to abandon deterrence based on retaliation; the Europeans believe their security and freedom of action rest on the vulnerability of the superpowers to nuclear attack. The SDI requires abrogation of the Anti-Ballistic Missile Treaty; the Europeans insist the treaty be preserved. Daalder is an excellent guide through complicated territory. He knows how to lay the analytical groundwork for the reader and when to step aside and let the flavor and color of European opinions emerge from the words of Europeans themselves. This is a first-rate book.

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Star Systems

Stellar Populations. COLIN A. NORMAN, ALVIO RENZINI, and MONICA TOSI, Eds. Published for the Space Telescope Institute by Cambridge University Press, New York, 1987. x, 245 pp., illus. $32.50. Space Telescope Institute Symposium Series, 1. From a meeting, Baltimore, May 1986.

In 1979 the International Astronomical Union held a colloquium on scientific research with the Space Telescope. At that time, the expected launch date was 1983; it is now late 1988 or early 1989. *Stellar Populations* contains the invited review papers from a meeting on that subject held at the Space Telescope Science Institute in May of 1986. This is an area of research in which the Space Telescope is sure to make great contributions and exciting discoveries. One's first impression on comparing this volume with the proceedings of the 1979 symposium (*Scientific Research with the Space Telescope*, U.S. Government Printing Office) is that tremendous progress has occurred within the past decade, even though astronomers have been largely limited to observations with ground-based telescopes. Because of the continuous improvement in the quantum efficiency of detectors and in the speed of computers, which in turn affects the ability of astronomers to analyze, interpret, and model their data, many of the problems outlined in 1979 have begun to be resolved. Further rapid ground-based progress is sure to occur, given recent projects for the construction of ever larger telescopes and the improvements in "seeing" that have been achieved by proper attention to thermal characteristics inside telescope enclosures and by the location of astronomical observatories at sites with extremely stable atmospheric properties.

The concept of stellar populations was most clearly enunciated by Walter Baade in the mid-1950s. The papers by Searle and by Sandage provide excellent summaries of the history of this idea. Baade divided the contents of stellar systems into two major classes, the regions of active star formation where the mean age of the stellar constituent is very young (perhaps only a few hundred thousand years) and the tranquil old system of stars in which nothing significant has happened for the past ten billion years (beyond the gradual aging of the individual stars). In our own Galaxy, the Galactic disk with its extensive gas clouds and its clusters of hot, massive, and very young stars is the prototypical example of Population I, whereas the collection of globular clusters that resemble for our Galaxy a system of small artificial satellites orbiting the earth is the archetype of the much older Population II objects.

This now seems simplistic; real galaxies contain a continuum of stars with related kinematic properties, chemical abundances, and age. The details of the relationships are still obscure, and fierce debates rage about whether any particular component is discrete or the tail of one of the three more or less standard and universally accepted constituents of galaxies: a flattened disk, an approximately spherical halo, and a central bulge. It is unfortunate that in many of the areas of greatest controversy, only one of the combatants was actually present at the May 1986 meeting. In the case of the question of the "thick disk" whose existence within our own Galaxy was proposed by Gilmore a few years ago, neither of the strongest proponents for or against this idea was present at the conference.

The papers by Mould, by Aaronson, and by Sandage present useful summaries of our current knowledge of the stellar content of the central bulge and halo of our own Galaxy, that of our nearest neighbors (the Magellanic Clouds), the dwarf galaxies (rather puny satellites of our Galaxy), and our nearest neighbor of a size comparable to typical luminous galaxies, M31 (the Andromeda nebula). They illustrate the immense difficulties faced by astronomers working in this field—we still do not know the distance to our closest neighbors, the Magellanic Clouds, within an uncertainty of 25 percent in spite of decades of work by many people. The theoretical uncertainties in stellar evolution (the modeling of the properties of a star, its luminous output, its radius, and so forth from the time it condenses out of a cloud of gas until its nuclear fuel is exhausted) are gradually beginning to yield to persistent efforts but remain a serious problem, as is summarized by O'Connell. Even worse, and far less tractable, are the uncertainties in the relative number of stars of different masses that are formed at a given time (the initial mass function), a subject reviewed by Larson, where the theory is so complex and there are so many variables that little progress can realistically be expected without guidance from observers, and observations are extremely difficult, since they require star-by-star counting and age dating within our own and other galaxies. The initial mass function may well be dependent on local conditions, complicating things still further, yet it is an essential parameter in trying to characterize galaxies that are so distant that only the composite light of all their stars together can be measured. Even with the power of the Space Telescope, it will be impossible to see stars as faint as our own sun, even in a galaxy as close as the Andromeda nebula.

