COMBINATORIAL PHILOSOPHY

by Kate Jones

Philosophy—a love of knowledge, learning, understanding, wisdom. A search for the truth about the world, the universe, reality, existence. A system for organizing the information and theories mankind has accumulated through the ages to explain existence and all it contains.

This definition of philosophy may not be the official, academic one, but it's the one I'll use for this outing.

In his intellectually intimate soul trek, *The Whys of a Philosophical Scrivener*, Martin Gardner leads us through a gamut of thought systems contrived by the most significant thinkers of the last few millennia. He identifies each system by its appropriate "*-ism*" and tells why he does not align himself with it. After examination of the whole palette, Martin "confesses" that he is a fideist, a Platonic mystic, a social democrat, and a believer in immortality. If anyone deserves immortality, in the way he defines it, Martin surely does.

About the perpetual tug-of-war between government planning and private enterprises between altruism and egoism—in economic systems, Martin likes to say that "there may be no best way. There may be many ways, equally good…"

Combinatorial puzzles—tiling sets of polyform shapes and colordifferentiated polygons displaying all the permutations of a certain type and enabling assemblies in countless ways and with special conditions or criteria for a completed array. The types of "recreational mathematics" Martin Gardner popularized in his *Scientific American* columns, notably pentominoes and MacMahon's three-color squares.

I have described elsewhere ("Those Peripatetic Pentominoes," Gathering for Gardner 1993; in A. K. Peters, *The Mathemagician and Pied Puzzler*, 1998) how Martin Gardner's writings on pentominoes directly influenced what has turned out to be the major part of my life's work: the development, production and marketing of combinatorial puzzle sets. What remains to be said is how such puzzles can serve as paradigms for theories of "all there is."

We can observe all around us that matter, energy, life forms, and their aggregations tend towards organized groupings or systems, by some dynamic yet to be fully understood, although crystals and fractals give us hints. Systems grow from unity, or singularity, to greater and greater complexity. *Example:* Polyforms, whether of squares, equilateral triangles or hexagons (the regular polygons that readily tile the plane), or more elaborate combinations, increase by leaps and bounds in the number of different shapes formed when the number of cells increases. From the 12 famous pentominoes (5 squares) to 35

hexominoes, 108 heptominoes, 369 octominoes—and that is just eight units! In how many more steps will the possible permutations exceed the number of atoms in the universe? Yet each shape is a distinct, unique entity unto itself.

The number of variations for each larger order builds on the previous set—expands hierarchically from the preceding level. So does the mind grow and organize its information, its non-stop flow of new sensory input. Each new bit of data gets integrated into the existing inventory, sometimes fastidiously, as in the scientific method, sometimes ramshackle, like a cluttered attic. All this experiential information serves as fodder for decision-making on a moment-to-moment basis for survival, security, goal achievement, which goes beyond the mere autonomous instinctual apparatus. The higher mental functions, abstract thought, "thinking about thinking," allow the mind to form complex operational rules for itself and to exert self-correction. This higher level of brain function can override many of the built-in, animal-level behaviors. Let's call this ability "free will."

In many situations, when pressed for a decision, we may face several equally valid options. "There may be many ways, equally good..." By some unfathomably complex set of algorithms, the mind will weigh the multitude of parameters and pop out an optimum answer, based on its unique context. Unpredictable? Probably. Especially from women, whose value assignments tend to be weighted in more complicated ways than men's. Shall we call this "intuition"? The workings of the subconscious? Causality? I would not call it determinism.

The 12 pentominoes can form a 6x10 rectangle in 2339 distinct ways. If there is a God, and if God knows everything, past, present and future, then God is aware of the infinitude of potentialities of how our world could develop, but would not necessarily know which convoluted strand or path, among all the infinite forks in the road, the world will take. We can know all 2339 pentomino solutions, but not know which one of them the next solver will find.

Societies, or human groupings, accumulate their cultural and regulatory structures from the gradual combinatorial melding of their distinct individual units. Some pieces of this "puzzle" are bigger than others and have more influence, weight or power. The blood-spattered history of the human race bears witness to an absence of organizing intelligence in accommodating all the pieces of the puzzle into a harmonious unity. America's founding fathers came the closest by setting forth a system to secure "life, liberty and the pursuit of happiness." Shown here are some puzzles with all-different "members" or "citizens" that have nevertheless been joined into a beautiful composition without having to demolish, mutilate or throw away any of its members. I frequently use this example to defend individual rights against totalitarians: the point is that the mutual good of both polar opposites—the group versus the individual—can be achieved without loss or harm to either. One just needs to find for each member a suitable niche. There is no "redistribution of wealth" here. No one exploits any one else, not the rich soaking the poor, not the poor draining the rich. None needs to be diminished for the sake of any other.























Since there are "many ways, equally good" to reach a goal, we can sometimes discover, among the many ways, some that are outstanding for various reasons: beauty of symmetry, balance of coloration, robustness of cohesion, flexibility for change. Here is an easy puzzle that readily assembles into other patterns (with acknowledgment to Dr. Alan Schoen, the inventor of patented rhombic circle tilings):



And here is a very complex set of curvy shapes with hundreds of relational positions for each type of piece:



There is delight in such diversity and adaptability. The open-ended freedom of logically coherent groups, where more than one way is possible and viable, speaks to the deepest needs of one's being: my survival craves the assurance of many options; don't fence me in; don't run me into a *cul-de-sac*. Let the puzzle unfold in many ways, surprising in its diversity, its ability to embrace all its parts into loving union.

Gene Roddenberry (creator of *Star Trek*) had a motto: IDIC—infinite diversity from infinite combinations. He was speaking humanistically, of course. But it well describes the very process of creation.

We can create ever more complex combinations. The two tilings below combine multiple levels of conditions. The one on the left has turned pentominoes into pentarhombs, and the rhombus-shaped array is tiled so no two of the same color share edges (with only 3 colors), and no two of the same pair (left- and right-hand versions of the same shape) are the same color. This set is also solvable so that all pieces of the same color are grouped into a single region—an extremely difficult solution to find by hand. The design on the right has 24 distinct directional, chevron-shaped tiles, each composed of 4 diamonds surrounding a vertex. Each tile has a different arrangement of the 4 colors, and the overall array contains 77 *quadrants* (2x2 clusters of diamonds) such that no two quadrants have the identical color pattern.

The more complex and restrictive the conditions, the fewer options remain and are generally harder to discover. While it is theoretically interesting to explore such rarefied combinations, in the scheme of *survival* mankind should seek to keep wide safety margins of multiple options. Happiness is proportional to such freedom. Survival in and of the universe is our grandest, the ultimate puzzle. I am content—no, ecstatic—to believe humanity is one of the superstrings in the universal continuum.



Solving puzzles like the two above can be a strenuous exercise in persistence and ingenuity. And we're dealing here with not more than 24 elements! Of course, one can simply appreciate the concept of such a problem without necessarily tackling it.

And finally, there is total delight in contemplating the meta-complexity of combinations of elements, from the Big Bang to the formation of galactic clusters, galaxies, solar systems, planetary systems, and our world—that enabled life to emerge, that eventually produced the complex organism that can perceive itself as existing, as being a part of all that is.

The energy matrix that defines an individual human being is a wondrous event, and the problem-solving faculty of its brain is its crown jewel. One of its prime directives is to grow, accumulate knowledge, survive. Another is to guard and nurture, preserve and expand its kind. I call this transcendental striving: Love.