The Claims of Science

Reliable Knowledge. An Exploration of the Grounds for Belief in Science. JOHN ZIMAN. Cambridge University Press, New York, 1979. x, 198 pp., illus. $18.95.

This book is about the limits of science as a guide for society. The stated aim is to ask "how much ought we to believe of what science might tell us about man as a conscious social being" (p. 10). It concludes that social science has not achieved and cannot ever achieve the status of reliable prophet or policymaker, social engineer or therapist. However, the bulk of the volume is devoted to a characterization of the physical sciences and a defense of them against contemporary attacks on their role as principal dispenser of reliable knowledge. Ziman provides a thoughtful, articulate analysis of scientific method, arguing that, where the *physical* sciences are applicable, they "provide as reliable a guide to action as is ever to be found" (p. 158).

Though the author, a physicist, disavows expertise in philosophy, he displays ample acquaintance with that subject and, as well, with a remarkable range of other disciplines relevant to his concern. His account exhibits a more realistic understanding of what scientific knowledge is and the way it is in fact acquired than many, largely normative, descriptions found in the literature of the philosophy of science. Nonetheless, his sophisticated view of the scientific enterprise does not compel his skeptical conclusions about social science, though many who are sympathetic to his conclusion will find the arguments worthy.

Knowledge is reliable, in the sense of the essay's title, if it will serve successfully as the basis for action. Reliable knowledge must lead to correct prediction; but it must also be important, that is, relevant to a choice of action that matters. The physical sciences achieve reliability by a complex social process whereby the statements of science must be, first, consensible (potentially affirmable) and, ultimately, consensual (in fact affirmed by most qualified scientists). On these definitions, there can be scientific knowledge that is not reliable (being unimportant) and nonscientific knowledge that is important but not reliable (being nonconsensual and nonpredictive). In brief, Ziman's argument is that social science must take one or the other of these forms.

Ziman's epistemology is distinguished by the primary role it ascribes to social structure—communication, public debate, and shared concepts. Ultimately it is these "sociological conditions" of science that distinguish it from other "intellectual artefacts," such as literature, law, and religion, and that lead to its claims of maximum reliability. Qualities taken as primary in other characterizations of science, such as logical consistency, empirical verifiability, generality, objectivity, and truth, are derivative, at best.

Although the production of science is a community endeavor, it is still done by individuals, and it is the alleged unformalizable, phenomenological character of individual human abilities, notably perception, on which the argument turns. On this subject, Ziman tells the Gestalt story as well as anyone has. Scientific observers perceive not data but "patterns" that are personal and subjective to the extent that they cannot be reduced to elements but that may be consensible if others perceive patterns with equivalent content. Perception initiates the construction of science, but patterns are not science. The process of reaching a consensus among observers produces "maps" (paradigms), which are the integrated, shared form of knowledge in the scientific archive. Maps combine information from diverse sources into a coherent network that supports our confidence even when parts of it are found to be incorrect. Ultimately, maps are assimilated to "pictures" in the minds of individual scientists who adopt and reify the scientific map. Science is neither subjective nor objective but "intersubjective."

This putative process is intuitively more plausible than the simple switchboard-and-archive theory of perception and thought that is perhaps still the conventional wisdom. However, there is no sound reason to believe that the processes of knowledge acquisition it champions need remain mysteries, as is required to support the book's central thesis.

Ziman wishes to warn us against placing too much reliance on social science. However, he has a second motivation for disparaging the claims of social science. He wishes to protect the reputation of physics (and biology) from the guilt by association that he sees resulting from the social sciences' continuing failures, many of which bear superficial (by his analysis) similarity to the often emotional adversary proceedings and the nonmonotonic growth of fact and theory in physics. Though he is able to distinguish the causes of those similar symptoms, I do not think all critics will be convinced, nor do I think these difficulties are the root causes of science's credibility gap.

To distinguish physics from social science, Ziman employs his theory of consensus building. Physics yields reliable knowledge because it selects just those problems that are amenable to mathematical analysis; in particular, it defines its variables so as to make empirical statements for which the inevitable gray area between truth and falsity is minimized. Thus it is able to map the three-valued world (true-false-undecided) onto the two-valued logic required by mathematics. The deductive power of mathematics then permits deep, important conclusions to be drawn.

In social science, just as in the physical sciences, observation must be the product of human perception. However, the significant variables in this domain are motives, feelings, and values, and these cannot be read from dials or questionnaires. They must be detected by empathic humans. The "patterns" so perceived do not map the three-valued world onto two-valued logic without sacrifice. Therefore, there are no methods of deduction from these statements that can lead to deep, certain conclusions. The statements that could achieve consensus are on matters of little relevance to important action decisions, though they may be of some interest. Therefore, social science will fail, notwithstanding the successes of physics.

The force of this argument is considerably dulled by its failure to emphasize the symbiotic relation of physics and mathematics and its surprisingly narrow characterization of mathematics. To a large extent, the necessity of physical theory was the mother of mathematical invention. Ziman does not feel that this will be the case for the social sciences, and he shortchanges the discussion of methods of analysis that are more appro-

priate than the mathematics of physics for overcoming the obstacles he so ably discusses. The currently popular approach to psychology via biology also escapes comment.

