dr. A. T. James described the development and operation of a simple detector for the continuous automatic determination of the radioactivity of carbon-14 and tritium. Attention had been directed to automatic determination because of the obvious disadvantages of the previously used discontinuous methods. Problems of stability at column temperatures as high as 200° C. had led to combustion of the eluted material to carbon dioxide and water, and the measurement of the radioactivity at room temperature. The detector consisted of a $4 \times \frac{1}{2}$ in. copper tube, plated internally and having a central tungsten wire electrode. Rhodium plating reduced the tailing exhibited by tritiated materials. Argon or helium was used as carrier gas, and carbon dioxide was bled into the feed to the detector to give a concentration of approximately 5 per cent. Chromatograms obtained with conventional detectors and the radioactivity detector were shown to superimpose extremely well. An integrated record could also be produced.

The next paper, on gas-liquid radiochromatography, by Dr. S. Popják, confirmed the disadvantages of discontinuous procedures for radioactivity measurements. The advantages of continuous monitoring over fraction collection had been evident over a period of three years using a scintillation counter. In the method described, carrier gas and eluted fractions were passed through a liquid scintillator in a specially designed apparatus, and the radioactivity measured by scintillation counting. Two isotopes could be measured simultaneously. Full details of the construction of the apparatus, its method of operation

and the associated electronic circuitry were given. A stepped record superimposed well on chromatograms obtained with a gas density balance. The efficiency of counting was of the order of 40–50 per cent for carbon-14 compounds, and 15–21 per cent for tritiated compounds.

Under the title of "Peak Symmetry in Gas-Solid Chromatography", Mr. C. G. Scott described recent work concerned with the properties of two active solid systems giving symmetrical elution peaks for hydrocarbons at column temperatures below the boiling point of the eluted component. When alumina is modified with sodium hydroxide, the energy of adsorption decreases to a constant value, at which stage symmetrical elution peaks are obtained. Such peaks can also be obtained from columns packed with solid organic crystals, although, to increase surface area and so reduce column lengths, the compounds are best deposited on 'Celite'. It had been found that heats of adsorption were of the same numerical magnitude as the heats of vaporization. Entropies of adsorption were calculated for *n*-heptane, benzene, iso-octane and cyclohexane, and values obtained for the first two compared with those obtained by Kemball for adsorption on mercury.

Mr. D. W. Hill and Dr. R. P. W. Scott described recent developments in the design of compact cathode-ray tube gas chromatographs. Apart from the high speed of analysis for vapours containing anaesthetics, the apparatus should be compact for easy transport and use in an operating theatre, and be capable of giving rapid repetitive results. The instrument was designed around a 6-in. square, long-persistence tube having a 20–30 sec. scan, and contained its own pump. An additional port in the sample injection system allowed a 100 : 1 gas dilution without the high losses of argon given by 'splitter systems'. The micro argon detector had been modified to reduce the effects of electron capture so that the strongly electron-capturing haloethane (2-bromo-2-chloro-1,1,1-trifluoroethane) gave a positive peak. Column packings for the separation of typical anaesthetic mixtures were mentioned. The quantitative response of the argon detector was dependent on temperature, and therefore the use of a thermostat or compensation was necessary. A simple thermistor compensator unit was described.