ground from the shut-down core. Fuel handling is carried out by means of a simple hand-operated tool under direct visual control.

Table 1 lists the main reactor parameters and Table 2 summarizes the fluxes available in the experimental facilities.

It is expected that about 75 per cent of the reactor operating time will be allotted to research and the remainder to postgraduate and undergraduate teaching. The initial demand for experimental time for research has been heavier than expected. About fifteen proposals have already been authorized by the Reactor Safety Committee and nearly half of these are large-scale experiments requiring prolonged use of the reactor. Two short experiments were completed during the commissioning period. So far, the majority of the experiments have been put forward by Imperial College staff, who have been in closer contact with reactor progress than other potential users, but general demand is expected to grow rapidly now that routine operation has begun. It is clear that the reactor is meeting a real need, and we look forward to a long and useful operating life.

OBITUARIES

Sir John Gaddum, F.R.S.

THE death, on June 30, 1965, of Sir John Gaddum has deprived physiology and pharmacology of one of their leading personalities. He died after a long illness, uncomplainingly borne, at his home in Cambridge at the age of sixty-five. Born in Bowdon, Cheshire, he was educated at Rugby and at Trinity College, Cambridge. There he read mathematics and, in his last two years, physiology as part of the Natural Sciences Tripos. It was later a source of merriment to him and of solace to his fellow sufferers that he only gained a 'second class' in physiology. From Cambridge he went to University College Hospital, London, where he obtained his medical qualifications in 1925. For the next two years he worked with J. W. Trevan at the Wellcome Physiological Research Laboratories in Beckenham.

Gaddum's first paper there on the antagonism of adrenaline and ergotamine on the uterus of the rabbit was an indicator of things to come: his interest in drug antagonism, his mathematical treatment of biological data, the use of smooth muscle as a convenient quantitative measure of drug action, were indicative of much of his later work. The years 1927–34 were spent at the National Institute for Medical Research, Hampstead, under the directorship of H. H. (now Sir Henry) Dale. Many of the papers of these years are exercises in quantitative pharmacology and have helped to lay the foundation of accurate measurement of drug effects, and of estimation of errors due to sampling and other sources. He introduced the 'normal equivalent deviation' in the evaluation of quantal assays. He devised or improved the biological assay of substances which occurred in tissues in such small quantities that their chemical determination was impossible. There was also the discovery, with U. S. v. Euler, of a biologically active polypeptide in tissues ('substance *P*'), and with H. Schild, of a fluorimetric test for adrenaline. However, the investigation he most enjoyed during this period was one which led to the discovery, with W. Feldberg, that acetylcholine was the chemical transmitter at preganglionic autonomic synapses.

During his stay at Hampstead, Gaddum married a former fellow student, Dr. Iris Mary Harmer, with whom he shared many interests during their long married life, and who now survives him. They had three daughters, all of whom are married.

During 1934–58 Gaddum held chairs in pharmacology in the University of Cairo, University College, London, the College of the Pharmaceutical Society of Great Britain, and Edinburgh. Here he succeeded A. J. Clark in 1942 after several war years spent in work for the Ministry of Supply, to which he remained an adviser for many years to come. The release of histamine, the nature of the transmitter at adrenergic nerve endings, the role of 5-hydroxytryptamine in brain activity, and the assay of bradykinin were among his interests in the Edinburgh years. In two papers he drew attention to the fact that many biological phenomena exhibit a lognormal distribution. He greatly improved the specificity of biological assays. This was done either by the use of specific antagonists, if necessary by desensitizing the tissue with a large dose of the substance the presence of which was suspected; or unambiguous clues to the identity of the unknown material were obtained by measuring its effect on many organs in parallel and estimating its potencies in relation to known reference substances. To the end of his life, Gaddum worked on active substances extractable from tissues, but his interest shifted increasingly to the search for new transmitters in the central nervous system. His last paper, started before he became ill and completed during the years of illness, deals with the chemical and structural requisites of central nervous activity. It is now in the press. In 1958, Gaddum accepted an offer from the Agricultural Research Council to succeed I. de Burgh Daly as director of the Council's Institute of Animal Physiology at Babraham, Cambridge. Always ready for new experience, he took up the challenge of learning about the needs of the physiology of farm animals and travelled all over the world to find out what was done in this field elsewhere. The growth of the Institute during his directorship is a telling tribute to his success.

