tion with *hirsutum* in mixed plantations and not to intercrossing between them.

The objectives of the work, nine in number, included improvement in such characters as yield, fibre-length, colour and disease resistance. In a description of his work, Harland examines and criticizes the orthodox pure-line breeding, which has been slavishly adhered to by many breeders. The advantage of a pure line is the uniformity of the commercial product, and he concluded that the value of this has probably been overrated, at least in cotton. For example, fibre-length from single seeds was found to be almost as variable as that from commercial bales made up from plants of diverse genotypes. On the other hand, the disadvantage of early fixation of the genes (favourable and unfavourable) has sometimes been overlooked, as effective selection is then confined to the original plants and the first selfed generation. In the past, far too few original plants have been used to provide sufficient genetic diversity for selection. As Harland shows, it is necessary, in theory, to start with 1,024 strains in order to obtain eight strains which will be above the average in seven characters at the end of selection. Furthermore, when a good pure line has been found, it is not necessarily good in the majority of the environments that any good commercial plant is likely to encounter. Lack of plasticity does not allow the slight adjustments by natural selection which would occur in a mixed population.

For the purpose of maintaining a certain degree of diversity from which further selection would be possible, and also for obtaining effective results quickly, Harland abandoned pure-line breeding. No self-fertilization was practised, and mixtures of strains were propagated. Selection was started on 22,000 boll samples, each taken from a single plant, from various commercial fields. A first selection based on all characters rejected all but 2,863 of them. Ten plants of each selected strain were grown, and bulk samples of the ten plants were examined for all characters. This not only saved much labour in single-plant selection; but it also eliminated heterozygotes which, although themselves good, produce bad offspring by segregation. Forty-one strains survived these bulk tests, which after single-plant selection provided two hundred plants for progeny testing. Two thousand seedlings were raised from these, and after subjecting them to bulk and single-plant selections forty-three strains finally remained. Ten of these were propagated, giving sixty-three strains in the following year. These were mixed together and distributed as commercial seed.

Thus Harland has been able to restore the good qualities of the cotton plant in Peru, and indeed to add further improvement in a very short time while retaining genetic diversity for further selection. In grasses, mixed strains have been bred at the Welsh Plant Breeding Station and utilized with success[2]. Hitherto it has been thought that, in respect of the requirements of variation, pasture crops were different since less uniformity is necessary than in more highly specialized crops, but in view of the success in cotton the mixed strain is worthy of trial in other plants. It should be especially useful in crop plants which suffer from pests and diseases in epidemic form, when genetic heterogeneity may prevent widespread destruction.

[1] Harland, S. C., "The Selection Experiment with Peruvian Tanguis Cotton", Inst. of Cotton Gen., Lima, Peru, Bull. No. 1 (1944).
[2] Stapledon, R. G., "The Breeding of Herbage Plants, etc.", Imp. Bur. of Plant Gen., Bull. No. 3 (1931).

OBITUARIES

Prof. J. K. Catterson-Smith

JOHN KEATS CATTERSON-SMITH, professor of electrical engineering at King's College, University of London, was born on December 27, 1882, and died on January 25, 1945. His father was a well-known artist who became head of the Birmingham School of Art. The son received his early education at the City of London School and then entered the University of Birmingham. Here he held the Bowen research scholarship during 1902–4 and published the results of investigations on transformers, direct current motors and rotary converters. After three years at Siemens Dynamo Works, Stafford, he returned to academic life as lecturer in electrical engineering, and after a period at the University of Liverpool became chief assistant to Prof. Silvanus Thompson at the City and Guilds of London Technical College, Finsbury.

Between 1904 and 1914 Catterson-Smith published a number of papers on the starting of motors, on commutation in direct current motors, on harmonics in three-phase networks and on the manufacture of large turbo-alternators. He also contributed to the theory of transformers, induction motors and cascade motors. In 1915 he joined the Navy in the R.N.V.R. and was sent to help enlarge the wireless station at Demerara. Upon returning to Portsmouth he took part in the new developments of thermionic radio apparatus, especially in connexion with submarines. He served at sea in submarines and was promoted to lieutenant-commander. In some of the radio and supersonic developments he and I collaborated at Portsmouth and Toulon, and in particular we solved the problem of synchronizing an electric motor with a tuning fork, in preparation for facsimile transmission. Some of this work was done at Finsbury, after he had returned to his old post. Here, also, he published papers on audio-frequency amplifier design and on the theory of intervalve transformers.

In 1918 he married Miss Rita Thom and settled down to academic life again at Finsbury; but in 1923 he was offered the professorship of electrical technology at the Indian Institute of Science, Bangalore, where Sir Martin Forster was then director. At Bangalore he spent several ardent years building and equipping new laboratories, installing heavy-current plant and inaugurating a wireless research laboratory. He founded the Institute journal *Electrotechnics* and probably wrote most of it during its infancy. He and his wife, I have been told, assisted greatly in promoting the social life of the Institute.

In 1930 Catterson-Smith was appointed professor of electrical engineering at King's College, London, in succession to Ernest Wilson. Among his original researches of this period are those on the paralleling of large transformers, and on the theory and measurement of positive and negative sequence components of three-phase currents and voltages in three-wire unbalanced networks. Then came the War and the College moved to Bristol.

