ment and Soviet need to curtail hard-currency energy sales will force the Soviets to retrench, moving toward energy autarky.

True, the political atmosphere that shapes the willingness of Western countries to permit their companies to become involved in facilitating Soviet energy projects is worsening. Yet two opposing tendencies militate against a Soviet drift toward autarky. First, the interest of the United States in keeping the Soviet Union on the world market as a supplier of oil and gas and off the world market as a consumer of those commodities may outweigh the political impulse to let the Soviet energy economy stew in its own juice. Precisely this consideration led President Carter to free over 50 energy-related export licenses from embargo by the U.S. government in January 1979.

Second, soon after the coming change in top leadership in the U.S.S.R., an entire generational turnover will cascade through the levels of the Soviet economy. If one quality is clearly visible among the new elite, it is dissatisfaction with the Brezhnev tendency to widen the gap between official rhetoric and practical solutions to problems. A sharpening of the alternative paths for the Soviet economy, of which energy is perhaps the most essential segment, is liable to occur in the jockeying for position accompanying the leadership change. Which tendency will prevail is impossible to predict, but all of the participants in the debate will have operated during most of their careers during an era of growing Soviet interdependence with Western economies that has been largely beneficial for Soviet development.

GLORIA DUFFY
Carnegie Endowment for International Peace, Washington, D.C. 20036

Regarding Technology

The History and Philosophy of Technology. GEORGE BUGLIARELLO and DEAN B. DONER, Eds. University of Illinois Press, Urbana, 1979. xxxii, 384 pp. $17.50.

The 24 papers in this collection come from a wide variety of disciplinary backgrounds and interests and collectively reveal a rich array of unexplored avenues in the history and philosophy of technology. Papers by N. Rosenberg, L. Mitcham, D. Wojick, M. Bunge, H. Burstyn, and H. Skolimowski are especially thought-provoking. In the following paragraphs I will try to address some of the central themes in the book, without dwelling on individual essays.

There seems to be general agreement among the contributors that technology is part of culture and that it should not be identified with applied science. On the latter score a distinction is drawn by D. S. Cardwell between "empirical" and "science-based" invention (p. 5). When it comes to applying this distinction in particular cases, however, it can be difficult to maintain, for it is not easy to say when plain empiricism leaves off and science begins, and some technological devices—for example the compass and Watt's heat engine—can be seen as examples of applied science.

Granted that technology is a part of culture, opinions differ as to whether it is "an adaptive strategy, a strategy not only for survival but also for growth and elaboration" (p. 135). Some authors think that at its current state of development technology is largely a cultural aberration practically in the same class as poverty or crime. Many objections are leveled against it. For example, it is claimed that technology is based mainly on "quantitative instrumental values" (p. 332), involves a limited notion of rationality (p. 329) and a limited metaphysics (p. 330), values only material goods and survival (pp. 301-305), destroys the value of human beings (p. 368), destroys humans' views of themselves (pp. 288, 295, 301), creates practically unmanageable interaction among people and other systems (pp. 91-95, 105), follows a technological imperative that seeks "standardization, systematization, concentration, homogenization, perhaps ultimately sterilization" (p. 306), generates a practically unmanageable rate of change (pp. 344-345), and provides the possibility of profound changes far out of proportion to any efforts required to produce the changes (p. 236).

Only a fool would deny some of these charges, at least some versions of some of them. But some of them are pretty plainly false, some are based on different views of what constitutes a good life for individuals and the human race generally, and some are based on different views about key concepts and their definitions. For example, Skolimowski is worried about the consequences of thinking about efficient means to ends that are hardly thought about at all. He is also worried, as are Wojick and Rosenberg, about what Daniel Yankelovich called "McNamara's fallacy," that of ignoring whatever cannot be quantified or measured. We ought to worry about such errors and actively resist them, but one should distinguish these pursuits from objections to technology. The errors are liable to be committed in the course of virtually any activity, whether related to technology or not. A more efficient strategy for preventing such errors would be to object not to technology but to the errors themselves. I used the word "efficient" on purpose because it is a familiar word and in the present context is a very efficient means to making more than one point. In a world of scarce resources, efficiency is laudable.

When people talk about instrumental values, they usually contrast them with intrinsic values. There are many reasons why some thinkers want to postulate these two kinds of values, but none of them are very good reasons. Usually it seems to be held that if there are no intrinsic values then finally nothing is really valuable because at best everything is only instrumentally valuable for getting something else. Those who take this view may be found also holding the view that there must be some unshakable basic truths about the world on which all knowledge finally rests, or else nothing can be known to be true. Such folks are haunted by the specter of infinite regresses, circular reasoning, and arbitrary decisions. However, many years ago Hans Reichenbach suggested that one might think of revisions in systems of knowledge as similar to repairing a ship at sea. One fixes this or that without tearing down the whole structure and sinking it in the process. Just as there need be no single plank on which the integrity of the whole ship rests, there need be no single truth or evaluation, screened from critical examination, on which one's values or knowledge rests. So whether one opts for a single sort of value or rationality is irrelevant to whether one makes errors of pursuing ends without thinking about them or neglects important things like love and friendship because they can't be measured.

Consider also the claim that technology destroys our view of humanity, say, by molding people in accordance with a technological imperative. First, it is not obvious that there has ever been a human being without any technology. Second, people do express themselves through some technology; remember musicians, painters, and sculptors as well as all the little things one fabricates to personalize one's world. Third, some people see the good life not as meshing with nature, with whatever consequences that has (some species have meshed right out of existence doing what comes naturally), but as managing nature (including our own baser natures) in the interests of humanly chosen goals. Of course it is possible to destroy one's view of humanity by overindulging technology, but it is also possible to get the same result by overindulging religion, sex, art, business, sports, or virtually anything else. The main threat is not in our machines but in ourselves, almost always first in ourselves.

