The second argument involves the sophistication of Schelling's aggregation models. It is useful to compare them to a simpler unenlightening kind of aggregating, mere summation. For example, a nation's church attendance for some year is the sum of individual attendance. One might try similarly to sum personality traits into national character, as when one speaks of authoritarian government as a product of an authoritarian populace.

Schelling's individuals, however, are not just added up but participate in interactive social processes. Each can make decisions that affect the decisions of others. It is this interactive nature of individual choice that leads to phenomena that are distinctively societal. Recall the critical-mass situation in which the same distribution of micromotives can lead to either of two sharply different macrophenomena: either widespread or minimal participation. It follows that the societal outcome is not a direct simple reflection of the individuals.

Even greater structural richness can be introduced into the models by allowing individuals to differ. You may require more participants than I do before you will consider a seminar or volleyball game worthwhile. How such tastes are distributed among potential participants will determine the number and nature of possible equilibria (pp. 102–110). In "sorting and mixing" situations, people differ in race, sex, age, and other variables as well as in their willingness to reside among, talk to, and send their children to school with various distributions of others (pp. 135–191). Adding in this possibility of individual differences enhances the variety of hypothetical configurations of microproperties from which to derive important and unsuspected macroconsequences. Perhaps the most dramatic and currently relevant of these is the fact that a rather "tolerant" bunch of people can very easily and quickly end up racing to segregate themselves (pp. 147–165).

This concludes my attempt to show that Schelling confronts genuinely societal phenomena, not just simple summations of individual behavior. I now turn to his views of institutions and traditions.

Schelling's view of social institutions, like much of neoclassical economics, hinges on the notion of equilibrium. When a social system is in equilibrium, no single individual is inclined to change behavior. But a given equilibrium may be undesirable in that some other outcome may be preferred by all the participants if only they could engineer a coordinated simultaneous change. Such an equilibrium is said to be Pareto nonoptimal. A well-known example occurs in the "tragedy of the commons," in which a shared resource, specifically a grazing area, is so overused by individual maximizers that the resource is destroyed and no one gets anything. Each individual may see that the grazing area will die but no one can save it simply by withholding only his or her own cows. Group action is needed and Schelling sees that his interacting individuals are unlikely to coordinate. The model does not explain *how* an institution will arise, but it does suggest that this situation is ripe for one. Here is Schelling's comment:

> A good part of social organization . . . consists of institutional arrangements to overcome these divergences between perceived individual interest and some larger collective bargain. [The collective bargain above is for everyone to graze fewer cows so the pasture survives.] Some of it is market-oriented—ownership, contracts . . . and a variety of communications and information systems. Some have to do with government—taxes to cover public services. . . . More selective groupings—the union, the club, the neighborhood—can organize incentive systems or regulations to try to help people do what individually they wouldn't but collectively they may wish to do. Our morals can substitute for markets and regulations in getting us sometimes to do from conscience the things that in the long run we might elect to do only if assured of reciprocation [pp. 127–128].

To be sure, some institutional arrangements do help meet a collective need, but others do not, and many a clear need goes unmet. As examples, one may ask what social need is met by the political apparatus of genocide, or conversely what institution has made a dent in the incidence of child-beating. Such examples undermine the predictive value of this treatment of the genesis of institutions.

Many of these collective solutions to undesirable equilibria require some form of enforcement. The resulting bureaucracy is itself the basis of a new social process, though Schelling does not examine it. On the other hand, he seems particularly delighted when no enforcement is necessary: "though planning is often associated with control, the crucial element is often coordination" (p. 121). Such is the case with daylight saving time, for example, and to a great extent with traffic lights, cases that are suggestive of a notion of tradition. Also tradition-like, in the sense of not requiring enforcement, is the case of actions that become symbols.

> If men think that prostitutes are the only women who smoke in public and if women know it and especially if prostitutes know it, women may—or there was a time when they would—confine their smoking to indoors [p. 117].

Here a self-fulfilling prophecy underlies a behavior convention.

Thus, with creativity, social-process models can be used to address institutional and traditional phenomena, though I leave it to sociologists and anthropologists to judge how effectively. It is clear in any case that Schelling's work is a substantial contribution on some aspects of how society works. The book has two great interdependent strengths: an extensive array of ingenious social-process models, tied to a dazzling range of everyday phenomena. Together these models and applications should facilitate a rich cross-fertilization of ideas; already they provide an account of many surprising and significant relations between micromotives and macrobehavior.

HENRY HAMBURGER
School of Social Sciences, University of California, Irvine 92717

Astronomy and Other Subjects

Broca's Brain. Reflections on the Romance of Science. CARL SAGAN. Random House, New York, 1979. xiv, 328 pp., illus. $10.95.

