

## SHORTER NOTICES

*Die mathematische Denkweise.* By Andreas Speiser. Zurich, Rascher, 1932. 137 pp.+9 pp. music.

This book is not a treatise on how mathematicians think. It is a collection of essays on mathematical thought as it is revealed in art and music, in philosophy and astrology. It is the work of a man of broad culture—one whose contributions to group theory are well enough known, but who is also at home in yet more esthetic realms and is conversant with the history of serious human thought.

The first chapter, *Delimitations*, while not attempting to define mathematics, sketches the history of its relations (in the few centuries preceding 1900, relations of decreasing intimacy) with philosophy and art, as well as with language, physics, and religion. There is good history, sound wisdom—a foretaste of a rewarding book. It is the symmetry and rhythm in art which is most closely akin to mathematics and especially to the mathematics of groups. (One might, of course, prefer to say that mathematics is artistic.) The love for such symmetry, for a neat formulation, sometimes leads Speiser to statements which are more suggestive than convincing. Thus, the triadic form of Proclus and Hegel is used to characterize center, radius, and circumference of a circle, and then: "Mathematics forms a triad with philosophy and art, wherein philosophy corresponds to the inert center, mathematics, as progressive research, to the *πρόδος*, art as limiting and formative activity, which attains beauty by being driven back upon the center, to the *ἐπιστροφή*."

Two chapters are next devoted to *Symmetries in ornamental art* and *Questions of form in music*. In the former there are examples from many stages of history (unfortunately it was financially impossible to give the illustrations which would have facilitated the argument). In the latter the symmetries in simpler musical forms are discussed, and here we do find a number of themes reproduced, and a considerable portion of a Beethoven sonata analyzed. That symmetry does appear here and contributes greatly to the beauty of the work is undeniable. Yet, were that quality sufficient, we could look forward to a machine for the production of masterpieces. In fact, symmetry, in the strict mathematical sense, is intolerable. Speiser recognizes this in describing musical performance. "The nuances are by no means gratuities of sensitive souls, but the main pillars of the reproduction of a piece, since they alone reveal its symmetric content. The extraordinary accuracy which artist and listener bring into play is one of the clearest proofs of the mathematical structure of the human spirit"—but is not the need for these very nuances also a proof that mathematics is not enough? An amusing hypothesis is this—"perhaps the good work of art is characterized by a minimal property; it is the simplest piece consistent with the symmetry complex which it contains." There is another aspect of the affinity of mathematics with music, which Speiser might have mentioned. The satisfaction coming from these two arts is, in part, due to that temporal element which is lacking in visual art. A musical composition, a mathematical