Donald W. Crowe | *Introduction to Slavik Jablan's "Modular Games"*

Slavik Jablan, a prize-winning expert on modular construction in a variety of contexts, has combined his artistic skills with his computer expertise to create the four Modular Games presented here. He calls these "OpTiles", "SpaceTiles", "Orn(amental)Tiles" and "KnotTiles". Each involves a small set of square tiles which can be combined in various orientations and reversals to make a bewildering array of designs and patterns. Though it is entirely possible for the "player" to while away the hours covering the computer screen with more or less random selections of tiles, for more systematic constructions it is helpful to print out the available "prototiles" for reference.

There are three pages of these for OpTiles (one Black-white, two Colored), two pages for SpaceTiles, and one for OrnTiles. (To call up the pages for SpaceTiles and OrnTiles, click on one of the numbers 1.1-10.2 or 1a-4d respectively on the introductory pages for those sections.) However, there are fewer prototiles than these printouts suggest. In the Black-white version of OpTiles there are really only five prototiles, each appearing in four versions as it is rotated repeatedly by 90° (except for the first two, which already have rotational symmetry, so that only one new version of each appears when they are rotated). But from the point of view of "antisymmetry" there are only three prototiles, since 2a and 2b are obtained from 1a and 1b by simply interchanging black and white, and 5a-5d are obtained in the same way from 4a-4d. Thus the enormous variety of "Op Art" patterns which you can create from the Black-white OpTiles is generated by only three basic building blocks. In the case of OrnTiles there are only two basic tiles; all the others are obtained by repeated rotation, or reflection, from 1a and 3a.

The OrnTiles have an especially interesting ancestry, for they derive from the "potato prints" that the artist M. C. Escher devised for his children. His son, George Escher, described in a 1986 talk entitled "Potato-Printing: A Game For Winter Evenings" how his father cut a potato in half, then carefully shaped the two flat faces into squares of the same size. In one square he carved a few lines, making sure that they met all four sides of the square in exactly

corresponding points, then cut away the potato to use as a stamp with an ink pad. He then stamped the other potato with the first as a stamp, to transfer the pattern, then carved the second to match the first, except that of course it is the reflected image. Judging by the illustrations in Doris Schattschneider's *Visions of Symmetry*, his formalization of this in 1938 is almost an exact prototype of OrnTiles 1a-2d. Later curved versions of 1943 strongly suggest the remaining OrnTiles, 3a-4d. Of course in Jablan's program these are multicolored, and we can dispense with messy inkpads.

From the layman's point of view much of architectural construction is modular: bricks, blocks of stone, strips of siding, decorative tiles, etc. It is only by working with modular elements and experimenting with their combinations that we learn – as children do with their Lego blocks – to feel the extent and variety of the visual and conceptual possibilities inherent in even very small sets of structural elements.

Samuel Beckett has alluded to these possibilities in an entertaining scene involving the main character of his comic novel *Murphy*. Murphy is in the habit of sitting in the park to eat his packet of five biscuits, "a Ginger, an Osborne, a Digestive, a Petit Beurre and one anonymous", the modules of his lunch, so to speak. He always eats the ginger last, because it is his favorite, and the anonymous first, because it is likely to be least tasty. The other three he eats in an order that varies from day to day. But one day he realizes that this reduces the number of possible ways he can eat his meal to a mere six. If he overcomes his prejudice against the anonymous he could increase this number to twenty-four. "But were he to take the final step and overcome his infatuation with the ginger, then the assortment would spring to life before him, dancing the radiant measure of its total permutability, edible in a hundred and twenty ways!" Unfortunately, in the midst of his rapture a hungry dachshund appears and eats all the biscuits, thus bringing the entire expansion of possibilities to an abrupt end.

In contrast to the sad ending of Murphy's combinatorial adventure, with Slavik Jablan's program no dog can eat your modules. You may contemplate your constructions at your leisure, and if you have a simple inkjet printer you can print them out to use in any way you like. The cross-reference to "Modularity in Art" in each of the four games clicks immediately to Jablan's article in the electronic journal *Visual Mathematics*, and thereby to a multitude of suggestive examples from Neolithic times to Celtic knotwork to Angolan sand-drawings to the present. Incidentally, if you want the tiles to fit together without any gaps you will need to use Internet Explorer rather than Netscape. Enjoy!

The author.

Donald W. Crowe is Professor Emeritus of mathematics at the University of Wisconsin, where he taught for 36 years. As a student of H.S.M. Coxeter his study of polyhedra gradually turned to finite geometries; both of these topics are represented in the recently reprinted Millennium edition of *Excursions Into Mathematics* (with A. Beck and M. N. Bleicher). At the instigation of Claudia Zaslavsky (*Africa Counts*) he began to investigate the geometric symmetries in real-world patterns. For the past 20 years he has worked with Dorothy Washburn to present this material in a form usable by archaeologists and anthropologists (Washburn and Crowe, *Symmetries of Culture*, University of Washington Press, 1988). He has collaborated with Joe Malkevitch, Dénes Nagy and Paulus Gerdes on mathematics education, Fijian patterns and ethnomathematics.