JOHN RONALD WOMERSLEY

F. SMITHIES.

John Ronald Womersley was born at Morley, in the West Riding of Yorkshire, on 20 June, 1907. His early education took place in local schools; he then went to the Imperial College of Science and Technology in London, where he obtained a first class degree in mathematics in 1928. After some further work at Imperial College, he joined the staff of the Shirley Institute at Manchester.

Here Womersley turned his attention to the application of mathematical methods to textile problems. He published an interesting paper [1] on the differential geometry of cloth, in which he set up the equations of equilibrium for a piece of cloth under tension and normal pressure and examined the appropriateness of various types of boundary condition; in particular, he calculated the form assumed by a circular cylinder of cloth subjected to tension at both ends. Another paper [3] on a textile problem, written in collaboration with G. A. R. Foster and J. Gregory, was of a more combinatorial nature, and was not published until some time after he had left the Shirley Institute.

While Womersley was in Manchester, he collaborated with D. R. Hartree in the development of the University's differential analyzer, and in devising techniques for its application to mathematical problems. In a joint paper [2] they discussed a method for the solution of the diffusion equation

$$\frac{\partial^2 \theta}{\partial x^2} = \frac{\partial \theta}{\partial t}, \tag{1}$$

with given boundary and initial conditions. The main idea was to replace (1) by the differential-difference equation

$$\frac{\partial^2}{\partial x^2}[\theta(x, t+h)+\theta(x, t)] = \frac{2}{h}[\theta(x, t+h)-\theta(x, t)],$$

and to solve this by a step-by-step method, proceeding from $\theta(x, t)$ to $\theta(x, t+h)$, and then allowing h to approach 0. The convergence of the approximations was speeded up by using L. F. Richardson's technique of " deferred approach to the limit ". The method was extended to non-linear partial differential equations of the form

$$\frac{\partial \theta}{\partial t} = \frac{\partial^2 \theta}{\partial x^2} + f(x, t, \theta).$$

Under the influence of L. H. C. Tippett, Womersley also became interested in the application of mathematical statistics to industrial problems, and especially in statistical quality control; these interests were to play an important part in his later career.

In 1937 Womersley moved to the Ballistics Branch of Research Department, Woolwich (later the Armaments Research Department). His first work there was concerned with the internal ballistics of guns. On examining current methods of charge adjustment at cordite proof, he found that they contained certain hidden and unjustified assumptions about the accuracy of the guns in which new lots of cordite were proved; in 1940 he initiated a statistical investigation of the cordite proof records, which led eventually to putting charge adjustment on a much sounder basis.

In 1941-42 the growth of mass production of material for the armed services led to demands from various departments of the Ministry of Supply and from industry for advice on problems of statistical quality control and sampling inspection, and Womersley found himself called on for informal advice, to begin with by some of the inspection departments of the Ministry. In the summer of 1942 it was decided to set up an official advisory service on statistical quality control, and Womersley was appointed as its first head; the service grew rapidly and played an important part in spreading the knowledge of sampling inspection methods and quality control, and also in demonstrating the usefulness of more refined statistical techniques in handling industrial problems.

In 1945 Womersley became the first Superintendent of the new Mathematics Division of the National Physical Laboratory; here work was begun on a new electronic computer, the ACE (Automatic Computing Engine), and sections were set up to deal with problems of numerical analysis and statistics, especially with a view to industrial applications. The article [4] was written at this time. From 1950 to 1954 Womersley worked with the British Tabulating Machine Company at Letchworth on the development of another electronic computer.

In 1954-55 he was engaged, in collaboration with a team at St. Bartholomew's Hospital, on an investigation for the Medical Research Council of the flow of blood in the arteries; this work resulted in a paper [5], in which he discussed the distortion of the pressure wave along the artery, and demonstrated the importance of the longitudinal oscillation of the walls caused by the viscous drag of the fluid. He continued this work and wrote a further report on it after his appointment in 1955 to a mathematical post at Wright Field, Ohio, in connection with the U.S. Air Force.

In 1957 Womersley had a serious operation in London; he appeared to make a good recovery, but it did not last, and he died on 7 March, 1958, at Dayton, Ohio. He is survived by his wife and three daughters.

John Womersley was tall and heavily built; his favourite exercise was walking, and he once walked with a newly purchased perambulator from Golders Green to his home in Wimbledon. He was proud of his Yorkshire origin and never completely lost his accent; he was always very good company, and had a fund of entertaining stories, in dialect and otherwise. He had a restless nature, and was often captured by some new enthusiasm; in consequence, he was always at his best when he was starting a new job or setting up a new organization. Once the show was in running order, however, he tended to lose patience with administrative detail and routine; he had many ideas about new uses for mathematical techniques, and he would soon be looking round for a new field in which his particular talents could be employed. Although not himself a brilliant mathematician, he was often the first to perceive the existence of a problem and to translate it into mathematical language; in this way he stimulated many others to do important work.

Bibliography.

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5. "Oscillatory motion of a viscous liquid in a thin-walled elastic tube. I. The linear approximation for long waves", *Phil. Mag.* (7), 46 (1955), 199–221.