other of these two time-scales—the τ-scale, with its infinite past time, for mechanical phenomena, and the t-scale, with an origin some two billion years in the past, for electromagnetic phenomena.

In the next major portion of the book (Part II), Professor Milne develops a system of dynamics, based upon the two systems of kinematics to which he committed himself in Part I. Here again the procedure is marked by the imposition of further ad hoc assumptions, the effect of which is further to reduce the full complement of possibilities which would otherwise be available. Among these is the arbitrary definition $M = m\ \xi^{1/2}$ of the invariant inertial mass of a particle, where ξ is a rather complicated function of position and velocity, but which is in essence the inverse of the Fitzgerald-Lorentz contraction factor met in the special theory of relativity. But the most serious limitation is that imposed upon the motion of a test particle by the requirement that a certain acceleration function G, which can in general depend on both t and ξ, is to have the fixed value $G = -1$. The justification for this restriction, which is put forward in conjunction with the study of statistical systems of particles in Part III, depends in part upon a dimensional argument which is compelling, even in the restricted kinematics to which Milne has committed himself, only if one is prepared to believe that the theory under construction is so universal that it will account for all dimensionless physical constants encountered in subsequent contact with the empirical. A novel theory of light-quanta, based upon this dynamics, leads Milne to the conclusion that Hubble and Tolman have over-corrected for the reduction in luminosity of a nebula caused by its motion, and are in consequence led to an excessive curvature in Hubble's general relativistic model of the expanding universe. Milne's result follows from the fact that in his t-kinematics, Planck's constant varies directly with the epoch—as does also the gravitational constant introduced later.

Part III examines the nature and distribution of a statistical system of particles, and leads, after the specialization mentioned above, to identifying gravitation with the tendency for test particles to be accelerated toward the particles of the substratum. The final Part IV consists in a partial extension of the a priori formalism to electrodynamics, in exploration of the possibilities which the new dynamics may there unfold. But by this point the self-imposed restrictions and ad hoc assumptions make it difficult to consider these developments, including a bizarre theory of the structure of spiral nebulae, as a fulfillment of the ambitious program upon which Professor Milne embarked at the outset.

In conclusion, the reviewer would like to say that the program to which Professor Milne has here applied himself—that of building up an abstract mathematical system of kinematics and dynamics and even electrodynamics—is an intriguing one, the exploration of which should lead the enquiring mind through vistas of possible uniform background worlds, against an appropriate one of which the real world with its variety would stand out in concrete relief. But he fears that the present attempt suffers from undue restrictions, both tacit and explicit, which impair its validity as the basis for a universal model, and that its methodological short-comings are too serious to be offset by isolated points of apparent agreement with the empirical.

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ZAMP

JOURNAL OF APPLIED MATHEMATICS AND PHYSICS (ZEITSCHRIFT FÜR ANGEWANDTE MATHEMATIK UND PHYSIK). Vol. I, No. 1, January 15, 1950. Edited by R. Sänger. Verlage Birkhäuser, Basel, Switzerland.

This is a new journal in the field of applied physics. Its aim, according to the publisher, is "to bridge the gap existing between the periodicals devoted to pure mathematics and physics on the one hand, and those confined to the construction engineering science, on the other hand."

It will contain survey articles, original papers, "Brief Reports," book reviews, and general information. The Brief Reports will be published six weeks after receipt of them by the editor, provided the author forgoes the proof reading. The languages can be German, English, or French. The original articles have a summary in a different language from the article itself.

The first number contains the first half of a very good survey article on semiconductors. The three original articles deal with wind tunnel experiments on airplane wings, circuit theory, and numerical solution of boundary value problems. There is only one Brief Report dealing with selection rules in x-ray diffraction.

In this first issue all articles are in German. Of the three original articles, one has its summary in English, the other two in French. The usefulness of the journal might be improved if the Brief Reports could also have one paragraph in another language as it is expected that these may often contain early information on important new work. Since the Swiss users of the journal are almost equally familiar with both French and German, it would seem somewhat more logical to use English for the majority of the summaries.

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Flying Blind

DEFORMATION AND FLOW. An Elementary Introduction to Theoretical Rheology. By Markus Reiner. 346 pp. Interscience Publishers, Inc., New York, 1949. $6.50.

A crystal or liquid can be thought of as a giant molecule. Such a giant molecule is made out of atoms which are joined by chemical and physical forces into a more or less tightly interconnected whole. The fiction that such a system is a continuum has been useful in classical hydrodynamics, in elastic theory, and in Debye's hands as a basis for a statistical theory of specific heats.

The continuum fiction, however, is at best a crutch. To solve Lagrange's equations for the normal vibrations has been shown to be extremely difficult by Blackman and others. Flow in general occurs where there are flaws providing empty space for the atoms to jump into. Thus for flow we need to know not only the regular structure of our giant molecule but the flaws in the structure. Such

BOOKS *Continued from preceding page*

things are still harder to know from direct calculation than are the normal modes of vibration. Nevertheless, the formal statistical theory for flow under stress is well known and can be applied to experiments. The parameters thus found from experiment suggest models which will explain the flow phenomena. Such a program is dismissed as metarheology in Professor Reiner's book and he proceeds with the classical continuum methods with only an occasional reference to molecular structure.

Considering this choice of what the reviewer would call "blind flying," to borrow a metaphor from aeronautics, the results are surprisingly good. However, instead of the rate of non-Newtonian flow being proportional to such things as the hyperbolic sign of the work done by the applied forces in the flow process (measured in units of kT), Professor Reiner must use unexplained power laws. There are other examples where one wishes the mechanical engineer were more interested in what molecules will and won't do.

On the other hand the rheologist, immersed in the molecular aspects of the subject, has the opportunity here to see due emphasis given to elastic theory. Cubical dilatation and distortion are separately treated and the complication of three-dimensional deformation and flow faced. The author employs in a most interesting way his wide knowledge of what has gone before. There are many interesting side lights. Altogether the reviewer found it a very interesting and valuable book which should do much good.

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From the German

LEITFÄHIGKEIT UND LEITUNGSMECHANISMUS FESTER STOFFE. By Eduard Justi and Co-authors. 348 pp. Vandenhoek and Ruprecht, Göttingen, 1948. Approximately 17.5 marks.

This book represents an attempt to bring together under one cover a general description of phenomena associated with the migration of electrons and ions in solid materials under the influence of electromagnetic fields. On the whole, an attempt is made to preserve a phenomenological viewpoint so that the text focusses attention on experimental relationships and results rather than on detailed interpretation of effects. The introduction of theoretical ideas does extend, however, to brief presentations of the Sommerfeld and band models of metallic substances and of the elementary theories of semiconductors and ionic conductors which have proved so effective in providing a semiquantitative understanding of the properties of these materials.

The book should have two general uses: It will provide an interested graduate student with a general view of the scope of problems associated with the flow of currents in solids; it is a handy reference book since each chapter contains a large compendium of references to old and recent publications concerning the topics discussed in the chapter.

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