Lacking reliable, scientific knowledge to guide political and social relations, what should serve? On the final pages, the author suggests that literature is best able to cut through the maze of cultural values. "The challenge to the behavioral sciences does not come from physics . . . but from the humanities" (p. 185). The traditional agents of social change—lawyers, priests, and politicians—do as well as we have reason to hope. Social science has yet to achieve sufficient literary quality to be a serious contender.

This essay is an example of literary social science at its best. Though much of it is intuitively winning, the gaps in its arguments and its ultimate lack of persuasiveness also demonstrate the limitations of this type of analysis. Its romantic conclusion about the value of the humanities as a source of social insight will be of little comfort to those who seek advice on specific policy, legislative, or judicial questions, on which literature, as a rule, stands mute or divided.

We of course should not have expected a definitive answer to the question Ziman addresses, for this requires a gratuitous conclusion about how much is ultimately beyond the human mind. The author examines and refines a viewpoint that has wide appeal among laymen and scientists alike, and much of his criticism of social science as it stands today is right on the mark. However, whatever novelty his analysis of science may possess, he does not contribute a new and winning argument but merely another vote. His doubts about the possibility of reliable social science come to rest on familiar ground: man somehow is just sufficiently competent to produce the wonders and mysteries of science and art, but not sufficiently so ever consciously to explain how he does it.

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Insects: Evolutionary Strategies

Sexual Selection and Reproductive Competition in Insects. Papers from a symposium, Washington, D.C., 1976. MURRAY S. BLUM and NANCY A. BLUM, Eds. Academic Press, New York, 1979. xii, 464 pp., illus. $23.

This volume is a collection of 13 papers that grew from a symposium organized by Daniel Otte at the 15th International Congress of Entomology. As in most such collections, the papers range widely in length, style, and quality. But they all address the question of the role of individual fitness in reproductive success, and they explore the evolution of male and female characteristics resulting from the battle within and between the sexes.

As most of the papers indicate, the behavior of an individual adult insect may be dedicated to an awesomely diverse and intricate set of strategies honed through evolution to insert the maximum number of its genes into the next generation. In this task the primary currencies are genetic and material benefits that may be won by force or deceit or through choice among displayed alternatives. Since the interests of the two sexes may be opposed, a dynamic evolutionary chase, examined in a mathematical model by G. A. Parker, is expected that will include separate male and female strategies and counterstrategies. The generalizations, given in several review papers and numerous introductions to narrower ones, are straightforward, but the details are endlessly complex and highly specific.

Most of the papers are not mathematical. Some of them deal with functional morphologies, such as those by W. G. Eberhard and by D. Otte and K. Stayman on the fighting armaments of male beetles (which have mandibles as long as the body). W. D. Hamilton discusses winglessness and lethal fighting weapons in male fig wasps, and D. K. McAlpine speculates on the possible significance of the eyestalks in a fly. Some of the papers contained in this volume suffer from poor illustrations, insufficient documentation, and redundancy. And there are other distractions. The flow in one paper is interrupted by 17 footnotes. I counted the word "may" 13 times on one randomly chosen page (p. 39) of a 53-page review. Perhaps this merely indicates a realistic attempt to be cautious while trying to cover all possible contingencies (the paper has 127 references). In any case, it emphasizes that much is a matter of interpretation, no matter what means are used to do the interpreting.

Some of the papers stand out in providing, in lucid fashion, evidence of the amazing sophistication of the sexual dirty tricks perpetrated by this prolific group of lowly organisms. For example, the paper by R. Thornhill documents the inter- and intrasexual struggle in scorpionflies. Males court females by offering them food rewards, and the females discriminate between males on the basis of the size of the prey items offered. Meanwhile the males battle each other in ball-and-chain fashion using their huge penis bulbs swung by motile abdomens. Females have nothing to lose, and much to gain, by bartering matings for food. They are willing and able to mate 15 times a day. A male, however, may lose the investment of his nuptial offering if another male mates after him and fertilizes the eggs. The male counterstrategy is to monopolize matings with a female by staying coupled with her. Long matings make the female refractory to subsequent matings (if not satiated) for several hours, allowing the initial male's sperm to fertilize the eggs rather than being pushed aside by the sperm of a subsequent male.

The paper by J. E. Lloyd also lucidly unfolds a fascinating scenario on signaling and sexual selection in luminescent beetles. It documents equally varied strategies of great apparent sophistication, making abundantly clear that messages not only are meant to communicate, they are also meant to deceive. Males have evolved signaling strategies to disrupt ongoing male-female dialogues. The painstaking research on such phenomena has also disclosed that females not only attract males of their own species to mate with, they may also mimic the flash patterns of other species to attract their males in order to eat them. I will henceforth view the spectacle of "fireflies" flashing in the night with increased awe and wonder.

In insects as well as most other animals, females, for the most part, make the greater material investment in the offspring, and they are stuck with a given genetic contribution after mating. They can afford to be (and generally are) choosy, since males are generally available. But males have nothing to lose by inseminating many females. Attracting females is not without cost, however, and nowhere is this more clearly demonstrated than in male crickets, whose calling attracts not only potential mates but also parasitic flies. The flies larviposit on the singing males and are then devoured. W. Cade neatly documents the strategy of "satellite" males that approach calling males to intercept arriving females while remaining silent, and unparasitized. J. Alcock further elaborates on the