Owen Saunders

1903-1993

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Submitted by the NAE Home Secretary

Owen Alfred Saunders, mathematician, engineer, and distinguished university administrator, formally professor of mechanical engineering, dean and acting rector of the Imperial College of Science Technology and Medicine, London, and vice-chancellor of the University of London, died on October 10, 1993. It is somewhat unusual for tributes to be composed after a certain interval, but in the case of Owen Saunders this is no disadvantage. On the personal side, tributes have continued to come in from old students and colleagues across the world. Almost exactly a year ago a memorial service was held in London at St. Margaret's Westminster attended by representatives of universities, learned societies, government and industrial research, by members of his family, numerous friends, and colleagues stretching back to his days at Cambridge in the early 1920s. One old student had crossed the Atlantic and the Japan Society of Mechanical Engineers presented a memorial plaque. It was not a sad occasion, and following the service friends and colleagues gathered at his old college where his presence had been quietly dominant since 1932. Someone said, "we will not see another gathering the like of this."

Owen Saunders was born in London on September 24, 1904. His father was a practical engineer with an inventive turn of mind; his mother, a school teacher of Welsh origin,

greatly encouraged Owen in his early studies. The family were of modest means and times were hard. However, Owen entered Emanuel School, London, and his sister Nancy studied music and became a concert pianist. Many memories of the young Owen as a highly intelligent, somewhat solitary schoolboy survive. He tended to find his own way in his studies and surprised his family by constructing his own crystal wireless receiver. He also overcame the advice of his headmaster and abandoned classics for science.

In 1921 Owen entered Birbeck College, London, and gained a general science degree in 1923. He was delighted with science and proceeded to Trinity College, Cambridge, with a scholarship to read natural sciences. In 1924 he gained an open scholarship. The freedom of Cambridge was greatly to his liking; he was inspired by the lectures of Horace Lamb and Rutherford. In the slender collection of papers in his study when he died were neatly bundled sets of notes of all his Cambridge lectures from so long ago. As we expected there was scarcely a note of his later achievements; he was the most modest of men.

It was during his years at Cambridge that Saunders first became interested in heat transfer research and its application to engineering design. Again, his independent nature intervened, and having failed to find facilities for the work he sought in Cambridge, he moved to the Government Fuel Research Station at Greenwich in London to work with Professor C. H. Lander. This was the beginning of a career-long devotion to the fundamentals of heat transfer in all its applications. It was also the beginning of a remarkable cooperation with Dr. Margaret Fishenden who had herself worked with Rutherford in Manchester. Together they set about correlating data particularly relating to furnace design. They also formulated a wide-ranging program of fundamental research.

Both Saunders and Fishenden had strong backgrounds in applied physics, mathematics, and fluid mechanics. They were also convinced of the value of close collaboration between industry and research in universities and government establishments. In this they were strongly influenced by Sir

Henry Tizard, and Saunders particularly was drawn into the inner sanctum of scientific effort that was so vital during the Second World War.

In 1932 *The Calculation of Heat Transmission* by Fishenden and Saunders provided, for the first time, a source book that enabled designers to apply, logically, the mass of data on all modes of heat transfer. It did more than this; it uncovered gaps in understanding and formed a basis for new experiments and correlations. It was in 1932 that Saunders moved to Imperial College where Sir Henry Tizard was rector; and Lander, professor of mechanical engineering. Margaret Fishenden also joined the team at Imperial College. In retrospect we can see this period as not only highly productive in research, but also as the beginning of a new style in mechanical engineering teaching with less emphasis on practical experience, (Saunders later referred to this as the "oily rag" approach) —and instead a devotion to fundamentals. This led to a softening of the boundaries between science and engineering.

It was at this time that Saunders undertook his pioneering studies of free convection over a wide range of conditions, including elevated pressure. In all his work there is a strong devotion to fundamentals and a fascination with the principle of similitude and logical design of experiments. A series of papers in the *Proceedings of the Royal Society* records his work on natural convection in liquids, including mercury; studies of flow and heat transfer in granular beds, and measurements of radiation were the subject of other important papers at this time. The heat transfer laboratory at Imperial College flourished and Saunders was drawn into the teaching of thermodynamics and dynamics in the mathematics department as well as in the engineering departments. War clouds were gathering over Europe and Saunders, under the influence of Tizard, was increasingly drawn into work for government.

