

designers, but are going to be very good technicians, if not technologists. There is nothing quite comparable in radio. Mr. Warren wondered whether the technical college should, as in France, undertake more of the practical side of apprentice-training—or whether industry is content to undertake this. He concluded with a plea that education should find room for social thinking and an awareness of the economic and philosophical problems of our age.

Mr. R. E. Burnett (manager of the Education and Technical Personnel Department of Marconi's Wireless Telegraph Co.), expressing personal views, maintained that the radio industry is playing a full part in co-operation with the universities and technical colleges in stimulating recruitment and in planning the future training and education of radio engineers.

Agreeing that there is still a tremendous shortage of professional engineers in this field, Mr. Burnett stated that the larger companies are spending more and more money in developing their own training schemes, including the provision of the equivalent of college facilities. The smaller, but progressive, firms are in many cases making a proportional contribution to the problem of providing adequate training by co-operating with local technical colleges and in some cases making arrangements with the larger companies who are able to provide their own schemes. He advocated that there might be an extension of this principle in view of the increasing number of organizations which are not at present in a position to set up their own individual training schemes.

Agreeing with Mr. Warren that the question of selection is important, Mr. Burnett feels that too little is done to help the student who fails to reach professional status or even Higher National Certificate level. He advocated that courses and examinations should be so organized as to enable the candidate who cannot reach the higher level to be accommodated in the technician or craft level. Similarly, not enough is done to encourage the successful craft apprentice to go forward to secure professional status.

Some graduates hold the view that, having completed their university training, it is not necessary to follow on with a form of training or apprenticeship course. Most of the larger companies, however, have found that it is to the ultimate advantage of the graduate to undertake further training in the shape of an apprenticeship course, if only to have a first-hand understanding of the working of the various departments which go to make up a large organization. The graduate who leaves the university and is straightway employed on a special task tends to become insular in his outlook and not to use fully his academic training.

In general, the output of the universities is so comparatively small that industry is compelled to look to the technical colleges and the other examining institutions for recruitment to its professional ranks. In return, industry must be conscious of the need for arranging sandwich and similar courses (at present in very small numbers) in order to provide adequate training facilities for able young men who, for one reason or another, cannot undertake a full-time university course.

Other speakers in the discussion dealt with the shortage of teachers. Too many technical colleges are dependent on the services of the part-time

lecturer who, by reason of his main job in industry, is unable to give adequate time and thought to teaching.

Mr. E. M. Wareham (chief engineer of Sanders Electronics, Ltd.) feels that there is a serious gap between the standard of training of a university graduate in electrical engineering or physics, and the standard required in the design and development laboratories. The average student has to have at least two years training and general experience before being entrusted with responsible electronic work in the design and development field.

Mr. C. W. Robson (head of the Electrical Engineering Department of the South East London Technical College) feels that very few firms are prepared to enter into an apprenticeship scheme which will give the technical colleges the maximum opportunity of playing their part in the thorough training of the younger man.

The technical colleges are, in the main, dependent on recruitment at the age of sixteen or seventeen years, when the work of the technical college has to be integrated with the activity of the employing firm. In the Ordinary National Certificate, Mr. Robson feels that there should be greater specialization in radio and electronics.

Other speakers expressed the view that industry, and particularly the radio industry, does not do sufficient to publicize in the schools the opportunities available in industry. The first contribution made by the radio industry in this connexion is the excellent booklet distributed by the Ministry of Labour on radio and electronics as a career.

It was suggested that a difficulty in persuading youth to go in for a radio engineering career is the fact that, in the first two or three years of technical college training, students are confined to training in electrical engineering. Mr. W. Dunn expressed the belief that, if the radio apprentice could, in his first three-year technical college course, secure acknowledgment and reward in the shape of an Ordinary National Certificate in Radio Engineering, his interest would be much better maintained than under the present arrangement of expecting him to take an ordinary National Certificate in electrical engineering before starting any serious study of radio and electronics.

E. WILLIAMS

OBITUARIES

Sir Shanti Bhatnagar, O.B.E., F.R.S.

