NOMENCLATURE OF MULTIPLE ENZYME FORMS

SINCE the original demonstration that some enzymes may exist in a number of different forms in the same species or the same tissue, a considerable literature has accumulated on the topic. There has been no unanimity in these papers on the method of identifying a particular form, as Wieme[1] has pointed out. In a later note, King and Thompson[2] stated that the specific question of the numbering of isoenzymes which have been separated by electrophoresis had been referred to the Standing Committee on Enzymes and the International Commission of Editors of Biochemical Journals. The Enzyme Commission in its report[3] had made no recommendation about multiple enzyme forms, and the International Union of Biochemistry, when it dissolved the Enzyme Commission and set up the Standing Committee on Enzymes[4], also set up a Sub-committee on Isoenzymes composed of the late E. J. King, C. L. Markert, R. J. Wieme, F. Wroblewski and E. C. Webb. After the death of E. J. King, N. O. Kaplan was appointed to the Sub-committee by the Bureau of International Union of Biochemistry. This Sub-committee reached certain decisions which have been approved by the Standing Committee on Enzymes and are set out here.

Multiple enzyme forms may be distinguished from one another by any of several means, for example, electrophoresis, chromatography, salt fractionation, ultracentrifugation, immunochemistry and reaction kinetics. The electrophoretic method has been most commonly used, particularly in clinical laboratories, and numbering systems which have been utilized have usually related to electrophoretic separation. Unfortunately, two quite different systems have been used; it is now recommended that:

"When multiple forms of an enzyme are identified by electrophoretic separation, they should be given consecutive numbers, the form having the highest mobility towards the anode being numbered one".

This system is in conformity with that universally used for the fractions obtained by electrophoresis of serum proteins.

Such numbering systems are probably to be regarded as temporary expedients until information is available about the chemical differences between the various forms. If the molecules of the different forms vary in the nature and arrangements of protein sub-units, a nomenclature should be used analogous to that which has been successfully used in the field of hæmoglobin chemistry.

The Sub-committee also considered the question of a suitable word to be used to describe multiple enzyme forms. Markert and Møller[5] originally proposed "the term *isozyme* to describe the different molecular forms in which proteins may exist with the same enzymatic specificity". Since then the forms *iso-enzyme* or *isoenzyme* have also been widely used, and the term has been limited to multiple forms in a single species. The majority of the Sub-committee felt that the latter forms were preferable as being more logical and in line with such terms as *isotope*.

It is, therefore, recommended that:

"Multiple enzyme forms in a single species should be known as *isoenzymes*, although since either form is readily intelligible this recommendation is not to be interpreted as excluding the use of 'isozyme' if any individual author prefers it".

EDWIN C. WEBB

[1] Wieme, R. J., *Lancet*, i, 270 (1962).
[2] King, E. J., and Thompson, R. H. S., *Lancet*, i, 589 (1962).
[3] *Rep. Commission on Enzymes of the International Union of Biochemistry* (Pergamon Press, Oxford, 1961).
[4] Thompson, R. H. S., *Nature*, **193**, 1227 (1962).
[5] Markert, C. L., and Møller, F., *Proc. U.S. Nat. Acad. Sci.*, **45**, 753 (1959).