From 1940 Saunders embarked on a series of full-scale experiments to boost the output of piston engines for military aircraft operating at high altitude. He showed that some 30 percent increase in thrust could be obtained by optimizing

the wave effects in the exhaust system. Later experiments to boost power output by the injection of liquid oxygen remained vividly in Saunders' memory. This was in part due to his having destroyed one Merlin engine on the test bed before the oxygen flow was well-regulated and also a curiosity, in long retrospect, as to the legality of carrying his oxygen injector on the London Underground!

It is almost certain that Saunders was aware of the work of Sir Frank Whittle on jet propulsion at an early stage. He would have been fascinated by the drive and inventive genius of Whittle. Saunders' own contribution sought to refine the mixing in the combustion chambers and improve the control system. As the cloak of secrecy was gradually lifted, we learned that Saunders had made important contributions to research on rockets and to a number of aspects of petroleum warfare.

In 1946 Saunders was appointed professor and head of the Department of Mechanical Engineering at Imperial College. He later served as dean of the City and Guilds College (the Engineering School of Imperial College) as pro-rector and for the years 1966 to 1967, acting rector. In 1967 he became vice-chancellor of the University of London. Throughout these years Saunders raised the standing of his department to a level of international distinction and contributed to the creation of the expanded Imperial College as a center of excellence in engineering and science. Saunders moved easily between scientists and engineers and was no stranger to the corridors of government.

Despite so many tasks, Saunders continued his research. His fascination with the future development of gas turbine in the air and on land and sea provided a focus for much of his effort. Pioneering work on heat transfer in supersonic flow proceeded side by side with flame radiation studies and fundamental work on the cooling of turbine blades.

Saunders continued to be closely associated with government and industrial research. Old interests were revived in the convective heating of liquids, improved studies of regenerators for gas turbines were undertaken, and there was constant concern with problems of flame radiation in collaboration

with the International Flame Radiation Committee of which Saunders was a founding member. Fundamental papers on natural convection and on heat transfer and flow associated with rotating discs were presented to the Royal Society. Saunders' last experimental studies examined the heat transfer and lubrication performance of piston rings.

It was some time before the interdisciplinary approach that flourished during the war years influenced the design of engineering courses. Saunders had a clear vision of the patterns of education that were needed, and he knew where to look for guidance. Friendships with McAdams and Max Jakob were long standing. The Massachusetts Institute of Technology was a Mecca for academics in the 1950s. New friendships developed with Professor J. H. Keenan and Professor H. C. Hottel. Both were frequent visitors to the United Kingdom and Saunders encouraged his young staff to venture across the Atlantic. Research was encouraged, and perhaps even more important, there was a near revolution in the teaching of engineering thermodynamics under the direct influence of Kennan. In addition, the advantages of teaching postgraduate courses were slowly appreciated. A course in gas turbine technology was the first, followed by nuclear power. Both courses had strong participation from industry on both sides of the lecture bench. New material filtered down to the undergraduate courses, which were finally extended to four years, and individual projects became a feature of the final years.

Honors both civil and academic were bestowed on Owen Saunders. He was elected to the fellowship of the Royal Society in 1958, he was president of the Institution of Mechanical Engineers in 1961. Honorary membership in the American Society of Mechanical Engineers followed also in 1961 as well as honorary membership in the Japan Society of Mechanical Engineers in 1965. Saunders was immensely proud to have been awarded the Max Jakob Memorial Award of the American Society of Mechanical Engineers and the American Society of Chemical Engineers in 1966. By a happy chance a comment by Max Jakob has been preserved in the record of the National Academy of Engineering: "There is scarcely a corner

of heat transfer in which something he has written is not to be found." In 1965 Saunders was created a Knight Bachelor. Honors from universities in the United Kingdom and overseas followed, and again it was a measure of his modesty that he never made a list of them! As vice-chancellor of London University in a time of change, his persuasive skills in administration were invaluable. It is significant that major reforms now (in 1995) being formulated are based in part on the *Saunders Report* written some twenty years ago.

The early years of a long retirement were saddened by the death of Marion, his first wife, and the loss of a gifted daughter. Owen was the most resilient of men. He remarried in 1981, and Daphne welcomed old friends to a new home closer to London. Life was still rich in music and friendships. He wrote sparingly but took immense trouble to pen accurate appreciations of old colleagues.

Saunders was a richly gifted man. He moved easily between mathematical analysis and experimental science. He had vision and clarity and applied both to engineering science and university administration. He was convinced that imagination was vital for success in engineering experiment and design. He was suspicious of solutions based only on experience of what had been done before. A friend of many years' standing, Dr. G. R. Feilden ended his appreciation of Owen with these words, "Let us all remember him for his teaching and research achievements, as a major advisor to governments, but above all, as a delightful and humane man."