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REVIEW

Low-Gravity Fluid Mechanics. By A. D. MYSHKIS, V. G. BABSKII, N. D. KOPACHEVSKII, L. A. SLOBOZHANIN and A. D. TYUPTSOV. Springer, 1987. 583 pp. DM 182.

A remarkable quotation from A. Yu. Davidov's 1851 treatise on capillarity, that the achievements of Poisson and of Laplace 'have completely exhausted the subject' and made further efforts superfluous, serves to initiate the text on p. 1. In fairness to the memory of an outstanding scientist, it should be pointed out that the comment was modified (and achievements of Gauss cited) for the later French and German summaries of his work, of which the present authors were presumably unaware. The quotation does provide an engaging *mise-en-scène* for the ensuing 580 pages, which offer a fascinating exposition of results in low-gravity fluid mechanics, largely those achieved in the USSR in the past 30 years. The words 'low gravity' should be interpreted in the sense of the motivating spirit of the book, in which the effects of surface tension on a stationary configuration are presumed to be manifested globally, rather than restricted to boundary layers. Much of the material envisages gravity or other force fields, and encompasses negative-gravity situations, such as occur with a hanging drop. Rotating liquids are discussed extensively and are a major point of emphasis.

The text offers linear theory superimposed on a nonlinear background. That is, a mass of liquid in static or dynamic equilibrium under the action of capillary forces and boundary conditions is assumed initially to be given. Its static stability is then examined, and/or its linearized dynamic oscillatory behaviour, under the assumption that the fluid is ideal or viscous. Thus in the first chapters particular stationary configurations are studied from a global point of view, using the exact equations. Much of this must be done implicitly or with the aid of computers, as precious few explicit solutions are known (the apparent simplicity of the equations is a deceptive lure). These solutions form the basis for the later linearization and for the bifurcation and spectrum analysis. At each stage the theory is first developed in general terms, using instructive elementary models as motivation. The results are then applied to particular geometries arising from symmetry groups. Much of this material is presented on a sophisticated mathematical level, and in addition to computational procedures offers general existence theorems and formal asymptotic estimates. The analysis here is carried out in precision and depth and forms the hard core of the book. The authors have nevertheless not forgotten the needs of the uninitiated; material that can be skipped by those looking only for the general idea or final result is indicated by grey strips in the margin.

A final two chapters cover convection in self-gravitating liquids and thermocapillary convection. Here the equations are much more complicated and the analysis depends largely on numerical calculations.

The book is quite readable, the single cavil coming to mind being that sections are not self-contained and the reader must occasionally search earlier sections to locate symbols and determine their meaning; it might have been helpful to include a list of symbols.

The bibliography is extensive; the authors claim completeness without qualification for the Russian literature. For material in non-Russian languages, it is somewhat sketchy despite its length and should best be regarded as offering starting

hints for a more extensive search. Some omissions that come to mind are papers of Vogel, Lieberman, Miersemann, Tam, Dussan V., Langbein, the reviewer, and the reviewer's own book on capillarity, which appeared shortly before this one went to press.

It may be worth remarking that there is almost no overlap of material between the two books; directions of current interest could in fact fill a number of further books without exhausting the topic. The nearly simultaneous appearance of these two volumes after a quietus of over half a century may be taken as augury of a new era of mathematical activity on capillary problems, in response (at least partly) to the needs of space technology and of medicine.

The book of Myshkis *et al.* contains an impressive amount of valuable material, in modern mathematical terminology and in accessible format. The price is high, but it offers value for the money. No serious scientist with any interest in or need to know about capillarity can afford to be without it.

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