ON New Year's Day, India lost a great public servant, Sir Shanti Swarup Bhatnagar, a man of exceptional ability and immense energy. As director of the Council of Scientific and Industrial Research, secretary of the Ministry of Scientific Research, and chairman of the University Grants Committee, he was the Prime Minister's right-hand man in implementing the policy to put science in the forefront of India's plan for the future. When inaugurating the forty-second session of the Indian Science Congress at Baroda on January 4, Mr. Nehru paid him tribute: "I have co-operated for the last six or seven years or more with Dr. Bhatnagar who, I think, has done—I say this with all respect due to others—more than anyone else for scientific development in India".

Twelve new national institutes and laboratories have been built, equipped and established in various

centres in India* during the past six years, and most of them are now in full operation. Anyone who has seen these institutes cannot but be astounded by the energy and drive of the man who in so short a time created them. Bhatnagar could well be called a master builder, for there is a unity of conception, and every detail, even the fountains in the gardens, had some special object emanating from his ideas. In the words of Dr. H. J. Bhabha, "in the short space of a few years Bhatnagar built the laboratories which are indispensable to any nation which aspires to leadership in the modern world, and he has provided the means whereby young Indian scientists of to-day and to-morrow can make their contribution to the betterment of India and its people". These laboratories will be an enduring monument to the imagination, enthusiasm and patriotism of Bhatnagar, who spared himself not at all. He travelled far and wide to seek the latest designs, the most suitable equipment, the recent techniques which would help to promote the efficiency of his laboratories. He was undeterred, he went ahead and got things done—he did not permit finance to baulk his objectives and yet they were achieved at remarkably reasonable cost owing to his exceptional foresight and ingenuity.

Although this chain of laboratories is Bhatnagar's great achievement, it absorbed only part of his energies as secretary of the Ministry of Scientific Research and as director of the Council of Scientific and Industrial Research with its numerous committees and activities. He was the mainspring of it all, and he had his finger on every detail of the Council's work. He possessed a clear, concise and well-docketed mind. He was the first to arrive at the secretariat and his light was the last to go out; driving his assistants hard, he drove himself harder. He had a kind heart and a keen sense of humour, and they appreciated the joy and privilege to work for him.

As chairman of the University Grants Committee, he had undertaken a further great and important task. Sir A. L. Mudaliar, vice-chancellor of the University of Madras, stated that "Bhatnagar had just got into full stride as Chairman and it was a great misfortune that at this stage the Commission should be deprived of his forceful personality, and his wisdom and guidance".

Alas, the strain of all this work for India and for science was too great, and in his sixtieth year his heart suddenly failed.

Bhatnagar was born in a small township near Delhi in 1895—the Prime Minister was present at his birthday celebrations held at the National Physical Laboratory (Delhi) last February—and the devotion accorded to him and the respect for his achievements must have pleased him. His father was a teacher at Bhera in the Punjab; but he died when Bhatnagar was only eight months old. He often spoke of his mother and the great influence she had on him during his early days at school, when with considerable struggle but great innate ability he managed to acquire the knowledge for entry to the Forman Christian College, Lahore. There he came under the influence of able professors, and took his

M.Sc. in chemistry in 1918 in the University of the Punjab. In 1919 he came to England and obtained admission to University College, London, where he worked under Prof. F. G. Donnan, for whom he had great esteem and affection. In 1920 he obtained a grant-in-aid from the Department of Scientific and Industrial Research and continued working on the stability and inversion of oil-water emulsions, and secured the D.Sc., University of London, in 1921. After that he spent some months in Europe, at the Sorbonne and at the Kaiser Wilhelm Institute (Berlin), and was then appointed professor of chemistry in the Benares Hindu University, where he remained until 1924, having started a centre of physical chemical research. In October 1924 he became professor of chemistry and director of the University Chemical Laboratories, University of the Punjab, Lahore, which post he held for sixteen years. This was his most active and fruitful period of research, during which he published many papers on physical chemical subjects—colloids, surface chemistry, photochemistry, and particularly magnetochemistry. He published, with K. N. Mathur, "Principles and Applications of Magneto-Chemistry", and devised with him an interference balance for magnetic measurements. His research in magnetochemistry gained him election to the fellowship of the Royal Society of London in 1943.

