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REVIEWS

JOHANNES KEPLER. *The six-cornered snowflake.* Oxford, Clarendon Press, 1966. xvi, 75 p., illus. 21*s*.

THIS exceedingly well produced little book is the first English translation of Johannes Kepler's (1571–1630) truly remarkable, although still little-known, essay *De nive sexangula*. Written in Prague probably in 1609, where Kepler spent the most fruitful years of his not too happy life from 1600 to 1612 as "Mathematician to his Imperial Majesty" Rudolf II, and dedicated to his friend and patron, the Privy Councillor J. M. Wackher von Wackhenfels, on the occasion of the New Year of 1610, it was printed for the first time in Frankfurt am Main in 1611. The first German translation from the original Latin by R. Klug appeared only in 1907 in a rather obscure place, i.e. the 56. *Jahresbericht des K.K. Staats-Gymnasiums zu Linz*, where Kepler had lived as a Mathematician to the County of Upper Austria from 1612 to 1626. Yet, G. Hellmann, in his fine little book *Schneekrystalle* (Berlin, 1893), was fully aware of Kepler having been the first to ask the principal question *cur semper sexangula*, why always six-cornered? As an astronomer, Kepler had gained fame not so much by introducing new observation techniques, but as a theorist who succeeded in proving the pre-established harmony of the World, the geometry of God. Throughout his life and work, Kepler had been equally fascinated by the regularities in little things, crystals, honeycombs, and snowflakes. Clearly Kepler could not find the answer to his self-imposed question. But it is not without intellectual delight that one follows Kepler discussing several explanations and rejecting all of them. He firmly believed in the *facultas formatrix*, the formative capacity of the Earth itself, but he could not, with the means at his disposal, uncover the form of the law. Even though Kepler could not escape Pythagorean and Neoplatonic thinking, he clearly stated the problem. Kepler did not even recognize that snow was crystalline but in trying to explain its regularity by the geometry of close packing of globules of condensed moisture, he introduced a principle which was only proved right in 1912 by Max von Laue.

After a very valuable synopsis which greatly facilitates understanding, there follows the modernized text of the 1611 Latin edition with the English translation by Colin Hardie on the facing pages. This is supplemented by a series of learned notes on textual matters, and historical and literary references. Professor B. J. Mason adds a commentary on Kepler's essay, discussing the scientific meaning and validity of Kepler's arguments, and adding the modern explanation of the hexagonal symmetry and shapes of snow crystals. He ends with the modest statement: "The broad features of snow-crystal design seem now to be understood but there are many fine points of detail that still require explanation before we can claim to have dealt satisfactorily with the question posed so acutely by Kepler more than 350 years ago". The booklet concludes with a fine essay on "Kepler's unsolved problem and the *facultas formatrix*" by L. L. Whyte. This is a short examination of the history of philosophical and scientific ideas on the genesis of forms. According to Nakaya the study of the conditions under which the most regular visible forms, the crystals, are generated, is still an "untrodden field". The last sentence of the essay, as to "what in the ultimate laws produces visually perfect patterns?", shows that "we certainly have not yet a comprehensive scientific substitute for Kepler's *facultas formatrix*".

Whenever a history of glaciology is written, due attention will have to be paid to Kepler's essay *De nive sexangula*. This fine English translation will no doubt greatly help to recall Kepler's early contribution.

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