won scholarly acclaim and foundation grants. Do the prophets seek applause from the young or leadership roles in the liberation movement? Conceivably. The authors do not ask such questions except about their opponents.

Both books, Gouldner's especially, give seriously misleading histories of sociology. At no time has Parsons's theory dominated the work of sociologists as Gouldner claims. Friedrichs correctly observes that other theories and even a few prophets have flourished concurrently. The other theories, collectively, have generated much more research than has Parsons's. His theory is so intricate that it is hard to extract from it simple hypotheses amenable to statistical testing. Social system theory and statistical research methods have appealed to sociologists because they have held out the promise of scientific status for the discipline, as Friedrichs points out; but it is not always easy to wed the two. Far from being dominated by any theory, research sociologists have more often chosen good methods than theoretical significance when they could not manage both, and sometimes their research has failed to produce much understanding of social life because the data were not seen in the social context a system theory can illuminate.

As for sociological research, Gouldner ignores it and Friedrichs does not examine it systematically. Much of it has decidedly not assumed that social life is all harmony. Quite the opposite view is apparent in numerous studies of race relations and community politics, for example. Such bias as has been brought to these studies has nearly always been liberal, with discrimination unmasked and communities described as controlled by oligarchies of rich men —and this before as well as after the federal cornucopia appeared in the late 1950's. Parsons has himself analyzed social changes and conflicts, and in doing so he has not departed from his social system assumptions, which include long-run equilibrating processes rather than static equilibrium conditions at given points in time. Some of the best studies of social change have used Parsons's ideas. A theory that stresses the mutual adjustment of system parts can be helpful in pinpointing sources of change and conflict when the parts are not adjusted. Such a theory does not define conflict out of existence any more than a physical theory involving the concept of equilibrium denies that explosions happen.

A central idea in both books is that when we pin an ideological tag on a theory by calling it repressive, prophetic, or whatnot, we say something about the validity of the theory. This notion is alarming, for it would turn sociology into substandard moral philosophy with the resonating of sentiments replacing reason and observation as the basis for constructing and judging theories. Thus Friedrichs and Gouldner have attacked more than one brand of sociological theory. They have attacked the rational underpinnings of the entire discipline, without which it cannot and should not be taken seriously as an intellectual enterprise. Many young sociologists find such attacks congenial, and a few are more direct in their plans to do away with objective sociological inquiry. But they are in the minority, and most sociologists will continue to do what they and other scientists have always done, using reason to construct theories and evidence to evaluate them.

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The Energy Ethic

Environment, Power, and Society. HOWARD T. ODUM. Wiley-Interscience, New York, 1971. xii, 232 pp., illus. $9.95.

Odum's book is another attempt to remind the world how disastrously out of tune we are with nature's balance, which we injure at our peril: he feels that to restore the harmony we must understand the workings of both ecosystems and societies. To this end, he develops a grand synthesis of the principles governing ecosystems and societies, an act of courage for which he cannot be too highly praised. Odum's primary concern is energy: he shows how dependent we have become not only on solar energy, which always has fed us and "always" will, but on the coal and oil that fuel the making and running of machines which enable so few to raise food for so many and which permit the productivity supporting our affluence. He has nightmares of what will happen when the exhaustion of these fossil fuels forces us to learn from the underdeveloped peoples whose balances we have so undermined how to live on solar energy alone, but he seems more concerned about how to preserve our "life support system" if atomic power sustains our ability to exploit and derange the planet.

The result is a most maddening work, which at first sight seems totally undisciplined, a chaotic mixture of the asinine, the banal, and the brilliant, with random observations, often in conflict with the available evidence, on nearly everything under the sun. Odum writes an oppressive jargon, interspersed with elaborate circuit diagrams meant to simulate energy flows in the systems he discusses. The first half of the book seems a jeremiad against our dependence on fossil fuels; the second half hymns the complexity of the industrial society these fuels maintain, identifying as God the system of energy flows linking nature and industrial man, and articulating rules of worship for this Antichrist. But in this wealth of confusion, there are themes of very great interest indeed.