Bhatnagar was, from all accounts, a very inspiring teacher; it was as a teacher that he himself was most happy. He took great trouble about his pupils, and many were the unbeknown acts of kindness and generosity. Not only was he a teacher of chemistry with a power of original work, but also he was widely read, and a gifted writer. His Urdu poetry, which was cast in a light vein, was much appreciated. His interests were wide, he was gay in conversation, lively in debate, and a wonderful friend. He had an unprejudiced outlook, having travelled widely and having many friends in many countries. Albeit, he was a great patriot and ambitious for India's sake.

In 1940, Lord Linlithgow (then Viceroy of India) was looking for a man to help to establish a government organization on the lines of the Department of Scientific and Industrial Research in Great Britain. He wisely chose Bhatnagar. Thereafter Bhatnagar became more closely linked with the Government machine at Delhi. It would have been difficult anywhere to find a man of more varied accomplishments, with such energy and drive. He had already had close connexions with industry. During his time at Lahore, he had devised processes relating to the purification of kerosene oil which proved helpful to Messrs. Steel Bros. It was characteristic of Bhatnagar to turn over emoluments received to public benefit, and he arranged with the company to found the Steel Bros. Research Scheme, which could be employed for research scholarships in the Punjab University Chemical Laboratories. Such schemes were extended when further ideas led to support for research from other oil industries.

It was in connexion with his activities while still at Lahore that he was made O.B.E. in 1936. He was knighted for his services on behalf of the Government in 1941.

During the Second World War and in connexion with the work of the Council of Scientific and Industrial Research, Bhatnagar's ideas fertilized many activities—for example, the production of anti-gas cloth and varnishes, foams, vegetable oil blends as substitutes for lubricating oils, glass substitutes, synthetic

* National Physical Laboratory of India (Delhi); Central Road Research Institute (Delhi); Central Building Research Institute (Roorkee); National Chemical Laboratory of India (Poona); Central Food Technological Research Institute (Mysore); Central Electrochemical Research Institute (Karaiikudi); Central Leather Research Institute (Madras); Central Glass and Ceramic Research Institute (Calcutta); National Metallurgical Laboratory of India (Jamshedpur); Central Fuel Research Institute (Dhanbad); Central Drug Research Institute (Lucknow); Central Salt Research Institute (Bhavnagar).

resins and plastics from waste products. He was the owner of a number of patents relating to textiles, wood products, mineral waxes, etc. He was in touch with all the chief industrialists in India and had connexions with many leading technologists in other countries; furthermore, he was skilled in negotiation, so that, with his experience in university life and his many personal scientific friends, he became invaluable as the centre of the growing scientific organization within the Government of India. When national independence came, the schemes on which his heart was now set quickly took shape. Some of them, indeed, had already been decided (for example, the building of a National Physical Laboratory).

Bhatnagar took a leading part in starting a number of projects, such as the formation of Indian Rare Earths, Ltd., for the processing of monazite sands and the search for atomic minerals. A number of metallurgical and chemical processes were developed or changed to suit Indian conditions and India's needs; for example, the enrichment of manganese ores proved a valuable enterprise.

His administrative successes were frequent; it may be mentioned that he was successful in gaining exemption from tax for expenditure on research, and from customs duties on scientific instruments essential for research. He was active in promoting the regional technological institutions, the Standards Institution and the National Research Foundation, and was a very useful member of the Council of the Indian Institute of Science, Bangalore. He instituted a documentation centre which was accommodated in the National Physical Laboratory building.

Bhatnagar took a lead in all that was going on in science in India. Before the War he had been sectional president (chemistry) of the Indian Science Congress (1928 and 1938). He was general president in 1944-45. He was president of the National Institute of Science of India (1947 and 1948), and as president in his address at the thirty-sixth session of the Indian Science Congress, he appealed to the young scientists of India for zeal in the cause of science and its application and zest for research.

