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A Tribute to Arthur Shercliff

Professor John Arthur Shercliff, F.R.S., Associate Editor of *JFM* and Head of the Department of Engineering at Cambridge University, died in Cambridge on 6 December 1983. Shercliff was an original and inspiring teacher and leader in Engineering Education with two special themes to his work: one an almost *grande école* belief in the necessity for an engineering education to have mathematics and physics for its intellectual binding; and the other, a reflection of his constructive Mancunian radicalism, a belief in the importance of engineers knowing and caring about the world around them.

Shercliff was a pioneer in the development of magnetohydrodynamics (MHD) and its applications to important problems of engineering. His early work was concerned with electromagnetic pumps and flowmeters and his fundamental studies of the flow of liquid metals through ducts of rectangular or circular cross-section under the action of a transverse magnetic field laid the foundations for much subsequent research in this area. It was Shercliff who discovered the characteristic $M^{-\frac{1}{2}}$ behaviour of singular layers that form parallel to the magnetic field at large Hartmann number M – layers that now bear his name. He was always at pains to find a simple physical explanation for the phenomena that emerged from the mathematics. The rotationality of the Lorentz force distribution was a property which was quite novel to the engineers of the 1950s, and it was a property that Shercliff repeatedly emphasized in his discussions of MHD flows. This preoccupation led him to a number of novel and highly significant problems in which this rotationality plays a crucial part. One of these is the problem of the flow generated in a half-space due to the injection of electric current at a point on the boundary – the weld-pool problem as it is called – to which Shercliff made a fundamental contribution in 1970 (*JFM* **40**, 241–250); it is now recognized that the Shercliff study is relevant whenever electric current diverges in a liquid metal. The same rotationality of Lorentz forces is central to the Alfvén wave mechanism, which Shercliff studied in the context of the design of energy-storage systems.

More recently, Shercliff was one of the first to recognize the potential of using high-frequency magnetic fields to control the shape of molten metals as they solidify. In a work of characteristic ingenuity (*Proc. R. Soc. Lond.* A **375** (1981), 455–473) he found the shape of a column of liquid subjected to a quadrupole-type field – a paper which has led the way for recent developments in the field of electromagnetic shaping and stirring. Typically, he would write one thought-provoking paper in a field, and then move on to new physical effects. His most recent work has opened up the new field of thermoelectric MHD, in which electric currents induced by temperature differences interact with magnetic fields to drive or control various flows. It remains to be seen whether such effects can be important in practical contexts; it was Shercliff's belief that the effects are important in the context of fusion engineering, and as for the other fields that he had pioneered, time will probably prove him justified in this belief.

Shercliff was born in 1927 in Manchester and educated at Manchester Grammar School and Trinity College, Cambridge, graduating in Engineering in 1948. He then spent a year in Harvard studying Applied Physics and Mathematics, returning to a graduate apprenticeship with A. V. Roe Ltd in Manchester, where he recalled fitting pipes together in the wings of the early Avro 'Vulcan' aircraft.

In 1951 he returned to Cambridge to take up his research work in the magnetohydrodynamics of liquid-metal flows in ducts, work which formed the basis of his book *Theory of Electromagnetic Flow Measurement* (1962). He became a Fellow of Trinity College in 1958. During this period he worked also on MHD projects in collaboration with the Harwell and Culham Laboratories of the UKAEA, and provided one of the first convincing demonstrations of resonant and travelling Alfvén waves in liquid sodium – waves whose existence had previously been only indirectly inferred from astrophyscial observation. Much of this work is described in his excellent textbook *Magnetohydrodynamics* (Pergamon 1965).

In 1964 he moved to the new University of Warwick as the founding Professor of Engineering Science. He was particularly involved in the development of industrial links with the University, links which were vital to the development of the School of Engineering Science, particularly in the fields of automation and control. In teaching matters, Shercliff resisted the formation of barriers between mathematics, physics, engineering and computer science, and it was a hallmark of the system developed at Warwick that students could choose a selection of courses cutting across these boundaries. Shercliff, in his own lectures to engineers and mathematicians, demonstrated his original and wide-ranging feel for 'fields'; from these lectures grew his textbook *Vector Fields*, published in 1977.

He returned again to Cambridge in 1980 to succeed W. R. Hawthorne as Professor of Applied Thermodynamics. Here he was instrumental in promoting the incorporation of computer and information technology in the undergraduate engineering curriculum. At the same time he led vigorous research groups in the technology of thermonuclear fusion, MHD, and flow and mixing in industrial processes. He became an Associate Editor of *JFM* on his return to Cambridge; his views on the role of *JFM* in publishing research of practical importance are set out with characteristic bluntness and vigour in the 25th anniversary volume (**106**) of the Journal.

Arthur Shercliff was an extraordinarily warm and humorous man and his fast and punning style would frequently leave his audience struggling to understand. In lectures, he would stand looking quizzically for the laugh! One of his favourite jokey questions, which would follow a rapid explanation of Kelvin's theorem and boundary-layer separation, would be 'Why do you blow candles out rather than suck them out?' It is tragic that the candle of his life has been blown out so soon. We have lost a gifted colleague and a trusted friend.

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