

and his interests. Here we have some basic material from which a historian might begin his study of the way the character of a great scientist allows him to further science through his influence as well as his own research. Anyone who has studied galactic astronomy, radio astronomy or cometary astronomy will find here some fascinating pieces of history. B. Lindblad's picture of galactic rotation was that the stars with greater velocity dispersion had slower rotation about the galaxy because of their greater pressure support. Each such subsystem was originally considered to rotate uniformly. It was Oort who saw that stars of very low velocity dispersion must rotate differentially and who then went on to show that this motion could already be seen in the observed proper motions.

Later, it was Oort who saw the importance of finding spectral lines in the radio region and sent van der Hulst on the search that led to his great discovery of the 21 cm line. Until reading this book I had always regarded it as a sad irony of fate that the Dutch, with that prediction but with no wartime experience of radar, just missed being the first to observe the line. Much credit goes to Muller for bringing the techniques up to date so quickly, but the gap was too great and, as he points out here, his task was made quicker by learning of the techniques used in the US which led Ewen to the first detection. However, Oort knew what should be done with the line to probe the astronomy of the Galaxy and so it was the Dutch who won the next round. It is sad that G. W. Rougoor who collaborated with Oort in some striking papers died when so young, but I am sure he would too have been a contributor.

However, if I may choose a favourite among Oort's discoveries, it is his determination of the total density of visible and invisible matter in our region of the Galaxy through his work on the gravity field. As Blaauw describes, this work opened the door to the astronomy of the invisible which has grown to be a major subject over the past ten years and in which the Westerbork telescope has played a major part. Some of the highlights of the discoveries are described in the well-illustrated contribution by Allen and Ekers, while van der Laan describes Oort's part in the use of Westerbork observations in his new role as Professor Emeritus.

I give the last word to van Bueren who contributes a well-written and perceptive article on Oort's role in Dutch astronomy: The kind and courteous Oort holds fast to his opinions with unbelievable firmness. He therefore finally always wins his argument, with colleagues as well as with research-financing organisations and government officials.

Perhaps this has been Oort's secret of success, which has helped him to put Holland in the forefront of modern astronomy. □

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Rheology from Russia

J.J. Hermans

Rheology of Polymers: Viscoelasticity and Flow of Polymers. By G.V. Vinogradov and A. Ya. Malkin. Pp.467. ISBN 3-540-09778-3. (Springer-Verlag: 1981.) \$57.90, DM 98.

THIS translation of a revised Russian text published in 1977 contains an admirable treatment of the rheology of polymers. It begins with a comprehensive introduction to the mathematics of deformation and flow, which covers both linear and nonlinear constitutive equations.

More than 30 pages on linear viscoelasticity are followed by rather brief, but pertinent, coverage of nonlinear theories. There are excellent sections on the newtonian and the non-newtonian viscosity of polymers in relation to molecular weight, polydispersity, branching, concentration and entanglements. A remarkably extensive discussion of about 40 pages covers normal stresses. There are further chapters on birefringence, rubber-like behaviour in flow (i.e. large recoverable deformations), the effect of fillers and the rheological properties of polymer blends.

The authors have wisely decided to emphasize concentrated solutions and melts, these being the systems of greatest practical interest. The well-known molecular models and theories that have been developed for very dilute polymer solutions are mentioned, but play no great role in the discussion of either the theory or the experimental data. In other words, the treatment is mostly phenomenological. Many empirical equations are discussed but, when at all possible, these are related to the phenomenological theory.

Particularly praiseworthy is the balance between theory and experiment. This is perhaps best illustrated by the fact that Chapters 2-7 contain about 180 figures showing experimental results.

Inevitably, in a book which covers such a vast field, one will notice omissions. For example, whereas empirical relations between non-newtonian viscosity and shear stress are mentioned, there is nothing on the requirement of zero slope at the limit of zero shear stress. To mention another example, in the chapter on uniaxial extension the investigator will find that many literature references are missing; conversely, it can be said that the value of the book is enhanced by some references with which the English, and even more so the North American reader is often unfamiliar.

The book will be a good introduction for anyone wishing to learn about this field. At the same time it will be a valuable reference work to scientists already experienced in the subject. □

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