that at inception was to have been about the interactions of pions and nucleons, but grew in the making to cover all of high energy physics in the 1960's. Horn and Zachariasen present a lecture-note review of the main experimental facts of very high energy interactions, the phenomenological framework for their interpretation, and the underlying theoretical ideas on which that framework is based.

A monograph is usually not a textbook. It presents the author's view of the subject, broad and authoritative perhaps, but invariably stressing the things that he knows best. Lindenbaum's book reflects his original intent and inclination. The research areas to which he was closest are treated with lavish care. Others receive short shrift. Only 74 pages are devoted to weak interactions and only 10 to electromagnetic interactions. Symmetry classifications and dispersion relations are the two theoretical topics given most extensive coverage. The 60 pages on dispersion relations reflect the zeal of a relatively late convert. Regge pole theory is cataloged, but suffers from the muddle of daughters and constraint equations that were topical in the late '60's. An abundance of data is presented, mostly in graphs with an occasional diagram of an experimental set-up. This mode of presentation properly gives the impression that high energy physics is predominantly an experimental science. Brilliant theoretical strokes have been accomplished from time to time, but much remains unexplained. Lindenbaum's book shows where much of the field was in 1970. It is traditional to commend the Oxford University Press on the handsomeness of its products. Certainly, Lindenbaum's book keeps alive the reputation. But it is regrettable that names are randomly misspelled, Vietnamese physicists are cut in two, and occasional figures are misattributed.

Horn and Zachariasen focus on total cross sections, elastic scattering, and single-particle inclusive spectra at very high energies, things that every graduate student knows are intimately related to unitarity (conservation of probability) in two-particle and three-particle collisions. They define the current jargon, survey the data by means of exemplary figures, and discuss the basic theoretical framework in the first 150 pages. As befits a "Frontiers" lecture note volume, the style is relaxed, the formulas are relatively simple, and the explanations are clear. Heavy technical discussion is reserved for appendices. The next 100 pages on models, first field theoretical and then multiperipheral, are more like a review. The material is technical; the reader is asked to accept much on faith. Nevertheless, the end results are there and references to the sometimes equally cryptic literature are given. More models (droplet, statistical, diffractive, hybrid) follow to the end. The reader who wants to see the various models confronted with experimental facts will be largely disappointed. The treatment is often stylized. The idea is uppermost; the grubby details of fits to data and reasonableness of parameters are generally ignored. Horn and Zachariasen is what it is advertised to be, an informal book on recently topical parts of high energy physics, about one-third phenomenology and two-thirds related theory. It should be useful in either lecture course or seminar.

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Issues Raised by Biology

Philosophy of Biological Science. DAVID L. HULL. Prentice-Hall, Englewood Cliffs, N.J., 1974. xii, 148 pp., illus. Cloth, $6.95; paper, $2.95. Prentice-Hall Foundations of Philosophy Series.

Working scientists have generally ignored an entire profession dedicated to explicating what they do. Philosophers of science have usually responded in kind by filling their journals with an arcane sort of laundry-washing that piles commentary upon commentary, soon losing sight of the scientific document that inspired it several generations ago. This lamentable gap is occasionally bridged by a man boasting competence in both fields—Percy Bridgman, to choose an old example—or by a philosopher with both exceptional insight and lucidity of style—like N. R. Hanson of late and good memory.

In this small book, David Hull has labored to integrate philosophy and biology for students and practitioners of both fields. I pay tribute to his skill and commitment by reporting a job well done in so few pages. In suspecting, as I do, that it will inspire no substantial rapprochement of the two disciplines, I merely comment upon a situation far beyond the power of a single author to correct.

Hull has chosen the lively strategy of few, relatively independent chapters directed to specific issues in preference to the logical, sequential, and laborious development of the Teutonic tome. He begins with a technical chapter on the possibility of reducing Mendelian to molecular genetics. (He is not sanguine about the prospect, but argues cogently that such a classical reduction might not be the *summum bonum* that a philosophy of science based on physics often portrays.) Following chapters discuss the structure of evolutionary theory, biological laws, teleology, and the controversy of organicism vs. reductionism. Hull takes very few positions, largely confining himself to explication and clarification—an admirable course in such muddy waters.

In his more specific discussions Hull touches (at least *en passant*) all the perennial issues in philosophy of biology: reduction, teleology, holism, prediction and explanation in historical science, to name a few. But his strategy precludes a proper setting of these issues within the history of Western thought and thereby fails to explain why they should concern us. Each chapter stands well by itself, but the cement is missing. (The Teutonic tome—if we reach the end awake, or reach it at all—provides this at least.) Thus I doubt that this book can be, as Hull hoped (p. xi), a self-sufficient introductory text for students. It is simply too difficult for what it must leave out.

Since Hull is a philosopher by profession, we might have expected a book about philosophy for biologists. Instead, for reasons good and not so good, it is more a work about biology for philosophers. Hull does not always succeed in avoiding excessive comment on the private debates that philosophers pursue with gusto and biologists know nothing about—for example, Ruse and Smart on laws, and peripheral aspects of the important (though seemingly endless) debate on Hempel and Oppenheim's thesis of symmetry between prediction and explanation. On the positive side, Hull has a fine knowledge of biology (both the facts and that elusive "feel" that only a professional can recognize); he becomes, thereby, our best emissary to the other culture. In this position, he can employ biology to enrich a philosophy of science based too much upon physics and its occasionally arrogant assumptions of hierarchy (with fundamental and derived sciences), proof, reduction, and the crucial experiment. This he does in suggesting, for example, that the logical empiricist account of reduction may fail in explicating the relationship between Mendelian and molecular genetics and that the inability of evolutionary theory to predict future phyletic events does not compromise its status as a scientific theory.

The complexity of biology provides both its strength and its uniqueness. If celestial mechanics had to treat interaction of thousands of objects with frequent, complex, and largely stochastic environmental change, then the study of planetary motions would become a "historical" science—but no less of a science for that. R. K. Merton has long argued that somewhere between the grandeur (or emptiness) of fully general theory and the day-to-day empirics of data gathering there must be room for "middle range" disciplines in sociology—a sociology of science or of religion, for example. There is, in the same manner, a legitimate philosophy of biology; and it must enlighten any comprehensive statement about science with its special treatment of all the problems that life's complexity inspires.

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