Book Reviews

Fatigue in Aircraft Structures. Proceedings of the international conference held at Columbia University January 30–February 1, 1956. Alfred M. Freudenthal, Ed. Academic Press, New York, 1956. 456 pp. Illus. $12.

The collection of papers and discussions which constitute this book represent the proceedings of an international conference held at Columbia University early in 1956 under the sponsorship of the Office of Scientific Research, Air Research and Development Command, U.S. Air Force, and the Guggenheim Institute of Flight Structures, Columbia University. The individual contributions have been assembled under three main subject headings: (i) basic physical mechanisms and theories of fatigue; (ii) fatigue testing and methods for predicting fatigue life; and (iii) actual design techniques for the prevention of fatigue failures in aircraft structures.

As a group, the five papers dealing with the basic mechanism of fatigue in metals provide a comprehensive summary of recent experimental and theoretical work in this field. Significantly, most of this work has been carried out in England and Australia. It is also evident that some of the latest theories which have been advanced to account for the origin of fatigue cracks in metals have reached a rather high level of sophistication, incorporating as they do modern concepts regarding the generation, motion, and interactions of dislocations and point defects—that is, vacancies. Although much of the information contained in these papers has been published elsewhere, those who are interested in the basic physical behavior of metals under cyclic stresses will nevertheless find this series of articles instructive.

The next six papers are devoted to the more applied or engineering aspects of the fatigue problem. Among the topics given special treatment here are the mechanics of fatigue crack propagation, the development of testing methods in relation to design needs, the interpretation of fatigue data and statistical prediction of fatigue life, and so on. The remaining eight contributions are concerned primarily with the design procedures which have been developed by the aircraft industry for the prevention of fatigue failures in civilian and military aircraft. These papers are especially interesting since they offer a comparison between the design practices adopted in England, Sweden, France, Australia, and the United States.

To the metallurgist and physicist, as well as the test engineer and aircraft designer who must deal with the effect of metal fatigue on the performance and safety of modern aircraft, this book therefore contains much of interest and value.

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Philosophy of Science. The link between science and philosophy. Philipp Frank. Prentice-Hall, Englewood Cliffs, N.J., 1957. 394 pp. $7.65.

I had intended to say that this book was thirty years out of date, but that would not be quite right. There are references to, and in some cases extended treatments of, contemporary topics scattered throughout the book. It is rather Professor Frank's knowledge of the issues that *concern* philosophers of science and the reasons *why* they concern philosophers of science that is thirty years out of date. Anyone who still thinks that the issue in philosophy of science is between "operational definition" and "metaphysical interpretation" might enjoy reading this book. Afterwards he should learn some *real* philosophy of science.

To take up the issue of operational definition: logicians of science have had considerable difficulty in finding out just what it is that operationalists are contending. Is the operationalist view that talk about molecules is "really" talk about human experiences with measuring apparatus? The only argument for such a view would be that molecules don't "really" exist and that measuring apparatus does "really" exist. This would be itself a metaphysical position (a species of subjective idealism). To make the thesis of operationalism more amenable to scientific discussion it has in general been identified with the *translatability thesis*. The translatability thesis is simply that every sentence in theoretical science is synonymous with some sentence in the observational vocabulary of science—that is, some sentence that does not contain any term purporting to refer to unobservable objects such as "molecules." The translatability thesis is, however, false, as some thirty years of logical investigation have shown. Frank mentions neither the attempts to make the thesis of operationalism precise (for example, Carnap's work on reduction sentences) nor the difficulties that have been shown to arise with the thesis when it is made precise. Rather he says that every term in theoretical science must be "operationally defined" and then proceeds to construe anything and everything as an "operational definition." For instance, he regards the requirement that the forces postulated by physical theory must be expressible as "simple functions" of the distances and velocities as part of the operational meaning of "force," and he says, without blushing, "the Newtonian law of force asserts that there is in every specific case a formula that would be recognized as "simple" by the scientists of our period" (page 111). It is odd to find someone seriously maintaining that Newtonian physics is *about scientists!* More generally, one may reply to Frank as follows: even a realist would admit that a good scientific theory should lead to successful predictions and that it should be as simple as is consonant with success in its predictive and explanatory function. This much can be said for the scientific theory embracing any term or terms whatsoever, not just the term "force." This is a far cry from saying that terms like "force" are *translatable* by means of terms referring to operations, or that when we talk about force, molecules, atoms, and so on, we are "really" talking about scientists or about the operations they perform.

The book might be used as a source book for some fairly standard ("Logical Empiricist") views in philosophy of science. For instance, chapter 3 is a fairly good presentation of the more or less "orthodox" view of geometry, and chapters 13 and 14 represent a surprisingly responsible discussion of current inductive logic. The "orthodox" view of geometry which Frank defends seems to me, however, to be a mistaken one. On this view, pure geometry is regarded as an uninterpreted calculus, and the principle that light travels in straight lines, which is used when we try to derive testable predictions from geometric axioms, is regarded as some sort of operational definition. This seems a distortion of the situation. It would be more accurate to say that even pure geometry is a meaningful theory which, however, does not