THE MEDICAL RESEARCH COUNCIL

THE latest report of the Medical Research Council* again impresses us, as previous reports have done, by the immense range and outstandingly practical value of the research work supported by the Council and carried out in numerous research centres in Britain and abroad. Established in 1913 as the Medical Research Committee, the Council was created and was granted its Royal Charter in 1920, and in November 1963 it celebrated its fiftieth anniversary at a dinner at the Goldsmiths Hall, at which the guest of honour was the Minister for Science. The Council re-formulated in its report for 1960–61 its concept of the part it should play, that is, "to watch over the whole field of medical and related biological research, so as to foresee the needs and opportunities: to give support to any promising research in these fields irrespective of the agent concerned; to work in partnership with the universities and professions on the one hand, and the various departments of Government on the other, so that new knowledge may be made available as the need arises". Following this aim, the Council has supported research in two main ways: by employing its own staff in its own institutes and research units; and by helping the work of the staffs of other agencies such as universities or hospitals by means of temporary or block research grants or by setting up research groups. Thus, apart from the National Institute for Medical Research at Hampstead, the Council has established 72 research units, of which four are abroad (one each in Gambia and Uganda and two in Jamaica) (see also *Nature*, **200**, 1039; 1963). During 1962–63 the Council set up three new research units: one, now in Cambridge, is investigating abnormal hæmoglobins: another, at Oxford, is investigating the psychological aspects of speech and language; while another, at the Imperial College of Science and Technology, is investigating metabolic reactions in the tissues of higher animals and in micro-organisms. Five other new research groups are devoted to biomechanics, megaloblastic anæmia, respiration and energy metabolism in the new-born, the immunology of certain skin diseases, and genetic problems in orthopædic conditions such as club foot and congenital dislocation of the hip. During the year 1962–63, research workers at the Medical Research Council published 4,730 papers in various scientific journals.

After paying a well-deserved tribute to the Rockefeller Foundation and its work, this report records the value the Council places on its happy relationships with this Foundation and its gratitude for the help given by the Foundation to medical research in the United Kingdom, especially by its establishment of the Rockefeller travelling fellowships between the years 1923 and 1963. Since their foundation, 203 fellowships have been awarded and many of the Fellows have become university officers of high rank. In 1964 the fellowships will be discontinued, but the Council will now award travelling fellowships of its own to replace the Rockefeller awards.

* Committee of Privy Council for Medical Research, Report of the Medical Research Council for the year 1962–1963. Pp. vii + 280 + 3 plates. (Cmnd. 2382.) (London: H.M.S.O., 1964.) 16*s.* 6*d.* net.

The report refers to the much-publicized subject of "Investigations on Human Subjects", and in this report 4½ pages are devoted to an important statement of the Council's views as to the considerations which should govern medical men who may propose for one reason or another to carry out experiments on human volunteers in order to advance beneficent knowledge. This statement will be heartily welcomed by all medical men and research workers. Important also and of great interest to all medical men and biologists is the section of the report entitled "Some Aspects of Medical Research", which will be published separately together with the Council's statement on responsibility in investigations on human subjects, under the title *Current Medical Research* (H.M.S.O. 4*s*. 6*d*.). As most readers will know, this section has been a feature of previous reports and has been published separately under the same title. This year it discusses the theoretical basis of organ transplantation; chromosome damage in man following exposure to ionizing radiations; clinical genetics and its applications (illustrated by 3 plates); recent studies on the control of ovarian function; microbial drug resistance; the chemotherapy of cancer; protein turnover in the central nervous system; and epidemiological research in psychiatry. All these articles have valuable bibliographies.

The rest of the report is devoted to an extensive summary of all the research work being done under the auspices of the Council, with details of the personnel employed in various capacities and indexes of their names and of the subjects they are working on and of the establishments in which they are working.

Taken as a whole, the report provides a valuable epitome of the main trends of the medical and biological research now being done not only in Britain but also in the tropics and elsewhere. The Council's work is unique. It deserves the widest publicity, for a nobler example could scarcely be found of the devoted co-operation of men and women of all grades of skill and experience for the benefit of their fellows all over the world.

G. Lapage

A HALF-CENTURY OF FRUIT RESEARCH

SINCE there have been less than forty half-centuries since the beginning of our present dating era, a jubilee provides a sufficient lapse of time over which to review progress in any field of sustained human effort. That East Malling Research Station came into being before the First World War was a major achievement, for money and effort were then but sparsely invested in the pursuit of new knowledge. The Station's first contribution to the fruit-growing industry was spectacular—the classification of rootstocks to give, for the first time, reliable, regulated production in orchards—and the name of its early director, R. G. (later Sir Ronald) Hatton, is inseparably linked with this. It was almost inevitable that subsequent contributions had to become more detailed—more intensive investigations of smaller parts of the whole problem of fruit production. Papers delivered during the three-day jubilee celebrations therefore give a unique opportunity for reviewing the work at East Malling as a practical whole*.

