

CONVOCAATION ADDRESSES

CONVOCAATION ADDRESS 1

FROM COLLOIDAL SCIENCE TO BIORHEOLOGY - A HISTORICAL REMINISCENCE

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Biorheologists are certainly familiar with such terms as anomalous viscosity, viscoelasticity, thixotropy, rheopexy, streaming double refraction, tactoid formation, and mesomorphic state of matter. The phenomena relating to these terms were discovered or investigated originally by colloid and surface chemists such as Bingham, Hatschek, Freundlich, Ostwald, Zocher and their collaborators in the period of 1920-1935.

As one of pupils of Freundlich I studied in his laboratory in Berlin during 1927-1929, when I was able to have personal contacts with most of these investigators and to acquire some knowledge about their findings and discussions. After returning to my homeland I began to make research on some of those phenomena, particularly thixotropy, dilatancy, rheopexy and related properties of some colloidal systems during 1930-1941, which later gave a stimulation for the further development in rheological research in Japan.

As Scott Blair writes in his latest book on Introduction to Biorheology the term "Biorheology" was first proposed by Dr. Copley at the First International Congress on Rheology held in Scheveningen (Holland) in 1948. With Dr. Copley I met for the first time in 1960 when he delivered a lecture on "Hemorheology. An Introduction" in the International Congress on Blood Transfusion held in Tokyo. His lecture aroused interests in biorheological research in my country, particularly through Dr. Oka who attended the lecture with myself.

My recent interest mainly lies in the study of mesomorphic states of matter from the viewpoint of colloid and surface chemistry as well as rheology. In this lecture I would like to make a sketch of lineage of the colloid and surface chemical approach to biorheology and, if possible, touch on researches in mesophases in connection with biological and biorheological problems.

CONVOCA TION ADDRESS 2

PROSPECTS OF BIORHEOLOGY IN THE FUTURE

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The biorheological exploration of life processes is of great significance among the perspectives pertaining to the future of biorheology as an organized science. Biorheological experimentation and treatments are bound to be more and more included in multidisciplinary research regarding many problems in the biomedical sciences.

In recent years, experimental research on atherogenesis included hemorheological considerations and studies. Atherosclerosis is an example of a multidisciplinary approach, in which hemorheological studies play an important role. A new theory of early atheroma formation was recently presented by the author (A. L. Copley, 4. Kölner Symposium on Cerebral and Coronary Vascular Disorders and Infarcts, Max-Planck-Institut für Hirnforschung, Cologne, 21.-24. June 1978, Brain and Heart Infarcts II. K.J. Zuelch, W. Kaufmann, K.-A. Hossmann and V. Hossmann (eds.). Heidelberg-New York, Springer-Verlag, 1978 (in press). This theory is based in great part on our surface rheological studies of β -lipoprotein-fibrinogen systems (A. L. Copley and R. G. King, Thrombosis Research 4: 193-198, 1974) and surface chemical studies by Miller et al. concerning the adsorption of lipoproteins on proteinaceous surface and their desorption from it (I. R. Miller, H. Graet and Y. F. Frei, in: Atherogenesis: Initiating Factors. Amsterdam, Assoc. Sci. Publ., 1973, pp. 251-266). This theory includes the theoretical approach to atherogenesis by Oka, involving polymer physics and hemorheology (S. Oka. In: Hemorheology and Thrombosis. Eds. A. L. Copley and S. Okamoto. New York-Oxford, Pergamon Press, 1976; Thrombosis Research 8 (Suppl. II): 305-313, 1976).

Although clinical hemorheology has been practiced since several decades more and more both diagnostically, such as the erythrocyte sedimentation rate, the viscosity of blood systems, and Hartert's thrombelastography and, therapeutically, e. g., by hemodilution, it is anticipated that clinical hemorheology will be greatly expanded to include many new hemorheological techniques and treatments.

Many biorheological tests and treatments, other than hemorheological ones, will be introduced in the practice of medicine and surgery. Clinical biorheology will play an important role in more successful clinical management including therapy and in prophylactic measures. It will also be applied towards better birth control and to more effective aid to the aged. Clinical biorheology will become a major discipline and taught in medical, dental and veterinary schools. It will also have a great impact on space bio-medicine and many biorheological tests will be carried out near zero gravity in spacelab modules.

Advancement of knowledge in biorheology will likewise be applied, among others, to genetics, the differentiation of cells, embryology and growth processes including cancer. However, biorheology will not be limited to problems related to life processes in mammals and other animals, but will be extended to those pertaining to micro-organisms including viruses and viroids, and, in particular, to plant organisms.

It is almost paradoxical that the flow of a non-biological simple fluid, such as water, was first studied by Poiseuille after he made his hemorheological observations, about 143 years ago, of the very complex microcirculation in animals. This led to what is well known as the Poiseuille law. There will be a growing number of stimuli from biorheological researches in non-biological scientific and technological areas. There will be also an augmentation of new theoretical biorheological approaches, which will be advanced for many complex biological manifestations and processes. These theoretical concepts will become available for application to medical, biological, other scientific and technological disciplines.

It is concluded that biorheology with its numerous and multitudinous applications will become one of the major life sciences and be an integral part in the further development of human society. Finally, the differentiation between life and inanimate matter may well be decided by biorheological investigation and the perennial question "what is life" may thus find an answer.