Gaddum's singular achievements were due to a combination of mathematical ability, technical inventiveness (he constructed many useful research tools, the last one, the 'push–pull cannula', in 1961), with an unflinching interest in all biological, in fact all natural, phenomena, of which physiology and pharmacology were but one section. He had the mind of a naturalist, looking for plants and birds on his travels, and possessed an intellectual curiosity which did not fail him to the end. The capacity to take interest in new disciplines stood him in good stead when he gave up his chair to become director of the Babraham Institute.

During the years that Gaddum held professorships he had pupils from many lands. These will remember not only his brilliant mind but also his complete lack of prejudice, his willingness to hear all views, his integrity and sense of duty, his kindness and modesty, and the way in which a busy man gave freely of his time to their many needs. Gaddum considered it a scientist's duty to encourage international co-operation, and he certainly made an outstanding ambassador of good will.

Among the honours conferred on him was the fellowship of the Royal Society in 1945, an honorary LL.D. from the University of Edinburgh in 1964, and a knighthood in the same year. MARTHE VOGT

Dr. H. J. Gough, C.B., M.B.E., F.R.S.

AFTER a working life devoted to research in engineering at the National Physical Laboratory, the War Office, the Ministry of Supply and Unilever, Ltd., Dr. H. J. Gough for the past ten years had been living in retirement at Rottingdean; but he had maintained his interest in his old pursuits and during his retirement had continued to

serve on several boards and committees. He died on June 1.

Gough will chiefly be remembered for his pioneer investigations into the mechanism of the fatigue of metals. On joining the staff of the Engineering Department at the National Physical Laboratory in 1913, Gough began his investigation of fatigue under the tutelage of Stanton and Bairstow. He soon made the subject his own, and after service with the Royal Engineers throughout the First World War (in which he gained promotion from the ranks in the field and was twice mentioned in dispatches) he returned to the National Physical Laboratory to continue his research. His book on *The Fatigue of Metals* was published in 1924, and this book, with the book by Moore and Kommers published about the same time, remain the basic references on this subject. In the 1920's, Gough, with Hanson of the Metallurgy Department at the National Physical Laboratory, began to investigate the process of fatigue in single crystals of metals. In crystals of aluminium he demonstrated that under all stress conditions, including alternating torsional stresses, plastic deformation occurred by slip on the slip planes and in the slip directions subjected to maximum ranges of shear stress, and he showed that fatigue cracks developed at the points of maximum resolved shear stress and in regions of heavy bands of massed slip. Afterwards, by tests on single crystals of zinc, silver, antimony, bismuth and iron, they demonstrated the importance of slip as a precursor of fatigue cracking in all the truly ductile metals, and also made observations on deformation twinning and cleavage. By comparative tests on pieces containing one or two large crystals, Gough demonstrated that the intercrystalline boundary played no essential part in the fatigue process: the fatigue crack still developed within the crystal grains, and in extending it neither avoided nor sought out the crystal boundaries.

In 1930 Gough succeeded Sir Thomas Stanton as superintendent of the Engineering Division, and the consequent increase in his administrative duties compelled him to delegate much of the further prosecution of his researches to his junior colleagues; but he continued to play an active part in investigations into corrosion fatigue, fatigue under combined stresses, fretting corrosion and study by X-rays of the nature of fatigue damage.

In 1938 Gough was called to the War Office as director of scientific research; and in 1942 he was awarded the C.B. and became director-general of research and development, Ministry of Supply. Of the many contributions Gough made to the war effort, most were not, of course brought to public notice, but the system developed under his guidance for rendering innocuous unexploded bombs earned the gratitude of us all.