Arms folded, casually attired, smiling as if on the Johnny Carson show, he stands in front of a Mars-like landscape and NASA spacecraft, his name superimposed in bold letters: **CARL SAGAN**. The publishers of *Book Digest* magazine knew well how to compose their cover. Two months prior to the publication of *Broca's Brain*, sections from it already were appearing there and elsewhere. Such is the impact of Sagan.

Astronomer, exobiologist, Pulitzer prize winner, raconteur, entrepreneur, Sagan has become probably the world's most famous physical scientist. Although his contributions to research have been numerous and significant, his forte lies in bridging disparate disciplines, in extracting crucial ideas, and in explaining it all to nonscientists; indeed he has an almost unique skill at persuading nonscientists that such matters are not only worth knowing but also are knowable.

The subtitle of the book, "Reflections on the Romance of Science," encapsulates its blend of accepted fact with personal conjecture. In Sagan's world the

romance is not monogamous; it is a flirtation with virtually every branch of thought and study. Science *qua* science lies at its heart, but other relationships provide zest and perspective. In the introduction, Sagan warns that, as is his wont, he has not hesitated to interject social, political, or historical remarks. If he had, this might become his last popular book. His core topics—planetary exploration, the quest for extraterrestrial intelligence, cosmic evolution—are intrinsically fascinating, but other writers address them too. Sagan's secret lies not just in subject but in insight and perspicacious linkages.

In these *Broca's Brain* abounds, but in flow it wants badly. Its five large parts and 25 chapters connect only loosely—hardly surprising given their heterogeneous origins, many having been derived or reprinted from earlier work. Nor is the volume lavishly produced—stunning color plates can be found elsewhere; ideas dominate here.

Sagan gives us a devastating debunking of several pseudoscientific theories, a fairly technical history of American astronomy, a pithy yet synoptic commentary on cosmology, a balanced encomium to science and technology, a personal critique of science fiction. But it all begins with Paul Broca, a major 19th-century neurologist and anthropologist, who founded modern brain surgery. Today, in Paris, a hundred years after his death, his bizarre Musée de l'Homme survives, with its collections of skeletons and skulls, shrunken heads and bottled fetuses, and scores of human brains—including his own. Recounting a visit to the museum, when he held the cylindrical bottle containing Broca's brain, Sagan launches chapter 1 with a jolting free association, teaching historical anthropology and brain physiology while speculating: In some sense, is "Paul Broca still there in his formalin-filled bottle? . . . Might it be possible at some future time, when neurophysiology has advanced substantially, to reconstruct the memories or insights of someone long dead?"

And so it goes. From expression of wonderment over nature's duality of complexity and knowableness to a succinct biography of Einstein, from an exposition of comparative planetary climatology to a comparison of science and theology, from contemplation of the origin of the Kaaba to musings over the end of the universe, the prose rushes forward. Topics outside Sagan's fields of formal education generally are treated philosophically or speculatively; in his areas of expertise, however, details abound.

Here, as in much of his earlier writing, Sagan ridicules chauvinism, broadly conceived; thus, solar system nomenclature should be "deprovincialized" to include recognition of other cultures and persons other than scientists, and even the use of robots to perform human functions is defensible. Sagan sees objections to the latter as a form of "speciesism," the "prejudice that there are no beings so fine, so capable, so reliable as human beings." Still, he himself cannot accept life centering on elements other than carbon, surviving in habitats other than planets, or evolving technologically in ways radically different from our own. Even though he has considered such possibilities more than anyone else, the world as we understand it simply does not seem to him to admit certain alternatives.

More than in his past books, Sagan here contemplates pseudoscience and religion. His trenchant, somewhat technical rebuttal to Velikovksy reappears here, along with an unnecessarily detailed criticism of a modern numerologist who claims to be God. Sagan's analysis of UFO's and ancient astronaut theories will not convince true believers; but for all others his evidence should be compelling.

At first his attack on pseudoscience, occupying more than a fourth of the book, seems like overkill. But this lengthy section squarely addresses seemingly mysterious topics and illogical reasoning patterns that commonly bewilder and befuddle the public. As modern astronomy, for example, has brought forth mind-boggling concepts, the esoteric yet plausible ironically has sounded increasingly like the fantastic and pseudoscientific, particularly to nonspecialists. Surely scientists have an obligation to the public that supports them to explain the differences and to share what they know of science's beauty, but too few do so. For this reason Sagan's thoughtful and articulate analysis is particularly valuable.

