tainly correct in stressing that the masculine character of Western science cannot be attributed to simple continuity with Antiquity (or, he might also have noted, medieval Muslim society). But in fact, the more we acknowledge that the three cultures were distinct, the more we are faced with the realization that women's exclusion from science must have some deeper cause.

This does not mean that we should revert to thinking that the "world without women" is natural. It does mean that we need a more comprehensive analysis of how the construction of gender functions in the realm of intellectual life. Why is it that the greater the percentage of women's participation in a given intellectual sphere, the more the general prestige of the sphere declines? Why is it that women's intellectual capabilities have, until recently, been so ignored and underdeveloped? To the question "what is women's education for?" most societies have answered "nothing." The most famous medieval female intellectuals—such as the playwright Hroswitha or the cosmologist, visionary, and medical writer Hildegard—were products not of the early and exceptional double (that is, "coed") monasteries that Noble praises but of that "world without men," the single-sex female nunneries. Even when women were educated, their curricula were often structured on a belief in women's lesser intellectual capabilities. When science worked its way into the curricula of the 19th-century American women's colleges, it did so largely because it was seen as a suitable substitute for the classical languages, Greek and Latin, which were the foundation of male education but which women were thought too intellectually limited to handle.

On second thought, maybe Noble's visual trick on the cover is not a *trompe l'oeil* after all. In a way, it is Dürer's original and its suggestion that there ever was a time of genuine equality between men and women that seems so odd.

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Vignette: Flights of Fancy

The content of much human consciousness does not conform to objective reality. Fear of ghosts and monsters is very basic and widespread in our species. . . . Yet when we speculate about animal thoughts, we tend to assume that they must necessarily be confined to practical down-to-earth matters, such as how to get food or escape predators. We usually suppose that animal thinking must be a simpler version of our own thinking about the animal's situation.

But there is really no reason to assume that animal thoughts are rigorously realistic. Apes and porpoises often seem playful, mischievous, and fickle, and anything but businesslike, practical, and objective. Insofar as animals think and feel, they may fear imaginary predators, imagine unrealistically delicious foods, or think about objects and events that do not actually exist in the real world around them.

—*Donald R. Griffin*, in *Animal Minds*

Mentalist Imputations

Animal Minds. DONALD R. GRIFFIN. University of Chicago Press, Chicago, 1992. x, 310 pp. $24.95.

This is an interesting and infuriating book. It is interesting because Griffin has selected the best new stories about animal cognition and has told them well. He has also made a sincere attempt to characterize evenhandedly the philosophical and theoretical minefield of animal consciousness he has so boldly entered. Griffin is a thorough scholar, a passionate writer, and one of the greatest admirers the animal kingdom has ever had. His book is also infuriating, however, because, as in his other books on the same topic (*The Question of Animal Awareness* and *Animal Thinking*), he simply does not grasp why most behavioral scientists have not joined him in making the study of animal awareness a research priority. The unfortunate result is that the tone of book is often impatient, even snide, when describing the attitude of the scientists who collected the data he presents.

The main thrust of Griffin's argument is that the legacy of strident radical behaviorism causes contemporary behavioral scientists to dismiss the idea that consciousness may exist in non-human animals. He argues that such dismissal jeopardizes our full understanding of animal behavior and cognition because conscious processes play a significant role in the functioning of all minds, human or not. In support of this claim, Griffin describes an enormous variety of fancy and flexible behaviors displayed by animals while searching for food, building nests and homes, using tools, communicating with others, or performing contrived laboratory tasks. These descriptions are accurate accounts of state-of-the-art studies in animal behavior, written at a level appropriate for advanced undergraduates and lay people with some knowledge of biology. Griffin has supplemented the more typical topics of the bee waggle dance and ape "language" with more unusual stories about beaver architecture (a full nine pages), bowerbirds (who build elaborate courtship platforms), and concept-learning in pigeons. His goal is not, however, simply to entertain and impress the reader; the intellectual stakes are considerably higher. Several times during each chapter, Griffin claims that the versatile behaviors documented for many species suggest strongly some "simple conscious thinking" and that only stubborn scientists bound by behaviorist dogma could believe otherwise.

It is, however, the legacy of the hypothetico-deductive method, not that of behaviorism, that leaves the muddy waters of animal consciousness uncharted. Each of Griffin's examples may indeed suggest conscious thinking, but none establish it. More important, Griffin is unable to specify what sort of data would support the hypothesis of animal consciousness. He indicates that studies of animal communication are likely to be most fruitful, but he does not indicate how. What questions do we ask of dolphins and crows and bees? And how do we ask them? The problem with the hypothesis of animal consciousness is not that behavioral scientists are uninterested in it or prejudiced against it. We have simply not thought of a way to test it. It is not, as Griffin claims, that students of animal behavior are unwilling to develop theories that include hypothetical constructs. There is not a widespread aversion to the idea of mentality; the entire field of animal cognition attests to that. It is in distinguishing empirically between mental events and mental experiences that we run aground. Griffin offers the alternatives of viewing animals either as genetically preprogrammed, inflexible, sleepwalking automatons or as thoughtful, emotional, rational, conscious creatures. This is a false dichotomy that unnecessarily polarizes the argument. To be without consciousness is not to

be without mental powers. Most behavioral scientists cheerfully acknowledge that many animals can integrate a great deal of information flexibly, adaptively, and rapidly; we just do not know to which, if any, of these cognitive processes the animals themselves are privy.