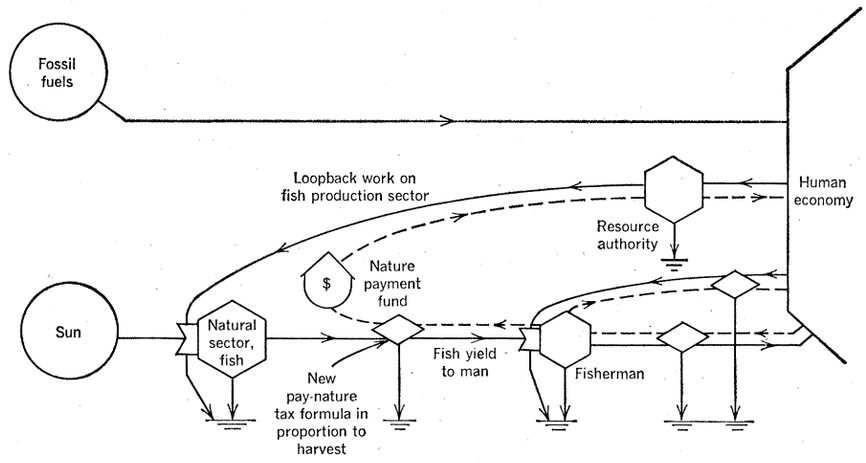
First is the theme of energy. A community evolves until there is no energy left over for a new invader to exploit. This tautology, like "the survival of the fittest," seems exceptionally useful. A mature community, then, should not leave unused energy to fossilize as coal or oil: Odum therefore claims Permian coal swamps were simple, immature systems. He is probably wrong: there are complex peat swamps in the modern tropics. His remark, however, forces us to ask why, in all this time, anaerobic bacteria have not evolved to digest peat in acid conditions. Odum extends this principle to assert that it is sinful to waste energy, for the Devil always finds mischief for idle energy to do, as in short circuits, riots by bored teen-agers, and floods of unused rainwater cascading from deforested mountains to the sea. The energetic extravagance of automobiles seems blasphemous to him.

More interesting is Odum's common philosophy of ecology and economics. Economists will no doubt associate it with an old and honorable school of thought, which I am too ignorant to name; ecologists may find his attitude

less familiar and more interesting. He views an ecosystem, like an ideal society, as a symbiosis. To make a living, Odum's man must form a "reward loop" in society's network: that is, he must stimulate his surroundings to supply his needs, either by seeding and weeding the soil that it may grow his daily bread, or by robbing, or by doing things that earn recompense. To survive, society must reward beneficial occupations and punish robbery and other harmful practices: presumably, "group selection" favors the most perfectly symbiotic societies. Odum would extend this story to ecosystems: a species must do something to its surroundings to eat, and if its doings hurt the community something will happen to eliminate it. Present communities are the result of long evolution: they must have evolved suitable checks and balances against harmful invaders to survive so long. But Odum is characteristically vague as to the origin of this property. Sometimes he seems to be thinking of group selection, but elsewhere he remarks that if one seeds a lake with a sufficient array of lacustrine organisms of no matter how diverse origin a community will rapidly evolve which uses enough of the available energy to exclude invaders: it is as if a selection between species were responsible for the harmony of communities, for their remarkable powers of "self-design" and "self-regulation."

This philosophy buttresses Odum's deeply rooted faith in capitalism, at least in capitalisms disciplined by a proper morality and policed by a decent government. Most ecologists and economists would see as their common ground their reliance on competition, either actual or potential, as a discipline for community structure. Odum would not disagree, but he prefers to stress the incentives capitalism gives for useful work. This attitude forces him to disapprove giving people something for nothing, as in ordinary welfare: this is not selfishness, as he insists on our helping other peoples and other countries to help themselves, even at risk to our national security. He accordingly ranks with those who would modify "the System" rather than destroy it. One reform he seeks is to "internalize" industrial costs, to make industrialists pay the true cost of the energy they use and what "unavoidable" pollution they cause; not the least of his achievements is providing a reasonably objective scale for evaluating these costs.

Is Odum right to consider a community an organism whose parts all work to a common purpose? He seems to suggest that selection between communities favors the most harmonious ones, but communities are rarely distinguishable individuals, nor have they a "reproduction" allowing a natural selection to operate. How, then, could communities get that way?



"Economic device to arrange proportional service payments to nature for its service to man in order to maintain loop reinforcement of man and his yielding systems."

The striking tendency of unused energy to find a consumer controls blatant disharmony. It is a poor evolutionary strategy to play dog in the manger: a species that depends on poisoning competitors that could exploit its resources better is bound to be replaced eventually. Positive harmony emerges from the circumstance that species take advan-

Two "associations which have monolithic structure and senescence." "We are used to the idea in urban renewal that some continuous building structures are more cheaply replaced than repaired. An example in a simpler ecosystem is the senescence of barnacle associations illustrated [above]. When old and top-heavy they break off or are broken off by animals that serve an urban-renewal role in the animal city. New growth and succession refills the gaps. Senescence apparently only occurs in those physically attached units of such complexity that the cost of disengaging parts for replacement becomes too high." [From *Environment, Power, and Society*]

tage of any part of their environment they can: a plant will happily feed a butterfly for carrying pollen even if its caterpillar is a most voracious pest. Odum speaks of herbivores' rewarding the plants they eat by fertilizing them; maybe selection favors animals with the most usable manure. Others (*1*) have spoken of protozoans, who must multiply quickly before their unavoidable replacement, as benefiting from the metabolites of other protozoans: apparently these interactions have evolved into a symbiotic pattern where the occupant of each niche secretes a metabolite essential to the others. The pattern spreads because invaders succeed which can take advantage of the symbiosis in such communities. I was a little more surprised when Odum spoke of herbivores' concentrating food in packages convenient for other animals to eat; what about elephants, which are specially selected to avoid predation? Odum would no doubt reply that even mammoths and whales found a predator to whom they were quite convenient; unused energy always does.