Although questions of ethics and social philosophy have tended to dominate studies of the philosophy of technology, this collection of essays shows that the full range of metaphysical, epistemological, and axiological questions arises quite naturally in connection with technology. Bunge is the premier contemporary system builder in philosophy, and it was to be expected that in his contribution he would systematically explore technology by way of the classical philosophical categories. I suspect, however, that a definition of metaphysics would have been useful here, for example, that metaphysical claims are synthetic a priori claims or claims about the world whose tests of truth are not dependent upon observation. On such a definition, claims like "With the help of technology man can alter certain natural processes in a deliberate and planned fashion" would not be metaphysical, contrary to Bunge's claim (p. 271). Bunge's views about pure science and technology are such that mission-oriented science becomes identified with technology. His idea of having two ethical codes, one "individual" and one "social," seems to entail the moral respectability of ethical egoism, which I imagine he dislikes as much as I do.

P. Caws draws instructive parallels between praxiology and epistemology, and Wojick skillfully compares disputes about evaluative policy with Kuhnian-type paradigm disputes. Mitcham's discussion of the etymology of "techne" and "technology" is superb.

In a helpful introductory essay, M. Kranzberg notes that he wishes the volume contained a paper written from a cliometric (quantitative historical) point of view. It seems to me that a healthy dose of American pragmatism with its naturalistic view of value would have been instructive. Modesty probably should, but doesn't, prevent me from suggesting that my *Foundations of Decision-Making* (Canadian Library of Philosophy, Ottawa, 1978) provides a pragmatic, cost-benefit approach to solution of some of the problems raised by these authors.

ALEX C. MICHALOS
Social Indicators Research Program, University of Guelph, Guelph, Ontario N1G 2W1, Canada

Ecological Classification

Plant Strategies and Vegetation Processes. J. P. GRIME. Wiley, New York, 1979. xii, 222 pp., illus. + plates. $28.95.

This book is an attempt to classify plant species on the basis of their ecological role or function. The task is particularly difficult with green plants, since they all consume the same basic resources (light, CO_2, and minerals) and produce the same basic metabolites. Consequently ecological classifications have to take into account the ways in which a plant gathers resources and interacts with other plants and with herbivorous animals. Traditional classifications have been based on, for example, morphological traits (herbs, shrubs, trees, vines, and so on) or form and function (hydrophytes, mesophytes, xerophytes, and so on) or the position of the perennating bud (the well-known Raunkiaer classification). None of these schemes, although they are useful, can be said to be entirely satisfactory. What is needed is a simple classification that is universal and is based on a theory that predicts the ecological forms given some independent environmental variables.

One of the big problems in arriving at a satisfactory ecological classification of plants is their great plasticity. For example, a species may develop into a small tree in one environment and into a large shrub in another or be an annual in one and a biennial or even longer-lived in another. To avoid this problem, the concept of "strategy" has been introduced. A strategy is defined in the present book as "groupings of similar or analogous genetic characteristics which recur widely among species or populations and cause them to exhibit similarities in ecology." By working with the genetic potentials of a species, rather than the expressed phenotype, the problem of plasticity is bypassed. Unfortunately, it is specific phenotypes, and not genetic characteristics, that are responsible for the ecological properties of plants. Furthermore, the inference of phenotypic characteristics from genotypes and vice versa is not operationally possible at present.

The theoretical basis for the classification proposed by Grime is very simple and is based on two supposedly independent environmental variables: stress, defined as "phenomena that restrict photosynthetic production," and disturbance, "the partial or total destruction of the plant biomass." On the basis of these two variables, four basic environments and strategies are identified: Environments with high stress and high disturbance are so inhospitable that no plants can grow there. In environments with high stress and low disturbance, such as deserts or the arctic tundra, the successful strategist is the stress-tolerant, that is, a plant type that is able to survive with low resource levels. In environments with low stress and high disturbance, such as agricultural fields, the successful strategist is the ruderal, that is, a plant type capable of quick regeneration because of either copious seed production or asexual vegetative reproduction. In environments with low stress and low disturbance, there will result a dense cover of plants competing for the abundant resources, and the successful strategist is the competitor, a plant type that allows the efficient harvesting and utilization of these resources. Since there are environments with intermediate degrees of disturbance and resource abundance, some additional, intermediate strategists are described: stress-tolerant ruderal, stress-tolerant competitor, competitive ruderal, and a kind of general intermediate type, the competitive-ruderal–stress-tolerant type.

The bulk of the book is devoted to a description of the phenotypic characteristics associated with the various strategies. Nowhere is information presented regarding the pattern of inheritance. Of particular interest is the treatment of growth as an adaptive characteristic. Another interesting aspect of the book is the separate description of the characteristics of the adult plant, called the established phase, and of those of the seedling, called the regenerative phase. This part of the book is the most interesting and contains well-documented data.

The book suffers in this reviewer's opinion from two major defects, which put the validity of Grime's classification in doubt. The first defect is in the definition of and the assumed independence of the two environmental factors that are supposed to drive the system. What Grime has done is to revive under different terminology the old issue of density-dependent and density-independent mortality. What he calls disturbance is classically associated with density-independent mortality, and resource abundance is usually associated with density-dependent mortality. As has been repeatedly shown, these two sources of mortality cannot always be identified, nor are they truly independent. For example, a nine-month drought in Arizona is seen by a plant as part of that environment's harshness and leads to what is defined as density-dependent mortality, while nine months of drought in New England would be a source of severe