After the War, Gough became engineer-in-chief to Unilever, Ltd., and was responsible for building up the Engineering Department of the Company's advisory technical division in London and for co-ordinating engineers' activities through the organization at home and abroad. The work he did in these fields established the importance of good engineering and did much to improve the status of the engineer.

Gough was elected to fellowship of the Royal Society in 1933 and was president of the Institution of Mechanical Engineers in 1949. During the period 1945–50 he played a large part in the establishment of the Mechanical Engineering Research Laboratory and in the transfer of research in engineering from the National Physical Laboratory to that establishment (now the National Engineering Laboratory). In the formative years of the National Engineering Laboratory, Gough acted as chairman of the Committee which supervised research there into all matters relating to strength of materials, and he took an active part in the organization of the conference on fatigue of metals held at the Institution of Mechanical Engineers in co-operation with the American Society of Mechanical Engineers in 1956.

H. L. Cox

Prof. D. S. Hendrie

Prof. D. S. Hendrie's death at the early age of fifty-six when he was at the height of his powers and when assuredly a great future lay ahead of him was a severe blow to Scottish agriculture. One could feel the acute sense of depression that settled over his College when the news came through. Although a man of immense ability, he had a most becoming modesty and the rare gift of making even the most junior lecturer feel important. His door was ever open to all callers and he was a ready listener to new ideas. He was at his happiest when mixing socially with his staff and students and he was a great champion of students' rights and privileges.

In 1954 Donald Hendrie was appointed principal of the West of Scotland Agricultural College and first professor of agriculture in the University of Glasgow. He brought with him a freshness of approach stemming, no doubt, from the five years he spent in New Zealand, where he was agricultural adviser to the High Commissioner for the United Kingdom. He was, in a real sense, coming home, for he had been a distinguished scholar at both of the institutions where he was now to play a leading part. He graduated B.Sc. with first-class honours in agricultural economics at Glasgow, winning many prizes and attaining the highest aggregate mark in the examinations for the National Diploma of Agriculture. He also held a B.Sc. in estate management of the University of London and a diploma in agricultural science of the University of Cambridge. As recipient of a Ministry of Agriculture scholarship, he spent a year at the Ontario Agricultural College, Canada. From 1932 until he went to New Zealand in 1949 he held a succession of posts, first as lecturer in the West College and then in Yorkshire with the Ministry of Agriculture.

It is a tribute to Prof. Hendrie's remarkable versatility and adaptability that he was as well thought of by the farmers of South-West Scotland as he was by the highest academics of the universities. He was as much at home in the fields of his native Ayrshire as he was in the classrooms and laboratories, but it was as a committee man and as an administrator that he was supreme.

The memoranda which flowed regularly from his pen were models of clarity, and they produced results. The complex interrelationships between university and college were a challenge to his abilities; they were soon sorted into satisfactory orderliness. It was also no easy matter to administer a College that existed in two parts separated by thirty miles, but under Prof. Hendrie's guidance the fusion was complete.

His talents were early recognized and he was asked to advise on the setting up of Faculties of Agriculture in two universities in Africa. He was a Governor of the Scottish Horticultural Research Institute, and of the Grassland Research Institute, Hurley. The many committees on which he served are too numerous to mention, but among the more important were the Scottish Milk Records Association, the Blackface Sheep Breeders Association, the Agricultural Research Council Standing Committee on Research Affecting Plants and Soils, the Livestock Records Bureau, and the West of Scotland Conservancy of the Forestry Commission. He was a member of the Government committee of enquiry into grassland farming of the Secretary of State's Scottish Agricultural Improvement Council, and chairman of its grassland committee.

He forged close links with industry, recognizing the important part that chemical firms have played and are playing in the development of agriculture.

In fine, we could ill afford to lose such a man, but we have cause to remember with gratitude his wisdom in developing agriculture in this area and his influence in wider spheres. He was a strong family man. In all his work he was aided and encouraged by his wife Jenny, and he leaves a son who is at present studying agriculture.

W. Fletcher