ance that civil nuclear power will not be diverted to nuclear weaponry and that its materials will not be stolen by terrorists. Each book looks more to diplomats and politicians than to scientists and engineers to persevere in the search for nonproliferation.

Each book is well written, reads well, and includes a welcome abundance of useful documents in its appendixes. Each should have a long, useful life.

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A Schema of Science

The Intellectual and Social Organization of the Sciences. RICHARD WHITLEY. Clarendon (Oxford University Press), New York, 1985. x, 319 pp. $34.95.

Max Weber prophesied that bureaucracy would pervade social life. Whitley's essay shows, among other things, the bureaucratization of science. The book develops the most systematic analysis yet seen of differences and similarities in the social organization of scientific fields in the mid-20th century, the high-water mark of university-based disciplinary control of scientific work. The final chapter analyzes changes that have set in since World War II, with centralized government funding weakening old university-colleague fiefdoms. The changes are fragmenting disciplines theoretically while homogenizing them methodologically and administratively. A Big-Science physics administrative model is increasingly imposed on research, and other fields imitate the methods of physics. In short, we see bureaucratic rationalization and centralization in science.

Whitley argues convincingly that there is more than one logic of inquiry in science. How scientists work and the kinds of knowledge they create are "contingent upon the social conditions of . . . production and assessment" of knowledge. Differently organized fields develop differently organized knowledge. Most writers have missed this point because they have taken physics as a model of all science. (An exception is Randall Collins, to whose *Conflict Sociology* [Academic Press, New York, 1975] Whitley acknowledges a substantial debt.)

To Whitley, systems of scientists' reputations are the core organizing mechanisms of science. Within fields, scientists compete for recognition—not just as a reward, but to validate claims on future funding. Research is reputed valuable to the extent that it helps others in its field do their work. This has implications. One must not stray too far from the customary ruts, or one's work will not feed into the work of others. Thus the quest for reputations produces a control system that inhibits deviant views and radical innovations. During the 19th and early 20th centuries, reputational systems became solidified in university disciplines.

Sciences differ with respect to two kinds of dependence among researchers. "Functional dependence" grows in tandem with standardized skills and narrowly specialized research topics, which facilitate borrowing of ideas and procedures, as in chemistry and physics. "Strategic dependence" is the extent to which others must be persuaded of the significance of one's work. It is high in fields such as physics and economics, where significance is judged by reference to a systematized theoretical core, and low in less theoretically coherent fields such as chemistry and sociology.

Sciences also differ with respect to two kinds of "task uncertainty." "Technical task uncertainty" has to do with the replicability of procedures and the unambiguity with which results are interpretable. Technical task uncertainty tends to be low in most natural sciences and to be high if lay audiences can influence problem formulation and competence standards, as they can in social sciences and ecology. "Strategic task uncertainty" refers to the extent to which clear intellectual priorities to guide choice of problems and assessment of significance of results are lacking—being low in physics and chemistry and high in biomedical research. Strategic task uncertainty tends to be high when there is a variety of funding agencies and no single prestige hierarchy dominates a field.

From these bare definitions and brief examples, Whitley's concepts seem to overlap. High functional dependence seems a lot like low technical task uncertainty. High strategic dependence resembles low strategic task uncertainty. The distinctions become clearer, mainly by illustration, when Whitley elaborates the analysis in a typology that cross-classifies the two aspects of dependence with the two aspects of uncertainty, each aspect being dichotomized as high or low. Of the 16 possibilities thus generated, seven are empirically stable. These seven are discussed at length by Whitley. The general idea is that the more standardized the techniques and the more monolithic the system of evaluation, the more a unified reputational system controls a field.

Whitley uses the same concepts to analyze the pecking order of fields. When there is functional dependence between fields, one that borrows ideas or techniques from others "may have few distinctive characteristics so that its boundaries and identity become threatened." For example, the old biological disciplines have lost much of their distinctive status because they have adopted procedures from chemistry and physics. When problems are coordinated across fields, as many recently have been, the transfer of ideas is usually one-way. Strategies of high-ranked fields penetrate fields whose theories are seen as less fundamental. A result may be unequal impacts of fields on funders, who take their cues from the most prestigious fields. This process affects styles of research more than it affects the division of money among fields, which is strongly influenced by political concerns such as the desire to cure diseases or reduce crime. Lower-ranking fields are funded, but biologists and sociologists may have to imitate physicists to get the money.

Whitley traces changes that began after World War II and are still continuing, and he locates their processes within his analytical scheme. Disciplines as defined by university departments have lost much of their grip on reputational control, and in biomedical science the disciplines have ceased even to coincide with major fields of research. With government funding of an increasingly hierarchical set of interconnected fields, "fundamental differences between types of knowledge and ways of producing them are neglected in favour of . . . standardization of research skills." The big-project administrative model, which arose in physics because of the immense cost of equipment in that field, has been inappropriately imposed on other fields because of the prestige of physics. (Chemistry, a small-project field that ranks just below physics, has been spared this fate. Whitley tells us why.)

The book keeps repeating itself. It uses too many big words where small ones would do. The distinctions between its concepts are often fuzzy. Its discussions of factors associated with differing organizations of fields generally describe rather than explain: it is not always obvious what is cause, what is effect, and what is tautology. When causal chains are made clear, most of them have originated in social trends or happenstance events that are outside the scope of the analysis. The elaborate typology of scientific organization is a cumbersome analytical apparatus.

