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BOOK REVIEWS

The Life and Legacy of G. I. Taylor. By GEORGE BATCHELOR. Cambridge University Press, 1996. 301 pp. ISBN 0521 461219. £45.

It might look surprising to have asked to review the biography of G. I. Taylor written by George Batchelor as I am someone not directly associated with the scientific life in Cambridge where G. I. Taylor spent most of his career, someone not trained as a mechanician, someone who had some difficulty with some words (especially in the nautical terminology, an essential part in G. I. Taylor's life). Clearly, I could not have met Taylor who died in 1975 at the age of 89 at the end of an extremely productive career extending over 64 years! Actually, I first met G. I. Taylor with a number of French colleagues discovering fluid mechanics at a Les Houches summer school, through his marvellous *Low Reynolds number* film shown to us a few days after his death. In this respect, together with Elisabeth Dubois Violette, Pierre Gilles de Gennes, Maurice Kleman, Manuel Verlarde, among others who received this first exposure through DAMTP scientists at the summer school, we would be honoured to be considered as second or third generation disciples since, anyway, G. I. Taylor did not really have a direct school.

But let us come back to G.I. as Batchelor, a student, later a colleague and friend, affectionately calls him. The book, which I enjoyed from beginning to end, actually did not surprise me because I knew a great deal of G.I.'s career through the four volumes of his collected works which, for us, have been an introduction to the field. We also learned much directly from his immediate colleagues and, in fact, because, as Batchelor tells us, Taylor was a simple man as well as a scientist of genius who could be approached directly.

What we learn first from this testimony is that Taylor was in a sense an 'opportunist', who was looking for simple problems he could solve elegantly with experiments and theory or, more properly said, who had the great talent of working on complex mechanical problems from diverse areas and making them appear simple.

The first 'opportunity' in Taylor's life was the expedition he made as a young scientist on an ice scout boat, the *Scotia*, which sailed through Newfoundland waters in 1913, a year after the *Titanic* was hit by an iceberg, in order to understand better the meteorological conditions in the region. The *Scotia* tour appears to me to play the same role for Taylor as the *Beagle* expedition for young Darwin! G. I. Taylor collected, during this tour, much data on turbulent atmospheric flows using kites and balloons, and from observations of fog and chimney smoke. The trip provided him with an introduction to the fundamental contributions he made throughout his career to the understanding of turbulence. G. K. Batchelor, a renowned expert in this field despite the fact that he came a little too late to have worked directly with Taylor on it, describes in detail this important part of Taylor's achievements. The question of why Taylor gave up turbulence after the Second World War, during which he had worked on military issues such as explosions, may be asked. It might well be that, considering the increased crowdedness and complexity of the field then, he chose to return to the discovery of original and simpler subjects in which he had such an insurpassed talent.

Complementary to the *Scotia* opportunity, his participation during the First World War at the Royal Air Force factory in the early days of aeronautics made him a pilot

with a deep understanding of the principles of flying although he was not as good a pilot as a sailor!

Beyond his many contributions to turbulence, there is some similarity in the problems solved in his two 'golden age' periods, as Batchelor calls them, after the two World Wars. The book contains many accounts of work which all became classic, like that on the motion of particles in rotating flows, centrifugal instabilities, the so-called Taylor–Couette problem. Just to try to grasp the methodology of Taylor's approach to discovery – one of the concerns of Batchelor – G. I. Taylor did what Maurice Couette carefully avoided in his thesis a few years before, which was to deliberately induce a centrifugal instability, not through any contrived perturbation to the flow but simply by working in the unstable region. Taylor realized that the Rayleigh criterion for stability in the problem should be revised to account for viscosity. He carefully calculated the flow pattern in the general case where the two cylinders rotate and only one part of the flow is unstable. He immediately devised a nearly perfect experiment where locally injected dye is introduced for visualization. He produced the full linear theory. This work by itself established definitively a distinction between instabilities leading to turbulence and those producing stationary patterns in a first stage, a field which has known many developments ever since.

The work he did after the Second World War is also particularly elegant and has become popular, particularly outside the fluid mechanical community: bubbles and film flow, Saffman–Taylor fingering, microorganism locomotion, in particular.

The scientific explanations in the book are given with a simple rigour which does not exclude tenderness and, sometimes, light criticism in view of the 'unencumbered' style of Taylor's work, aiming at the result but not necessarily so scrupulous in terms of formal rigour.

The book contains a large account of Taylor's life. First as a sailor. From the age of 13, when he built his first sailing boat in his bedroom, to his thirties when he sailed away from the coast of Great Britain with his wife Stephanie and close friends, we have many accounts of 'sport' with a clear correspondence between the way he sailed and the way he carried out his research work: a sense of observation, pleasure in what he was involved in, imagination. He also liked to share, especially later in his life, everything he had been engaged in previously in work as well as in his other activities. The book offers us many enjoyable pages written by Taylor himself. Quite paradoxically, this quality in sharing through popular talks, letters, and reviews did not make him a particularly remarkable professor, and he apparently enjoyed the status of Royal Society Professor which protected him from intense teaching.

The book also contains an interesting account of his numerous interactions at the Cavendish, starting with those with Rutherford as well as with other founders of modern fluid mechanics in the world. His work on solid mechanics and plasticity, another important legacy of Taylor, is also included through two short contributions by Professor R. Hill and Sir Neville Mott, which complete the scientific panorama in the book.

The life and legacy of G. I. Taylor will undoubtedly find its way onto many bookshelves of mechanicians but, more generally, of all physical scientists concerned with the interaction between theory and experiment at its highest level, eager to understand a little better how simple genius works.

E. GUYON

Magnetic Fluids: Engineering Applications. By B. M. BERKOVSKY, V. F. MEDVEDEV & M. S. KRAKOV. Oxford University Press, 1993. 243 pp. £47.50.

Magnetic Fluids and Applications Handbook. Editor-in-Chief B. M. BERKOVSKY. Begell House Inc., 1996. 831 pp.

The way in which these two books develop the subject of magnetic fluids is similar. There is a natural path of progression from description of the colloidal systems containing magnetized particles, through properties, governing equations and basic phenomena, to applications. The similarity here may well stem mainly from the fact that the Editor-in-Chief of the *Handbook* is one of the authors of the monograph published by the Oxford University Press.

Twenty-eight authors, well known for their work with magnetic fluids, have contributed chapters or sections of chapters in the *Handbook*. This has resulted in substantial coverage of the field, with the individual contributions welded together by what must have been firm editorial direction. The *Handbook* does not have quite the coherence of the monograph, which provides in some ways a more readable introduction to the field, apart from an irritating lack of quality in the translation into English. However, my advice to a new student of the field, seeking an introductory text, would remain *Ferrohydrodynamics* by R. E. Rosensweig (Cambridge University Press, 1985). The books which are the subject of this review would be for further reading.

As indicated by the titles, both books are strong on applications. There are particularly substantial sections on ferrofluid seals, with detailed discussion of different geometrical arrangements, but many other possible uses are reviewed.

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