In the domain of electrical engineering Catterson-Smith will be remembered for the originality of his experimental work, for the careful workmanship of the apparatus he constructed and for his lucid exposition of what may be called the physiology of electrical machines—which ranged from large turbo-alternators to electric kettles and electric toys. His was one of those minds that restlessly endeavour

to improve the operation of every machine encountered; his mental processes consisted in first gaining a thorough insight into the operation of the existent machine and then applying remedies to the weaknesses disclosed. This passion for improving and inventing continued to the end of his life. For example, during the last two years he had been working on an improved electrical tele-mechanism of great ingenuity.

In Catterson-Smith there was an unusual and happy blend of art and science. His artistic instincts called for craftsmanship and appropriateness, his scientific instincts for accuracy and efficiency. These qualities imbued all his work. In addition, he possessed a personality of great friendliness and charm. No wonder he gained the affection of all his students and colleagues. W. H. ECCLES.

Prof. James Muir

BY the death, on February 17, of Prof. James Muir, emeritus professor of natural philosophy in the Royal Technical College, Glasgow, there has passed a great teacher and a man singularly devoted to science and to the quest of knowledge for its own sake.

Dr. Muir was born in 1875, and his early interest in science was stimulated by his education at Allan Glen's School, Glasgow. On leaving school, he entered his father's business; but the influence of his school training led him to consult Prof. James Blyth, on whose advice he entered his evening class at the Technical College. Thus began a connexion with that College which was to remain unbroken throughout his life.

Muir graduated B.Sc. in 1896 at the University of Glasgow, with special distinction in engineering and astronomy, and D.Sc. in 1902, having obtained the associateship of the College in mathematics and physics in 1897, in which year he was awarded an 1851 Exhibition Scholarship at Cambridge. His researches at Trinity College, under Prof. Ewing, into the effect of temperature on recovery from overstrain were published in the *Proceedings of the Royal Society*, and he was awarded the B.A. degree of Cambridge, followed in 1904 by the M.A. Returning to Glasgow, he became chief assistant to Prof. Blyth, and then assistant to Prof. Andrew Gray at the University of Glasgow.

In 1906, on the death of Prof. Blyth, Dr. Muir succeeded to the Freeland chair of natural philosophy in the Technical College, Glasgow, and he entered upon his duties with a boundless enthusiasm which continued during the thirty-two years which ended with his retirement in 1938.

Prof. Muir always gave foremost place to his teaching and to the interests of his large classes of day and evening students. Nevertheless, he found time to use to the full the resources of his department in conducting many valuable researches on behalf of the industrial firms of Glasgow, and during the War of 1914–18 these researches were directed to the service of the country. He willingly and enthusiastically entered into any movement for promoting the welfare of the College, such as the work of the *College Research Journal* and the re-arrangement and cataloguing of the founder's library.

Prof. Muir will always be remembered as a great teacher whose constant aim was to induce his students to think for themselves, to abhor anything slipshod and to enjoy hard work as he himself enjoyed it. The sincerity and love of truth shown in his scientific work was carried into his everyday life; 'he nothing common did or mean', nor could he compromise upon ethical principles. His students, like all his immediate colleagues, grew to look upon him with affectionate respect: they found him always approachable and eager to share and stimulate their interests. On his retirement, as an expression of their admiration and regard, his former students and colleagues founded and endowed the James Muir Prizes in natural philosophy, and presented to the College the fine portrait by David S. Ewart which now hangs in his old lecture room.

Dr. Muir's tastes were simple and his wants were few. From his student days he had a great love of the Scottish hills, and friends have most pleasant memories of holiday climbs in his company. At the time of his death he had prepared the manuscript of a text-book on physics and he was engaged on a memoir of the founder of the College. Prof. Muir was unmarried and is survived by three sisters.

Mr. F. R. S. Balfour, C.V.O.

BY the death of Frederick Robert Stephen Balfour on February 2, arboriculturists and horticulturists have lost a valued friend and counsellor. Though primarily an arboriculturist he was also a keen naturalist and a true lover of all kinds of plants. He had the advantages of having the means of travelling and of inheriting from his mother the beautiful estate of Dawyck in Tweeddale which possessed a number of interesting and historical trees. In later life he had important business interests in the City of London, and it was probably his business ability which led him to include experimental forestry plots on a large scale at Dawyck.

Balfour was born on March 11, 1875, and was educated at Loretto and Trinity College, Oxford. In his early days he spent four years on the Pacific coast of North America, and, although he was greatly interested in all the plant and animal life, it was the trees which captivated his imagination. He was familiar also with the trees of eastern Canada and the north-eastern States and had a working knowledge of the wonderful forests of south Chile. He became, therefore, a recognized authority in Great Britain on American trees, especially conifers. When he returned to Scotland he developed the collection of North American trees at Dawyck, introducing several species for the first time, his favourite being the rare *Picea Breweriana*, and trying out practically every species which could be expected to survive. In addition to his New World conifers he had also a collection of the more hardy Asiatic species mostly introduced by E. H. Wilson, whose second expedition to China he helped to finance. He had a great knowledge of British birds and was proud of his notable collection of foreign ducks and pheasants. From the economic point of view his most important contribution to sylviculture concerned the trial of promising, but as yet unfamiliar, species under forestry conditions or on the mountainside.

Balfour's published communications are scattered throughout a number of journals; his account of David Douglas, his "History of Conifers in Scotland" which covered a wide field, and a paper read recently before the Linnean Society on Archibald Menzies being perhaps the most noteworthy.

As a member of the Home Grown Timber Com-