A true perspective was introduced at the outset in a paper by W. S. Rogers and D. W. Way, who, speaking of strawberry culture, stated bluntly "the need is for cheaper production and greater economy of labour, and the most likely contribution to this, on the cultural side, is in the use of herbicides". This conclusion followed a gratifyingly long-term review of all aspects of culture, for W. S. Rogers has been concerned with the trials for thirty-six years. R. I. C. Holliday spoke of the herbicides, of which simazine has proved the outstanding material so far for soft fruits. The work on rootstocks still continues, and W. S. Rogers discussed the features of Malling-Merton 104, 106, 111 and Malling XXV among others. Trees are also being worked 12 in. above the ground to give a 'built-in' insurance against the soil-borne fungus causing collar rot. Sufficient water is a basic need for any crop, and J. E. Goode demonstrated average increases per acre of 4 cwt. of black currants per in. of water applied as irrigation. D. W. P. Greenham, investigating problems of manuring and soil management, has also linked them with water needs. Dessert apples have not responded greatly to applications of phosphate or potassium, and after being planted for 32 years have only responded to light dressings of nitrogen during the past ten. This work seems to indicate the need for careful timing of the applications of water and nitrogen to give the maximum desired effect. The long-term nature of this work also is particularly valuable. Still on the subject of management, J. F. Wilson showed that proper composting of hop bines and trash after picking by stationary machine destroys the *Verticillium* fungus causing wilt. This is a most welcome adaptation to a modern economic tendency, and provides better facilities for checking the spread of *Verticillium* than those previously possible.

It takes a great deal of detailed research to simplify and improve measures of direct control of fungal and bacterial diseases, but there are three most welcome instances of this. *Botrytis* fruit rot of strawberries is a tantalizing disease of greatly varying severity between localities in the same season, and between seasons in the same locality. M. H. Moore has shown that much infection arises from earlier attack of the fungus during flowering, so a spray of thiram or captan then is far more effective than later. Apple scab and apple mildew are now being controlled by sprays designed to reduce infection in the spring, and *Gloeosporium* diseases in store by reducing infection in the orchard between July and September (J. E. Crosse). Spores of the *Verticillium* wilt fungus of hops are relatively short-lived in the soil (G. W. F. Sewell and J. F. Wilson). They do not attack grasses, thus suggesting measures of control by grassing down for short periods and linking with the control by composting mentioned here. Life-cycle investigations of codling moth and tortrix have also led to more effective timing of sprays against these insects, as described by G. H. L. Dicker. There are now highly efficient insecticides, but their very efficiency brought an increase of fruit-tree red spider mite which requires separate control.

Virus diseases limit fruit production greatly, and A. F. Posnette reviewed the methods of virus control—relative isolation of stocks, the planting of healthy material, the control of aphids and other vectors and the thrilling development of heat therapy. The recognition of leaf-hopper and soil nematode vectors has brought new methods of control, but the older methods of planting only virus-free stocks are still highly effective, for "trees (now ten years old) of our cherry and plum mother tree clones have yielded three times the crop produced by virus-infected trees often used for planting orchards in the past". J. T. Legg showed that degeneration of the hop can be explained by the joint attack of 'nettlehead' and 'line pattern' viruses, but here again, vigour can be maintained by planting only virus-tested stocks supplied by the Station through the Ministry of Agriculture's A-plus scheme.

* The Kent Incorporated Society for Promoting Experiments in Horticulture. Jubilee Annual Report of the East Malling Research Station, Maidstone, Kent, 1st October, 1962, to 30th September, 1963. Pp. xxx + 208. (Fifty-first year.) (East Malling, Maidstone: East Malling Research Station, 1964.) 17*s*. 6*d*.; 2.50 dollars.