He attended many conferences in foreign lands, as representative of India. He was a delegate to the Empire Universities Congress at Edinburgh (1931) and at Cambridge (1936); to the British Association and the Michael Faraday centenary celebrations (1931), and at the Liverpool meeting so far back as 1923. He was a member of the Indian Scientific Mission for the Government in 1945 and leader of the official delegation at the Empire Scientific Conference in 1946, and a member of the Indian Atomic Energy Commission which visited Great Britain in 1948. He attended the United Nations Scientific Conference on Utilization and Conservation of Natural Resources in New York, 1948. He made many tours to Europe and America in connexion with his work, and these included recently visits to the U.S.S.R. and to South America.

Bhatnagar was an honorary D.Sc., Oxford (1946), and had received the honorary doctorate of Delhi, Allahabad and Patna, and was honorary professor of chemistry of the Universities of Delhi, Benares and the Punjab. He was a Fellow of the Syndicate and member of Council of Benares University. He was a Fellow of University College, London. He was a Fellow of the Institute of Physics and of the Royal Institute of Chemistry (London), and was made an honorary member of the Society of Chemical Industry (London) in 1943 and honorary vice-president (1945-

48). He was a past-president of the Indian Chemical Society and recipient of the Reddy Prize in Chemistry, 1947.

The joy of Bhatnagar's full, eager life was marred by the loss of his wife, Srimati Lajwanti, in 1945. He had two sons and two daughters. A son and daughter-in-law lived with him, and his home-life was still a happy one. He had a little farm outside Delhi in which he took great pleasure. But one could not imagine his tireless soul resting at ease in this world while there was work to be done. Providence ordained that he should suddenly be taken away so that others, by the very shock of his loss, may be fired with his zeal. He has provided the means for scientists in India in many branches of science to do great work.

ALFRED C. EGERTON

Dr. G. F. C. Searle, F.R.S.

A MEMORIAL service for the late Dr. G. F. C. Searle, a former Fellow of Peterhouse, Cambridge, who died on December 16, was held in the College Chapel on January 21, at which colleagues, former pupils and friends gathered as a tribute to the passing of a notable personality.

Searle was the son of the late Rev. W. G. Searle and was born in the vicarage at Oakington, Cambridgeshire, on December 3, 1864. His ninetieth birthday was celebrated by a tea-party at the Cavendish Laboratory on December 3 last, when a large and distinguished company heard him give an account of his boyhood and youth, and of his introduction to physics when taken by his father to see the newly erected Cavendish Laboratory and shown over the building by James Clerk Maxwell, then recently appointed the first Cavendish professor of experimental physics.

Searle won a foundation scholarship at Peterhouse and, entering the University, read for the Mathematical Tripos, which he took in 1887, being classed as a Wrangler. In the following year he studied physics for Part II of the Natural Sciences Tripos. He began research work in 1888 in collaboration with Prof. J. J. Thomson on a determination of the ratio of the electromagnetic unit of electricity to the electrostatic unit, a research which was published in the *Philosophical Transactions of the Royal Society*. This was followed by many independent publications, mostly dealing with magnetic measurements or electromagnetic theory, but occasionally with properties of matter or heat. These researches gained for him the fellowship of the Royal Society in 1905 and the award of the Sc.D. degree by the University of Cambridge in 1912.

Searle was appointed to a University demonstratorship in 1890 and to a University lectureship in 1900. He retired from both posts in 1935. At the outbreak of the Second World War, however, he returned to work again and only gave up finally, and with reluctance, at the age of eighty-three, having then worked under three Cavendish professors. Sir J. J. Thomson has placed it on record in his book, "Recollections and Reflections", that "Searle has done more for the teaching of practical physics at Cambridge than anyone else". He taught a large class in practical physics at the Cavendish Laboratory—that for students working for Part I of the Natural Sciences Tripos—and for more than forty years nearly every Cambridge man taking physics was at some time his pupil. On the occasion of his ninetieth