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PREFACE

STUDIES of flow-properties of materials have been made from very early times. The construction of water-clocks hardly comes within this category but the way in which water changes its viscosity with changing temperature would seem to have influenced the construction of a water-clock made by Amenemhet in the middle of the 16th century B.C. for the use of the ruling Pharaoh.

The angle of the reconstructed "clock", an obtuse conical vessel with a hole at the bottom, was found to differ by some 7° from that theoretically required if the fall in level of the water was to be linear with time. It is supposed that Amenemhet must have made an empirical correction for the change in the viscosity of water during the night.

The Hebrews and Romans did little rheology and the Greeks, though they debated at length whether motion is an illusion or whether everything is in a state of flux ("πάντα ῥεῖ") seldom did experiments. Early Indian philosophers studied what we should now call the rheological properties of materials and, like the Greeks, developed an atomic and, in a sense, a molecular theory. The Arabs appear to have contributed little, but they kept learning alive during the dark ages.

Leonardo da Vinci certainly studied problems of hydrodynamics and Galileo's work on mechanics sometimes came near to rheology. A few less well-known men, such as Bernard Palissy the potter and painter, also had rheological interests.

Quantitative rheology, however, owes its parentage to Robert Hooke who published his law of elasticity "ut tensio sic vis" in anagram form in 1676 and Isaac Newton who, in his "Principia" (1687) implicitly defined "lack of slipperiness" (viscosity) as the constant ratio of force to rate of flow.

It is difficult to trace the earliest accounts of studies of biorheological phenomena, since they doubtless go back into remote antiquity. Following the discovery of the circulation in blood capillary vessels by Marcello Malpighi in 1686, a number of successive observers, such as Anthony van Leeuwenhoek, Lazzaro Spallanzani and Albrecht von Haller gave descriptions of their observations of such phenomena. However, it was not until Poiseuille (1835) made his *in vivo* studies on the circulation in blood capillary vessels that rheological treatments have been applied to the flow of blood.

Although the circulation of the blood was known to a few people in the 17th century, many years passed before the idea was widely accepted. An interesting historical survey of this development has been given by Sir Arthur Thomson in last year's Harveian Oration to the (British) Royal College of Physicians (*Brit. Med. J.*, 18 November 1961).

Streaming in plant cells was first observed by Corti in 1774 and the study of protoplasmic streaming has become particularly profitable during the last two decades—first by William Seifriz in Philadelphia, U.S.A., and more recently by Noburo Kamiya and his school in Osaka, Japan.

The name "Rheology" was first given to the science of the deformation and flow of matter, when the (American) Society of Rheology was founded by E. C. Bingham and his friends in 1929. Although Bingham himself worked on problems of blood flow, the term

"biorheology", to apply to the rheology of living systems or materials directly derived from living systems, was not used until A. L. Copley proposed it at the 1st International Congress on Rheology in Holland in 1948.

In 1950, a symposium on Rheological Problems in Biorheology was held at Lund in Sweden and an account of this was published as an appendix to the first book specifically devoted to biorheology, edited by A. Frey-Wyssling two years later (N. Holland Publ. Co.). Biorheology played an increasingly important part in subsequent International Congresses.

In 1958, a most successful meeting was held in London, England, to discuss the "Flow of Blood in Relation to the Vessel Wall" and a year later, the Colloid and Biophysics Committee of the Faraday Society collaborated with the British Society of Rheology to organize a meeting in Oxford on "Flow Properties of Blood and Other Biological Systems". The proceedings, reviewed elsewhere in this Number, were published in book form in 1960.

In 1961 a Symposium was held in Israel on Rheology and Microcirculation, an account of which is also given in this Number.

This ever-increasing interest in the study of the deformation and flow of living and inanimate biological systems or of biological materials suggests the need for a common meeting ground for publications in this field.

It is the earnest hope of the Editors-in-Chief, Editors, Publishers and Members of the Advisory Board of "Biorheology" that our new journal will provide such a forum.

A.L.C. G.W.S.B.
Editors-in-Chief