What have ecological communities to tell us of morality and religion? A Taoist (*2*) wrote:

> If you indeed want the men of the world not to lose the qualities that are natural to them, you had best study how it is that Heaven and Earth maintain their eternal course, . . . the birds and beasts their flocks, the trees and shrubs their station. Thus you too shall learn to guide your steps by Inward Power, to follow the course the Way of Nature sets.

Nature is full of lessons on the benefits of avoiding unneeded disequilibrium. Microorganisms (*3*) possess forms of drops and splashes, not because surface tension formed them, but because such equilibrium forms avoid unnecessary stress. Likewise, overreliance on poisoning competitors rather than outcompeting them is a shortsighted strategy, a "crime that does not pay." I am not sure, though, that ecology gets us far beyond the "silver rule": do not unto others as you would not have them do unto you. Real cooperation between species seems too opportunistic, and poisons too frequent, to say more.

In population genetics, one encounters "selfish genes" (*4*) which spread by biasing the meiosis of heterozygotes in their favor (meiotic drive or segregation distortion). Most such genes are harmful to the population: on chromosomes other than the distorter's, selection favors modifiers suppressing the distortion. The transmission rules of genetics are thus *selected* as "rules of fair play." At loci close to the distorter, however, selection may favor "riding the distorter's coattails": organisms with too few chromosomes, like parliaments with too few members, may be easy to subvert. Only with sufficiently loose linkage or numerous chromosomes or both is there a reasonable chance that selection will favor the good of the species.

Likewise, decent rules of conduct, which Odum would prefer to see grounded in religion, are necessary to society's survival. Odum uses his understanding of communities to explicitly construct a morality and religion. To quote his summary of the subject:

> The key program of a surviving pattern of nature and man is a subsystem of religious teaching which follows the laws of the energy ethic. . . . We can teach the energy truths through general science in the schools and teach the love of system and its requirements of us in the changing churches. System survival makes right and the energy commandments guide the system to survival.

I find the construction of a God for reasons of state singularly unpleasant: a belief in a God we ourselves made, as opposed to the One who made us, seems to me to lack point, and this particular Antichrist seems to me a superb vehicle for a rather nasty tyranny. Odum's morality, on the other hand, is well worthy of study. I don't doubt that ecology groups will be publicizing some of his "commandments."

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Pollution Economics

Environmental Side Effects of Rising Industrial Output. ALFRED J. VAN TASSEL, Ed. Heath Lexington, Lexington, Mass., 1970. xxiv, 550 pp., illus. $19.50.

This is a collection of essays appraising pollution problems in the United States as of 30 years hence from an economic point of view. Each essay was written by a graduate student in a research seminar in the School of Business at Hofstra University, under the direction of A. J. Van Tassel. Each addresses a different problem—industrial water, population growth, electric power, pesticides, and so on. The authors undertake the large and difficult task of estimating current pollution coefficients —ratios of pollution to economic output—in various sectors and technologies and of forecasting how these might change. These coefficients are then multiplied by the economic activity levels that Resources for the Future has projected for the year 2000 (H. H. Landsberg, L. L. Fischman, and J. L. Fisher, *Resources in America's Future*, 1963). In this way estimates of pollution flows for that year are generated.

Van Tassel in the concluding essay judges that there is likely to be an increase in pollution, which may be held within tolerable limits by technological changes and legislative restrictions. However, "if the projected quadrupling of gross national product between 1960 and 2000 has validity, the battle promises to be a hard one" (p. 431), and he opts (p. 450) for a reduced rate of economic growth.

The flow model implicit in the book is approximately as follows: The economy in its several sectors in year t utilizes its capital stock, labor force, technology, institutions, and environmental resources in production activities as in the chart on the next page. The writers see the volume of bads as primarily dependent upon three variables: volume of annual production, technology, and institutions. The model is a sensible analytical statement at a gross level, and the authors correctly imply that feedbacks from the obnoxious bads cause technology and institutions to change. They give little attention, however, to the political and economic processes by which this occurs; and without such analysis how can they judge whether or not the response to the pollution feedback—the dotted lines in the chart—will overcome the tendency for the annual rate of pollution to increase? Is it purely chance whether new legislation occurs in $t + 1$? How much will it depend upon odors, or Ralph Nader, or economic and health damage, or crusades by scientists? As the annual pollution feedback tends to become larger each year, year after year, does society become acclimated and less sensitive, or does it become militant? What roles