Peeling apart nature

George Sugihara

Hierarchy: Perspectives for Ecological Complexity.
By T.F.H. Allen and Thomas B. Starr.
University of Chicago Press: 1982. Pp.310. $27.50, £22

IT IS somehow ironic that while the sciences of the very small (e.g. atomic physics and chemistry) and of the very large (e.g. astrophysics) have achieved such great success, a middle-sized phenomenon such as the ecology of the natural world has been so elusive to scientific scrutiny. From the human vantage point, ecological systems appear unmanageably complex. To what extent could this complexity be a consequence of our anthropocentrically scaled perceptions? Of more practical importance, how should the investigator resolve interdependent ecological systems into manageably small pieces without destroying the complexity of the whole?

As Allen and Starr tell us, the beginnings of an answer to these questions are now coalescing into a set of ideas known collectively as hierarchy theory. The term "theory" is used liberally here, in that there is as yet no systematic statement of rules or principles to be followed. Nonetheless, as energetically reviewed in this book, there is a definite body of problems and insights related to scaling phenomena that form the basis of current thinking on hierarchies.

In its most general sense, a hierarchy is defined as a partial ordering of a set of objects. Herbert Simon, a founding spokesman for the field, uses the example of a nested set of Chinese boxes to illustrate how the relation "contained in" may generate such an ordering. Similarly, in an ethological context the relation "dominates" may generate a hierarchy in dominance relationships. Although a given set of objects may or may not be hierarchical depending on the ordering relation chosen, there is reason to believe that the natural world is organized hierarchically in an ontological sense. This follows from the argument that systems built in such a manner, from stable parts of intermediate complexity, tend to evolve much faster than those constructed at once.

The challenge posed by this viewpoint is to find a natural ordering relation and a means for discerning discrete objects or levels for such systems. Are the categories individuals, populations, communities, ecosystems reasonable object levels? If so, what is the meaningful ordering relation? Or conversely, given a meaningful ordering relation can one discern discrete object levels? Simon suggests that natural frequency might be an important ordering relation. Thus cells operate at a higher frequency than individuals, which in turn cycle faster than populations etc. Allen and Starr suggest that "constraint" loosely defined might be important, with higher hierarchical levels constraining lower ones.

The philosophical framework for dealing with hierarchies falls roughly under the heading of dialectical materialism. It differs from the single-level view offered by reductionism in that the whole is regarded as a contingent structure which is understood in terms of the simultaneous action of several different levels of organization. To understand the whole, one must understand interactions between the various levels in the structure. This viewpoint was enunciated recently by Stephen Gould (*Science* **216**, 380–387; 1982) as a framework for studying evolution. Natural selection, he advocates, should be viewed as operating simultaneously on levels above and below the individual, from gene through clade. It is the interactions between levels that shape the path of evolution. Thus, for example, benefits to the individual gained by specialization may be offset by its cost to the species. Such negative and positive effects between levels may be responsible for stability and change in evolution.

On the more tactical side, hierarchy theory attempts to embrace problems related to scaling in making observations and measurements. As pointed out by Allen and Starr, while algal ecologists are willing to consider time frames which span multiple generations, for terrestrial ecologists the time frame usually includes only a fraction of the life span of a single tree. Thus our anthopocentric scale as investigators may introduce a kind of observational parallax. Whether we are willing to accept communities as distinct objects or blurred continua may depend on the grain of our observations.

Given the scope and novelty of the subject, Allen and Starr have attempted an ambitious task in drawing together many of the threads of thinking on hierarchies. They present this in a very personal synthetic style with wit and zeal, incorporating jargon and concepts from systems' science, statistics and science fiction. Although the authors overstate their position somewhat, this book should fill an important role if it helps to stimulate a future systematic and rigorous treatment of hierarchies. □

George Sugihara is a Eugene P. Wigner Fellow in the Environmental Sciences Division at Oak Ridge National Laboratory, Tennessee.

Feast of proteins

Peter D.G. Dean

Protein Purification: Principles and Practice.
By Robert K. Scopes.
Springer-Verlag: 1983. Pp.282. DM79, $31.60.

AN HOUR or two in the company of genetic engineers might lead you to believe that protein purification has no place in bioengineering. By contrast, I have felt for some time that the need to isolate ultra-pure cloned proteins from cell pastes has become an urgent problem and see it as a bottleneck in the manufacture of such proteins.

In *Protein Purification*, Robert Scopes demonstrates his skill as a practitioner of purification techniques *par excellence*. He attacks and analyses his subject (and incidentally provides answers for the bioengineer at the same time) with clear and considered opinions in a manner which is instructive to the beginner, reassuring to the experienced bench worker and thought-provoking to the supervisor. I found this short book a feast and a genuine pleasure to read. The delightful, chatty style reminds one nostalgically of yesteryear's undergraduate tutorials.

The growing range of protein purification methods is presented with a refreshing mixture of interesting theory (a rare quality) and a wealth of practical data and practical tips. Thus the section on affinity elution begins with four pages of introductory theory, continues with a page of practical steps, five pages of more theory and ends with a page of applications. This section is immediately followed by 20 pages on affinity adsorption of which a third is devoted to dye ligand chromatography.

The organization of the chapters takes the reader from "the enzyme purification laboratory" through "making an extract". The latter chapters make up an introductory section which is followed by a series of chapters on separation techniques, precipitation, adsorption and separation in solution. Perhaps one of the most useful set of chapters is the final four which include accounts of maintenance of enzyme activity, optimization procedures, measurement of enzyme activity and analysis of purity.

Errors are remarkably few and the layout is attractive; the author is to be commended particularly for his clear diagrams. The few trivial omissions that I noticed were recent developments in solid-phase ampholytes, high-performance liquid chromatography, the use of detergents in dye ligand chromatography, affinity gel filtration and the more recent work from Wilchek's laboratory on the mechanism of the cyanogen bromide activation reaction.

This excellent text is a must for all undergraduates wishing to learn about protein purification. It should also be on every laboratory shelf where proteins are being handled or purified. □

Peter D.G. Dean is a Reader in the Department of Biochemistry, University of Liverpool, and a Director of P & S Biochemicals Ltd.