

age the trust essential to the integrity of science.

What of the second thesis of Broad and Wade, that the conceit of scientists somehow renders them especially vulnerable to fraud? The weakest portions of the book are those designed to support this argument. Much here hangs on the authors' contention that scientists adhere to a myth of logic: "Researchers are imbued in their lengthy training with the notion that science is a realm of thought where logic and objectivity reign supreme." I don't think so. This is a straw man, meant to imply that scientists are unrealistic, hence easily deceived. In real life, scientists are nowhere near so breathless about their work. Instead, they are by and large very much aware of the temptation to go beyond the evidence and most of them resist it. In this regard it is curious that Broad and Wade imply that there was something reprehensible in the reluctance of scientists to embrace the theory of continental drift, despite its "intuitive plausibility," until there was "incontrovertible evidence of the sort that compelled even the blind to see." It is disconcerting to find a critical attitude toward the attachment of scientists to evidence in a book devoted to suggesting that they are too easily swayed by rhetoric and propaganda.

Perhaps the most serious error in the depiction of science in *Betrayers of the Truth* is the implication that scientists do not take into account the possibility of self-deception. This is not so. Much of the thrust of modern scientific methods is directed at this problem. As examples, the randomized controlled trial, the heavy reliance on statistical analysis, and indeed the very format of scientific reports are designed in large part to deal with the possibility of self-deception. Yet Broad and Wade represent the conventions of the scientific report—"as stylized as a sonnet"—as a sort of public relations trick "so as to give the appearance of objectivity." They favor a much freer form, one that would permit the scientist to describe "the excitement of discovery, the false leads, the hopes and disappointments, or even the path of thinking that may have led him through the various steps of his experiment." This idea conveys little understanding of the purpose of the scientific report. One reason for the impersonal format is, as Broad and Wade should know, to require the researcher to confront his or her data. In short, it is to reduce the potential for obfuscation, bias, and, I would add, tedium that would be introduced by an account of the author's agonies and ecstasies.

Broad and Wade are on their surest ground in arguing their third thesis, that the responses of the scientific community to the recent cases of fraud were inadequate. The responses varied somewhat, but in general were marked by confusion and a horror of "going public." They were also slow. In the Soman case, no attempt was made to evaluate the extent of Soman's fraud until a year after he was known to be guilty of plagiarism and accused of having fabricated data. Even where institutions and individuals dealt with fraud swiftly, they did so quietly, with the aim of removing the guilty researcher from the particular institution. There was little sense of urgency in notifying journals to which the guilty researcher had submitted manuscripts, other collaborators who might not know of the fraud, and other institutions where the investigator had worked earlier. It was almost as though the concern was more with avoiding the taint of fraud than with preventing its propagation in the scientific literature.

Broad and Wade are correct, then, in seeing the responses as inadequate. Their tone of outrage, however, is inappropriate and does not allow for the complexities and uncertainties of dealing with a situation as it unfolds, rather than in hindsight. Much of the disorganization and delay simply reflected the fact that the scientific community had never developed mechanisms for dealing with fraud. Without established procedures, individuals who are faced with the possibility of fraud in their midst are subject to a number of concerns that make it difficult to act. These include uncertainties about due process and the legal ramifications of making an accusation of fraud, as well as the desire to protect the reputation and funding of the laboratory and the institution. Furthermore, the recent cases were handled not only on an ad hoc basis but usually by people close to the guilty researcher and to the work, who were therefore subject to bias.

Because of these problems, several academic medical centers, including Harvard and Yale, have recently moved to establish uniform guidelines for dealing with accusations of fraud and assessing guilt. The Association of American Medical Colleges appointed an Ad Hoc Committee on the Maintenance of High Ethical Standards in the Conduct of Research, which issued its guidelines last year. Such efforts are important and necessary steps. We also need to examine systematically ways to modify the incentives to publish, so that the emphasis on quantity is reduced.

It would be a pity if the scientific

community allowed the misconceptions in a book such as *Betrayers of the Truth* to deflect it from the important point that we must take fraud seriously and continue our efforts to develop mechanisms for dealing with it effectively.

MARCIA ANGELL

New England Journal of Medicine,
Boston, Massachusetts 02115

Ecological Interdependences

Ant-Plant Interactions in Australia. RALF C. BUCKLEY, Ed. Junk, The Hague, 1982 (U.S. distributor, Kluwer Boston, Hingham, Mass.). x, 162 pp., illus. \$54.50. Geobotany 4.

Mutualism between ants and higher plants is a fascinating subject of coevolutionary study for myrmecologists as well as botanists. The subject can be approached from the point of plant or ant adaptation or both and includes interactions such as ant predation on seeds and leaves and mutualisms involving ant-epiphytes, extrafloral nectaries, and myrmecochory (ant dispersal of seeds). The principal theme of *Ant-Plant Interactions in Australia* is the impact of ants on plants through seed predation and seed dispersal and the role plant species play as distributional determinants and limiting resources for ants. How tightly coupled are these interactions? What are the ecological variables that have led to the evolution of ant-plant interdependence? These questions are chiefly considered within the framework of population structure and dynamics.

Much attention (seven of 11 chapters) is paid to ant-seed interactions, which are indeed significant in Australia: roughly one-third of all plant species of the dry sclerophyll flora are myrmecochores. Of particular importance and interest is the book's treatment of the relatively unknown ant fauna in arid and semiarid areas of Western Australia and their relationships with plants. The individual contributions, however, are somewhat uneven in terms of scope, breadth of discussion and implications of results, and quantitative substantiation of hypotheses. The reader at times requires more information than is given to evaluate points raised. The narrative could be tighter in some papers. A few figures are difficult to comprehend owing to a lack of information in the text or legends. Occasionally I noted a confusion of terminology or an inaccuracy, particularly in regard to ant literature.