I found this book a useful summary of current knowledge. In it one encounters the many questions that will undoubtedly dominate the study of the subject for years to come. The papers present thoughtful reviews of recently published work and of studies in progress by the authors and their collaborators. Unfortunately, the book does not include any of the numerous interesting results that were presented in the poster sessions.

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Modern Zoophytology

The Growth and Form of Modular Organisms. J. L. HARPER, B. R. ROSEN, and J. WHITE, Eds. Royal Society, London, 1986. 250 pp., illus., + plates. £43. First published in *Philosophical Transactions of the Royal Society of London*, series B, vol. 313, no. 1159. From a meeting, London, June 1985.

Modular Organisms: Case Studies. Papers Relating to a Discussion Meeting [London, June 1985] on Growth and Form in Modular Organisms. Royal Society, London, 1986. 116 pp., illus., + plates. Paper, £12.75. *Proceedings of the Royal Society of London*, series B, vol. 288, pp. 109–224.

Although his *scala naturae* had no place for evolutionary convergence, Aristotle commented at length on the often striking similarity of marine invertebrates and plants. Indeed, until 1740, when Abraham Trembley demonstrated that the green hydra (*Chlorohydra viridissima*) was in fact an animal, colonial marine invertebrates were collectively referred to as "zoophytes." The remarkable architectural similarity of plants and clonal animals, beautifully illustrated on the frontispiece of the first of these sympo-

sium volumes, is an ancient preoccupation enjoying a modern reincarnation.

The modern fascination draws upon a number of traditionally distinct academic clades and can be traced through a series of symposia. On the zoological side, colonial-animal paleontologists and systematists came together in 1973 to produce *Animal Colonies* (R. S. Boardman, A. H. Cheetham, and W. A. Oliver, Jr., Eds.; Dowden, Hutchinson, and Ross) and were joined by population biologists to produce the 1979 volume *Biology and Systematics of Colonial Organisms* (G. P. Larwood and B. R. Rosen, Eds.; Academic Press). The botanical path was less tortured, a situation easily attributable to John Harper's monograph *Population Biology of Plants* (Academic Press, 1977). Exponents of the botanical and zoological perspectives, by now having begun to discover each other, came together in 1985 to produce *Population Biology and Evolution of Clonal Organisms* (J. B. C. Jackson, L. W. Buss, and R. E. Cook, Eds.; Yale University Press).

The quickening pace represented by these two new volumes published by the Royal Society testifies to the excitement surrounding the topic and the growing appreciation of its significance. Indeed, the generalizations emerging are of staggering proportions. Modular (or clonal) organisms violate Weismann's doctrine, challenging the traditional biological basis of individuality and clouding the question of the unit (or units) upon which selection acts. Modular organisms escape many of the surface-area–to–volume constraints that govern the structure of unitary organisms and that form the basis for much of our understanding of physiology. Modular organisms are often freed from senescence on time scales recognizable by humans and often display complex life cycles that can occur only in organisms possessing a continuously active totipotent stem cell. The demography of modular organisms cannot be characterized by the age-specific functions that underlie virtually all modern ecological and evolutionary theory, a particularly disturbing fact given that the majority of the surface of the land and the floor of the sea is carpeted by such organisms.

These generalizations, though largely the discoveries of the contributors, are not presented for the first time in these volumes. Rather, the volumes consist of reviews and a series of case studies. The volumes are organized in a curious two-tiered fashion. The larger, hard-bound volume (*The Growth and Form of Modular Organisms*) presents the reviews, and the smaller, paperbound volume highlights selected posters presented at the symposium from which the volumes stem. Yet several narrowly defined case studies are interspersed with reviews in the large volume, and some studies of general significance are relegated to the small one. In particular, McKinney's demonstration of repeated convergence of architectural styles following mass extinctions and Cheetham's elegant history of macroevolutionary trends within a given branching architecture (which contains perhaps the best evidence for punctuated change to date) certainly merit a seat at the high table.