Despite these flaws, the book is a major contribution. Whitley has identified social-structural factors that interact in complex ways to determine how scientists behave. If sociologists of science give the book the attention it deserves, it will be a gold mine of research ideas. Even in its present typological form, the analysis makes us notice many big and little questions. Why are chemistry and physics organized in radically different ways? Why are economists, the theoretical elegance of whose field rivals that of physics, so disdainful of facts? Why are research administrators more influential in biomedical science than in physics? Why are journal articles so short in chemistry and so long in sociology? (This last is not just a matter of scientific versus humanistic trappings; the more precise and mathematical sociology becomes, the heftier its articles grow.) The book abounds with such questions and answers some of them.

When researchers pursue Whitley's leads, they assuredly will prove him wrong about this and that detail. But nobody henceforth will have an excuse to generalize from an idealized model of "science" to its diverse fields without taking account of the kinds of socially rooted differences he shows between sciences.

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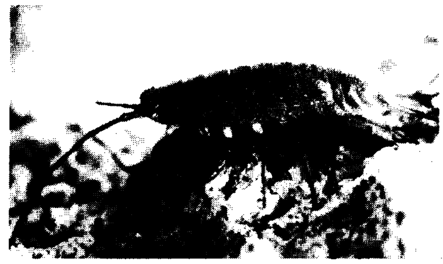
Land-Dwelling Crustaceans

The Biology of Terrestrial Isopods. S. L. SUTTON and D. M. HOLDICH, Eds. Published for the Zoological Society of London by Clarendon (Oxford University Press), New York, 1984. xxvi, 518 pp., illus. $55. Symposia of the Zoological Society of London, no. 53 (July 1983).

In 1893 the Reverend Thomas R. R. Stebbing of Worcester College, Oxford, remarked in his treatise *A History of Crustacea*:

> The Isopoda form a vast and widely distributed army. They are all of retiring habits, never needlessly courting attention, and they have never tempted mankind to search for them as food. Amidst this prudent love of obscurity, the services which they doubtless often render as effective scavengers are in some measure counterbalanced by the damage which some of them inflict on submarine structures and the depredations committed by others on the fruits of the garden. In proportion to their importance in the economy of the world, the Isopoda have hitherto attracted little of popular notice.



A terrestrial isopod, genus *Ligia*.

Although there are thousands more species of isopods known to science now than in Stebbing's time, these crustaceans remain relatively obscure to most biologists. About 4500 species have been described, and at least as many more, particularly from the tropics, await description. Almost half the described species are terrestrial, inhabiting a wide range of environments at all latitudes. Many species inhabit xeric environments, and one (*Hemilepistus reaumuri*) is even a dominant animal of North African desert habitats. Terrestrial isopods (pill bugs, sowbugs, and woodlice) are the only crustaceans to have entirely abandoned the aquatic world, and as such they have attracted the attention of some ecologists and evolutionary biologists. *The Biology of Terrestrial Isopods* reports and reviews recent research on these isopods and will be of interest to a wide range of ecologists and physiologists.

Prior to 1950 few biologists worked on terrestrial isopods; today several dozen study them. Most of these biologists are represented in this volume, which comprises 26 papers by 41 contributors, 13 of whom are North Americans. The coverage has been restricted to physiology, ecology, and behavior, and matters of systematics, evolution, and biogeography are not considered; in particular the possibility that the terrestrial isopods are an artificial (polyphyletic) group is not addressed. The contributors have a perhaps unwarranted tendency to extrapolate results for a few genera to all terrestrial isopods.

The book is divided into two sections, Structure and Physiology and Population Biology. Most of the papers fall within the realm of physiological ecology, however, and this is clearly the emphasis of most contemporary research on terrestrial isopods. The editors have ensured that each paper is well focused and includes an abstract or summary. Virtually all the papers are informative and well written, and a few are especially notable.

The contribution by M. R. Warburg *et al.* is especially important in updating Eric Edney's work on effects of climate on oniscidean distribution and abundance. R. G. Chiang and C. G. H. Steel generate a model for using isopods to investigate arthropod hormonal systems. Their work is supported by Y. Katakura's study documenting the role of androgenic gland hormones in regulating sex differentiation. The importance of terrestrial isopods as monitors of pollution is evinced by S. P. Hopkin and M. H. Martin's study identifying heavy metals from the digestive ceca of woodlice at concentrations higher than have been recorded from soft tissue of any other terrestrial animal. W. Wieser presents a succinct, thorough review of physiological attributes that have contributed to the success of terrestrial isopods, and H. Schmalfuss illuminates the morphological-behavioral adaptations of the group. Several field-oriented studies are reported, including a review by Sutton *et al.* of population biology in seven species of woodlice in which the hypothesis of *r*- and *K*-selection is found inadequate to explain observed life history patterns. In a somewhat related study, N. Takeda establishes a strong case for pheromone-based aggregation behavior in oniscideans and its role in water conservation and growth.

Other topics covered in the volume include the role of the gut in osmoregulation, neuroendocrinology, cuticular transpiration, fine structure of pleopod lamellae, marsupial structure and organization, function of the digestive ceca, hemolymph pressure studies ("hemodynamics"), diseases of isopods, feeding and digestive biology, and ecology and behavior of desert and tropical isopods.

This book contains a wealth of information. Perhaps most important of all, it demonstrates the suitability of isopods as experimental subjects for studies of population biology, endocrine biology, physiological ecology, invertebrate social behavior, and numerous other biological topics. As J. Cloudsley-Thompson notes in the introduction, "Woodlice neither bite nor sting, and they are easy to rear and maintain in captivity."

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