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★ **Incidence and symmetry in design and architecture.**

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*Cambridge University Press, Cambridge*, 1983. xi+306 pp. \$57.50; \$16.95 paperbound.

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“The purpose of this text is to develop mathematical topics relevant to the study of the incidence and symmetry structures of geometrical objects. . . and to expand the reader’s geometric intuition.” The authors carry out their stated purposes by teaching graph theory and symmetry, each in about 100 pages.

The presentation is intended for mathematical beginners, who will find themselves led but not coddled. For example, Dijkstra’s algorithm for finding minimum cost spanning trees appears (unattributed) on page 38 at the end of Chapter 1; by then the reader has seen definitions and examples of graphs, homeomorphisms, equivalence relations and metrics. Succeeding chapters treat planar graphs and Kuratowski’s theorem, polyhedra and Euler’s formula, bracing grids of squares in the plane, some graph optimization problems, maps and tessellations, and the classification of 2-manifolds.

The second half of the text begins with a study of the isometries of the plane and the definition of a group. The next chapter classifies the discrete groups of isometries of the plane. The treatment is careful and well illustrated, and the theorems are proved. This is no mere catalogue. Then some progress is made classifying the crystallographic groups in space. Finally, finite groups are used to study symmetry and enumeration. Along the way the reader encounters and proves Lagrange’s theorem, studies group isomorphisms, learns about the cycle structure of permutations, and about group actions on finite sets—orbits, stabilizers and Burnside’s lemma.

The authors succeed in combining intuitive geometric appeal with reasonable rigor to lead naive readers to deep theorems. Exercises are plentiful, relevant, and often difficult. The book was written for students of art and design, but there are other possible audiences. Prospective secondary school teachers could study it with profit. The text would be a good choice for the once popular course in liberal arts mathematics. But beware—even with a good text it takes a good teacher to convey such subtle mathematics in an appropriately elementary way.

Reviewed by *Ethan D. Bolker*