Griffin assumes that animals are better off being conscious, that it has advantages over sleepwalking: consciousness appears important to us, so it must confer similar benefits on non-humans. Though Griffin does acknowledge that non-conscious processes appear to be our mental workhorses, he emphasizes the contribution of awareness to human behavior. Recent evidence, however, suggests that consciousness may be something of an afterthought even in humans. For example, an electrical change ("readiness potential") measured on the scalp occurs just before a voluntary movement. Libet *et al.* (*Brain* **106**, 623 [1983]) have shown that the conscious urge to make that movement occurs some 300 milliseconds *after* the readiness potential, not before. One interpretation is that consciousness is the explanation we provide *post hoc* for a subclass of neural events.

Our subjective experience of mental causality does not necessarily reflect accurately how mental and neural events are related. And the cognitive achievements of animals described by Griffin, as complex as they are, are no fancier than what humans can do without awareness. Philosophers, who are released from the burden of designing experiments, more readily agree with Griffin on the importance of consciousness to humans. Biologists, however, will be more receptive to hypotheses about animal consciousness that specify its adaptive function, the benefits that consciousness buys animals in terms of fitness. An example would be Nicholas Humphrey's idea (*The Inner Eye*, Faber and Faber, 1986) that conscious processes allow animals to model the minds of other animals and thereby better predict behavior that is of consequence to them.

There is merit in Griffin's straightforward argument that our own phenomenology tells us that consciousness is real. Because of our knowledge of our own consciousness, we are naturally curious about which other creatures might be conscious as well. Griffin does a marvelous job of encouraging and directing that curiosity. But appealing to continuity of mental experience between humans and non-humans is not enough for a science of awareness. Methods must be devised for trapping the ghost of consciousness in a bottle. It isn't a project I'd recommend to anyone without tenure.

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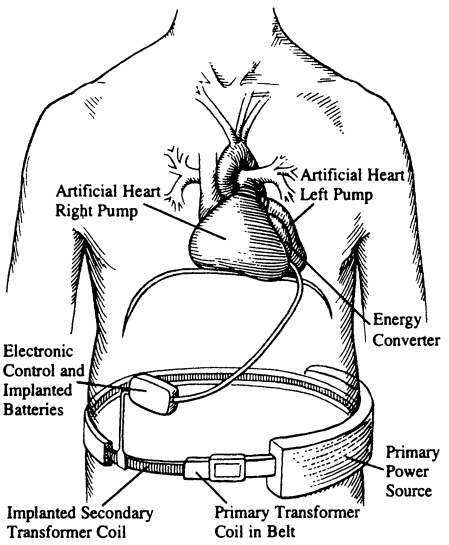
Devices and Incentives

Managing the Medical Arms Race. Public Policy and Medical Device Innovation. SUSAN BARTLETT FOOTE. University of California Press, Berkeley, 1992. xiv, 286 pp., illus. $35.

The United States spends more on medical devices—technologies that range from tongue depressors to multi-million-dollar CAT scanners—than any other industrialized nation, and the acquisition of costly and underutilized equipment has been identified as one of the drivers of escalating health care costs. At the same time, devices such as CAT scanners and pacemakers have dramatically improved the quality of life for thousands of patients, and technologies now under development promise further breakthroughs in medical practice. Grappling with the issues involved in framing public policy in the medical device industry is thus both central to the larger health care debate and a reflection of it. While on the one hand we lament the escalating costs of health care, on the other we demand open access to the latest technologies. We want our cake, but we don't want to pay for it.

Foote's book demonstrates the ways in which these incompatible demands have shaped a maze of federal policies whose full impact cannot be easily gauged. *Managing the Medical Arms Race* is a well-written introduction to the plethora of public policies that have shaped innovation in medical devices. Foote shows that public policy toward the industry has reflected the sharp divide that characterizes the current health care debate. On the one hand, the federal government—through agencies such as Medicare and Medicaid and the National Institutes of Health—has actively encouraged the development and dissemination of new techniques. On the other, regulatory policy and recent efforts to reduce reimbursement rates have sometimes severely hampered innovation.



"A fully implanted artifical heart system." [Reprinted in *Managing the Medical Arms Race* from *Artifical Heart and Assist Devices: Directions, Needs, Costs, Societal and Ethical Issues* (National Institutes of Health, 1985)]

For example, Foote suggests that through the 1960s and '70s government payment policies "promoted widespread diffusion of medical technologies regardless of cost." As one example she instances the case of kidney dialysis. In 1972 Congress amended the Social Security Act to provide for federal reimbursement for nearly all the costs of dialysis for virtually everyone with end-stage renal disease. In 1972 the program cost the government $242.5 million. By 1983 it cost Medicare $2.2 billion and supported a flourishing and profitable market in equipment such as artificial kidneys, delivery and monitoring equipment, and disposable equipment such as blood tubing and connectors.

Turning to the ways in which federal policy has restricted innovation, Foote suggests that in some cases the burden of meeting the requirements of the Food and Drug Administration may have kept innovation from the market or may have dramatically slowed its introduction. She also documents in some detail the effects of recent pressure to curb spending on Medicare and Medicaid on device innovation. In the case of cochlear implants, for example, a federal decision not to reimburse hospitals for full costs appears to have thrown the future of the industry into considerable doubt.

Foote's book is a welcome contribution to the health care debate and clearly demonstrates that there can be no easy answers to the questions it raises. Through a host of well-presented examples she shows that public policies affecting the industry have been shaped in widely differing arenas, that they have addressed quite different concerns, and that they have often had quite unexpected implications. She makes us fully aware of the complexity of health care policy and the difficulties inherent in framing a coherent response to the current crisis, and she raises a host of complex and disturbing questions that must be addressed.

The book's major weakness is its failure to provide us with a coherent framework for framing or evaluating policy. Has federal policy encouraged too much innovation? Too little? Foote shows us that some government policies clearly inhibit innovation while others encourage it—but since, as she demonstrates, inhibition is appropriate in some cases and inappropriate in others, the simple distinction between "inhibit" and "encourage" cannot be used as a guide to