In contrast, Sagan's discussion of science and theology seems unsettlingly dilettantish: Either he has cut incisively through centuries of thought and reflection or he does not fully understand the issues. Many of us would agree with his piquant views, but, laconic rather than compendious in his analysis, he has trivialized a complex subject. He proceeds with tact and caution unusual for him, although it is unlikely that much of what he says will shock either scientist or theologian, especially in our post–God-is-dead era.

In defense of his "critical" remarks on pseudoscience and religion, Sagan comments that "the well-meaning contention that all ideas have equal merit seems to be little different from the disastrous contention that no ideas have any merit." Not a bad idea to remember in times of seductive egalitarianism. (Or, as Leo Szilard once said, "I'm all in favor of the democratic principle that one idiot is as good as one genius, but I draw the line when someone takes the next step and concludes that two idiots are better than one genius.")

Drollery distinguishes the memorable from the routine, and *Broca's Brain* contains the usual array of Saganisms. A sample:

- At an International Astronomical Union meeting, Moscow was officially ruled to be a state of mind.
- According to Jacob Bronowski, all the Easter Island monoliths resemble Benito Mussolini.
- "Both Barnum and H. L. Mencken are said to have made the depressing observation that no one ever lost money by underestimating the intelligence of the American public."
- Re pseudoscientists, "The fact that some geniuses were laughed at does not imply that all who are laughed at are geniuses. They laughed at Columbus, they laughed at Fulton, they laughed at the Wright brothers. But they also laughed at Bozo the Clown."

To the specialist, much of the information Sagan puts forth in the book will be familiar or seem conjectural. But even for such a reader there will be fresh insights. Sagan's ruminations raise a torrent of disturbing questions: "Are we incapable of constructing a cosmology that is not some mathematical encrypting of our own personal origins? . . . Would marsupial cosmology deduce a brief interlude of radiation in a premature Big Bang followed by a 'Second Dark,' and then a much more placid emergence into the universe we know?" Sagan suggests connections—some possibly invalid—that others have not even surmised. That is one of the virtues of the book. Responsible, creative scientists occasionally should wonder aloud, even about their discipline's social dimensions, connections with other enterprises, and future prospects.

For the nonspecialist, the book will be frustrating reading, with uneven technical detail, loose connections, and an overabundance of polysyllabic jargon. But if the reader can make it through,

this curious volume can answer old questions, raise new ones, open vistas, become unforgettable.

In short, Sagan has done it again. The book's title may be Broca's brain, but its subject is Sagan's.

RICHARD BERENDZEN
American University,
Washington, D.C. 20016

Mesoamerican Settlements

Prehistoric Coastal Adaptations. The Economy and Ecology of Maritime Middle America. Papers from a symposium, St. Louis, May 1976. BARBARA L. STARK and BARBARA VOORHIES, Eds. Academic Press, New York, 1978. xx, 316 pp., illus. $21. Studies in Archeology.

This volume is a collection of essays most of which were originally presented at a meeting of the Society for American Archeology. Its purposes are to present a sampling of the archeological and ethnohistorical research being carried out within coastal habitats of Mesoamerica; to define the nature of the coastal ecosystem as a type; and to examine the significance of coastal habitats in the overall pattern of Mesoamerican prehistory.

Ten papers bearing on these questions are presented under the headings Procurement Patterns, Settlement Patterns, and Exchange Patterns. These papers are preceded by a historical review of coastal studies and are followed by an Overview section that includes a commentary by William Sanders and a summary statement on "future research directions" by the editors.

The first goal of the volume is fulfilled through the presentation of research findings from the coastal zones of Mexico, Belize, Costa Rica, Nicaragua, and Panama. "Coastal" is considered to denote an ecotype in which most of the subsistence and technological resources of a population are derived from marine, estuarine, or lagunal sources. On this criterion the geographically diverse Mesoamerican coastal habitats are analytically comparable.

With respect to the second goal, then, the definition of coastal environments is a cultural one, and the distinction between ecology and economy is blurred. Although many papers acknowledge the importance of interaction among sociocultural, biotic, and abiotic variables, the last two are usually discussed from the viewpoint of assessing exploitable resources. Little in the discussions indicates a theoretical position from which human populations are regarded as but one component of an ecosystem, and there is no introduction to or treatment of the structure, productivity, or variability of the coastal habitat relative to ecotones or other communities. Because of the restrictions imposed by the anthropocentric view of environment, for this reader the volume falls short of defining the nature of coastal ecotypes. The volume primarily treats the economics of maritime adaptations, ranging from local consumption of subsistence products to long-distance trade of nonsubsistence goods. Investigations of biological and geomorphological processes are subsidiary, but are identified by the editors as a future research priority.

