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Vehicles: Experiments in Synthetic Psychology by Valentino Braitenberg

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## BOOK REVIEWS

Kitcher's book is a valuable contribution to the philosophy of mathematics. It is gracefully and clearly written and will be informative and interesting for a wide variety of readers. By contemporary standards, it is reasonably priced. In appearance, the book is only of average quality, but it seems remarkably free of misprints.

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*VEHICLES: EXPERIMENTS IN SYNTHETIC PSYCHOLOGY.* By VALENTINO BRAITENBERG. Cambridge, Bradford Books/MIT Press, 1984. Pp. ix, 152.

The working hypothesis that the mind is the brain may set us off on the right foot, but it doesn't take us very far. The problems that then confront the would-be empirical theorist are enormous: the human brain's billions of neurons overwhelm piecemeal analysis by the biologist, and the productive variety and evanescence of the human mind's activities baffle the psychological modeler. In this elegant little gem of a book, Valentino Braitenberg, an eminent brain researcher at the University of Tübingen, proposes a method for cutting through this daunting complexity, and exhibits with delightful wit and enviable clarity the power of a strategic insight: "the law of uphill analysis and downhill invention."

As Braitenberg observes, ". . . it is much more difficult to start from the outside and try to guess internal structure just from the observation of behavior" than it is to "create little machines that do certain tricks" and then "observe the full repertoire" of their behavior. Artificial Intelligence researchers have always exploited this "law," of course, and have often been delighted or dismayed by the actual repertoire of their creations. Braitenberg's strategy is to model whole organisms rather than bits of human micro-competence (playing chess, answering questions about restaurants), and to obtain the needed oversimplification of his models by starting with comically simple, idealized organisms—"Vehicles"—and gradually adding complications and refinements, a process that fruitfully

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echoes evolution by natural selection and yields many insights into the historical and structural constraints on design-development in living things.

Braitenberg's Vehicle 1 has a single "motor" and a single "sensor" connected to the motor so that the Vehicle is propelled forward with a force proportional to the intensity of whatever its sensor is sensing. Notice that simple as the "laws of behavior" are for such a simple Vehicle, they must already be hedged by *ceteris paribus* clauses about conditions; *given* the mechanism, it is easy to say what these complications and perturbations from "normal" behavior would look like, but an exhaustive catalogue of "stimulus and response" or input-output contingencies would by itself be quite inscrutable. Vehicle 2a is two of the first Vehicles tied together side-by-side, and Vehicle 2b simply crosses the leads of the sensors, creating a temptingly biological capacity for homing behavior—Vehicle 2b turns toward higher concentrations of whatever its sensors sense and rushes towards them. Add inhibitory links, more sensors, and start fiddling with the response relations—non-linear, non-monotonic, thresholds and square waves—and pretty soon you have created in imagination Vehicles capable of astonishingly lifelike (I would say "biological" rather than "psychological") behavioral profiles. By the time we reach Vehicle 8 in the progression, a lens has been mounted in front of a bank of sensors to create an eye, and the necessity of a psychological description of the resulting competence is borne in on one with more persuasiveness than any formal argument could provide. Vehicle 14, the last in this pioneering progression, is plausibly equipped with memory, the capacity for learning, foresight, planning, "egotism and optimism." As one might imagine, covering such a huge evolutionary distance in so few steps requires a bit of handwaving in the engineering department. Some connections have to be soldered of "Ergotrix" and "Mnemotrix" wire, which has rather special—but certainly physically realizable—properties. And by the time we have reached the last few Vehicles, it is hardly obvious that they will behave just as advertised.

The harvest of this exercise in thought-experimental exploration is gloriously bountiful; deep insights and tempting hypotheses spring from almost every page. Why, for instance, are so many creatures—from fish to human beings—wonderfully sensitive to visual patterns exhibiting symmetry around a vertical axis? Try to figure out your own speculative, "ecological significance" answer before checking out Braitenberg's answer, which is too profoundly biological and satisfying to be wrong. The empirical underpinnings and inspirations for Braitenberg's speculations are well presented in a final chapter, "Biological Notes on the Vehicles," which shows the value of constraining one's armchair imaginings with solid and detailed empirical knowledge.

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These 14 Vehicles cry out for computer simulation, and just as I had resolved to spend the next year or so getting them—and dozens of cousins that occurred to me—to trundle about on the screen of my micro-computer, I learned from the publisher that Braitenberg is preparing just such software simulations, which should be available for several popular micro-computers from the publisher in the near future. At last: Dungeons and Dragons for grownups, and a completely serious method of investigating biological and psychological hypotheses at the same time.

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*TRUTH AND FALSEHOOD IN VISUAL IMAGES*. By MARK ROSKILL and DAVID CARRIER. Amherst, University of Massachusetts Press, 1983. Pp. xvi, 145. \$16.00 cloth; \$8.95 paper.

Pictures plainly enhance understanding—sharpening sensibilities, affording insights, revealing affinities, altering beliefs. They do so, according to Mark Roskill and David Carrier, because they are true or false. The authors recognize that pictures are not true in the way that 'Snow is white' is true. But they maintain that 'true' has a wider range of uses, many of which apply directly or by analogy to visual images. In *Truth and Falsehood in Visual Images*, they invoke generic concepts of truth and falsity to explain a variety of pictorial effects. They do not attempt to generate a theory of generic truth, but show how generic truth and related concepts apply to specific pictures—advertisements and photographs as well as paintings. An understanding of the network of generic concepts is supposed to emerge from an understanding of their applications. The book discusses visual truth, visual implication, and visual lying, and ends with an all too brief discussion of how to analyze visual truth and falsehood.

The issues are important, and not just to aesthetics. Roskill and Carrier ask how and what symbols can communicate, and how our views can be altered—for better or worse—by the symbols we encounter. Such questions should be central to epistemology. Although I doubt that truth is the proper medium of exchange, I am convinced of the importance of finding some conceptual currency for dealing in such issues. My reservations about the generic concepts may indeed stem from a failure to understand them. The authors eschew explication, preferring to let the examples speak for themselves. Unfortunately, the examples are often silent.