The papers either report on specific new findings or combine reviews of prior

research and literature with presentation of new findings. The subject of one is an applied study of the effect of pesticides in deterring ant predation of aerially sown agricultural seed. This seems out of place in a volume on coevolutionary relationships. New ideas on ant-plant associations emerge from a few chapters, including the hypothesis that myrmecochory is an adaptation of plants living in poor soils. The final chapter is a worldwide review of ant-plant interactions that in quality supersedes other reviews of which I am aware. It is followed by an excellent comprehensive bibliography of literature up to and including 1981.

The value of this collection is in its synthesis of past literature and present research on ant-plant associations in Australia, North America, and South Africa. In addition, it develops in the reader an awareness of research in progress and provides easy access to the literature for those entering or interested in the field. It is a valuable companion to recent review papers on granivory in desert ecosystems and community structure in ants and a worthwhile supplement to current treatments of animal-plant coevolution.

JAMES F. A. TRANIELLO
Department of Biology,
Boston University
Boston, Massachusetts 02215

Salt Appetite

The Hunger for Salt. An Anthropological, Physiological and Medical Analysis. DEREK DENTON. Springer-Verlag, New York, 1982. xx, 650 pp., illus. \$149.80.

This book is by far the most comprehensive examination yet undertaken of the abundant and diverse literature on the appetite, or hunger, for salt. Denton's goal is to set the subject in a broad context by discussing it from both a behavioral and a biological vantage. Using this discussion as a basis, Denton then addresses the wide-ranging and at times controversial literature on the medical implications of salt intake and the etiology of hypertension. Much of the work of Denton and his colleagues is discussed in the book.

Sodium is essential for such processes as neuronal function, cellular metabolism, and blood pressure regulation. A central theme of the book is that for many mammals, particularly humans, selective pressures favored the evolution of mechanisms insuring adequate levels

of sodium. Denton cites anthropological evidence suggesting that environmental salt was scarce throughout much of primate and human evolution. He goes on to suggest that by virtue of a largely vegetarian diet (meat was rarely available) sodium intake was low relative to potassium intake and that this dietetic pattern favored the development of salt appetite and a complex endocrine system for sodium conservation. In a chapter on salt in history, Denton discusses the symbolic and social, as well as the physiological, aspects of salt.

Denton gives numerous examples of salt hunger exhibited by animals in their natural habitats and by humans in clinical studies. The salt appetite drive is aided by a recognition system in the salt taste receptors. Denton reviews the evidence that sodium deficiency, and presumably also experience, can enhance a hunger for salt. He discusses the contribution of taste to the more general problem of learning to consume foods that are nutritious and to reject those that are toxic. The rich literature on learned appetites and learned aversions illustrates the capacity of organisms to associate the taste of a substance with its gastrointestinal effects.

In addition to salt appetite, animals have efficient mechanisms for retaining salt by way of increased activity of the renin-angiotensin system and aldosterone biosynthesis in response to physiochemical changes associated with sodium regulation. A significant part of the book is devoted to research investigating these changes and the degree to which they may be causally linked with both endocrine response and salt appetite. For much of the discussion Denton draws upon his own research, in which sheep are used as a model preparation for the study of endocrine factors and sodium and water homeostasis. One of the more controversial chapters concerns the putative brain renin-angiotensin system and its possible role in sodium deficiency.

In the final chapter, on salt intake and hypertension, Denton argues that excessive salt intake throughout life is a plausible factor in the genesis of hypertension, particularly given selection pressures that favor both salt hunger and salt retention. Confronted with a high-salt environment, humans are naturally inclined to overindulge in salt but have insufficient mechanisms for excreting it. Along these lines Denton suggests that the greater incidence of hypertension among North American blacks may be the legacy of greater and more persistent stress on sodium homeostasis.

Initially, the book's length is startling given the subject matter, but the length is easily understood given the book's scope. The book contains controversial but interesting material on cannibalism, pica, and electrical brain stimulation and stream of consciousness passages that may seem peripheral to the topic but are nevertheless woven nicely into the fabric of the book. Most of the published work on salt hunger appears in review articles, book chapters, or symposium proceedings; Denton's book is the only place where all the literature is integrated in a single text. He should be applauded for his authoritative and scholarly effort.

ROBERT J. CONTRERAS
Department of Psychology,
Yale University,
New Haven, Connecticut 06520

Solar Astronomy

The Sun, Our Star. ROBERT W. NOYES. Harvard University Press, Cambridge, Mass., 1982. viii, 264 pp., illus. \$20. Harvard Books on Astronomy.

The study of the sun is, after the study of planetary motions, the oldest branch of scientific astronomy. In spite of its obvious importance as the source and sustainer of life on the earth and as a Rosetta stone for the study of other stars, the sun tends to get little or no attention in many beginning university astronomy courses and textbooks in this country. This is one reason that *The Sun, Our Star* is so welcome. It is an accurate, up-to-date review of solar research, written for the intelligent person who has a little knowledge of physics and astronomy.

The Sun, Our Star replaces the book *Our Sun* by the late Donald H. Menzel in the series Harvard Books on Astronomy. The Menzel book, first published in 1949, was a spirited description of the solar research of that era. It was a thorough review, accurate yet entertainingly written—in short, a tough act to follow. But Robert Noyes has risen to the occasion, creating a comprehensive description of the sun and of current research on its structure, its active phenomena, and its ultimate fate. The book is attractively illustrated with photographic views of the sun in its many aspects and numerous diagrams to help as Noyes leads the assiduous reader through the complexities of solar research.

The book is sprinkled with interesting asides, such as a story about a flock of homing pigeons disoriented and ulti-