The comments and criticisms of the overview section are fruitful in synthesizing the individual studies and in fulfilling the third goal of the volume. For this reviewer, Sanders's comments generate the most provocative contributions to the overview. Rejecting arguments that attribute the settlement of coastal areas to the abundance and dependability of those habitats, Sanders suggests that early permanent settlements and ranked societies occur in coastal zones only where costly fishing and collecting can be underwritten by agricultural surpluses generated by inland groups. He hypothesizes that riverine ecosystems are more likely loci of such developments than coasts. In criticizing the analyses of settlement systems by archeologists, Sanders suggests that, aside from difficulties arising from deficient data bases, central-place models based on market principles of profit will be unsuccessful in archeological analyses because prehistoric exchanges were probably based largely on redistribution. The final theoretical point made by Sanders is that archeologists' time would be better spent studying local exchange systems than long-distance trade as a factor in sociopolitical evolution. Drawing on studies of ecological energetics, he suggests that control over production and distribution of high-consumption, general-use, low-value goods (local production) is more important to social stratification than is long-distance movement of low-consumption, restricted-use, high-value items.

The editors correctly point out that Sanders's propositions are dependent on a number of unproven assumptions. As part of their summary they expand on methodological and theoretical issues he raises, as well as bring some substantive data to bear on their assessment with respect to coastal dynamics. The value of Sanders's critique and the editors' discussion lies in the fact that both suggest questions for debate and should prompt research that transcends a focus on a single habitat or a single culture area. In this sense the volume addresses itself to a broader readership than the Mesoamerican coastal specialist.

DON S. RICE
Department of Anthropology,
University of Chicago,
Chicago, Illinois 60637

Books Received

Alcoholism. New Directions in Behavioral Research and Treatment. Proceedings of a conference, Os, Norway, Aug. 1977. Peter E. Nathan, G. Alan Marlatt, and Tor Løberg, Eds. Plenum, New York, 1978. x, 404 pp., illus. $35. NATO Conference Series III, vol. 7.

Alimentation et Travail. Nutrition and Work. Proceedings of a symposium, Nancy, France, Sept. 1977. Centre National de la Recherche Scientifique, Paris, 1978. x + pp. 205–742, illus. Paper, 96 F. *Annales de la Nutrition et de l'Alimentation*, vol. 32, No. 2–3.

Brain Mechanisms in Memory and Learning. From the Single Neuron to Man. Papers from a symposium, London, 1977. Mary A. B. Brazier, Ed. Raven, New York, 1978. xviii, 400 pp., illus. $30. International Brain Research Organization Monograph Series, vol. 4.

A Business-like Approach to COBOL. Henry Mullish. Crowell (Harper and Row), New York, 1978. xx, 346 pp., illus. $11.95.

Chemical and Biochemical Aspects of Electron-Spin Resonance Spectroscopy. Martyn Symons. Halsted (Wiley), New York, 1978. xiv, 190 pp., illus. $19.50.

Chemical Toxicology of Food. Proceedings of a symposium, Milan, June 1978. C. L. Galli, R. Paoletti, and G. Vettorazzi, Eds. Elsevier/North-Holland, New York, 1978. viii, 388 pp. $48. Developments in Toxicology and Environmental Science, vol. 3.

DNA. The Ladder of Life. Edward Frankel. McGraw-Hill, New York, ed. 2, 1979. xviii, 234 pp., illus. $8.95.

Drugs, Lipid Metabolism, and Atherosclerosis. Proceedings of a symposium, Philadelphia, Aug. 1977. David Kritchevsky, Rodolfo Paoletti, and William L. Holmes, Eds. Plenum, New York, 1978. xii, 444 pp., illus. $37.50. Advances in Experimental Medicine and Biology, vol. 109.

Electromagnetic Interactions of Hadrons. Vol. 2. A. Donnachie and G. Shaw, Eds. Plenum, New York, 1978. xvi, 574 pp., illus. $57.50. Nuclear Physics Monographs.

Electronic Measurements. Philip Kantrowitz, Gabriel Kousourou, and Lawrence Zucker. Prentice-Hall, Englewood Cliffs, N.J., 1979. xiv, 398 pp., illus. $18.95.

Enzyme-Activated Irreversible Inhibitors. Proceedings of a symposium, Strasbourg, France, July 1978. N. Seiler, M. J. Jung, and J. Koch-Weser, Eds. Elsevier/North-Holland, New York, 1978. viii, 360 pp., illus. $49.

EPH-Gestose. Übersicht und statische Studie über 2485 Schwangere mit Gestose-Zeichen. R. Barthel-Wottke and C. Goecke. Organisation Gestosis-Press, Basel, 1978. 136 pp. Paper, SFr. 20. Publication No. 13.

Growth and Development of the Full-Term and Premature Infant. Lectures from a

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