Though the reviews present little that is genuinely novel, the overall quality is high. Jackson and Coates's contribution reflects the pulse of current investigations in clonal animal ecology, macroevolution, and morphology, exploring new ground in the population genetic consequences of limited sexual dispersal in clonal taxa. Bell presents a taxonomy of branching simulations, which is sure to encourage further study. Gottlieb accurately diagnoses our understanding of the genetics of modular form as rudimentary, highlighting the pitfalls that await future investigations of the quantitative genetics of traits in the absence of any understanding of relevant environmental controls on gene expression. Hardwick focuses on the crucial issue of diplontic selection and its potential for insuring cooperation between cell lineages within a growing plant. Curiously, though, he does not explore the possibility that the very patterns of apical dominance suggested to be agents of diplontic selection might themselves be an adaptive response to competition between variant cell lineages—a view that may provide a powerful perspective on the comparative developmental biology of modular organisms. Particularly welcome is Mackie's reminder of the classical tradition in the study of animal coloniality.

The editors are to be credited for the production of a polished volume, though given the general lack of standardization in terminology an annotated glossary would have been helpful. Also a source of irritation is the failure of botanical authors to cite the relevant zoological literature, and vice versa. In such a field, some redundancy and rediscovery are inevitable, but one would hope not to find it in a symposium devoted to the synthesis of botanical and zoological advances. Moreover, some contributions bear no obvious intellectual connection to the symposium theme; Trinci and Cutter's review of hyphal extension is fascinating, but a *non sequitur* in this book, and several important themes in modular organism research lack representation; there is no treatment of the fundamental similarities in stem cell differentiation in modular organisms, population genetics makes only a brief appearance, and paleobotanical perspectives are absent.

The fundamental distinctions between unitary and modular organisms arise as a consequence of different styles of development, particularly with respect to germ-line determination and secondary somatic differentiation. Ultimately these volumes and the growing research tradition they represent speak to the pervasive influence of development in shaping population structure and evolutionary dynamics. Despite their limitations, the symposium proceedings provide a valuable introduction to the biology of modular organisms and, together with their predecessors, present compelling support for the editors' claim that, for many problems, "the distinction between the biology of modular and unitary organisms is more profound than the classic distinction between animals and plants."

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Books Received

Arithmetic Duality Theorems. J. S. Milne. Academic Press, Orlando, FL, 1986. x, 421. pp. $38. Perspectives in Mathematics, vol. 1.

Art and Cartography. Six Historical Essays. David Woodward, Ed. Published for the Hermon Dunlap Smith Center for the History of Cartography, Newberry Library, by the University of Chicago Press, Chicago, IL, 1987. xvi, 249 pp., illus. $65. Kenneth Nebenzahl, Jr., Lectures in the History of Cartography.

Biology of Heritable Skin Diseases. K. D. Wuepper and T. Gedde-Dahl, Jr., Eds. Karger, Basel, 1987. viii, 254 pp., illus. $162.75. Current Problems in Dermatology, vol. 17. From symposia, Gleneden Beach, OR, Oct. 1985, and Oslo, Norway, Feb. 1986.

The Biology of Moral Systems. Richard D. Alexander. Aldine De Gruyter, New York, 1987. xxii, 301 pp., illus. $34.95; paper, $16.95. Foundations of Human Behavior.

The Biology of the Interferon System 1986. K. Cantell and H. Schellekens, Eds. Nijhoff, Dordrecht, 1987 (U.S. distributor, Kluwer, Norwell, MA). xii, 579 pp., illus. $110. From a meeting, Espoo, Finland, Sept. 1986.

Experimental Approaches to Mammalian Embryonic Development. Janet Rossant and Roger A. Pedersen, Eds. Cambridge University Press, New York, 1987. xiv, 558 pp., illus. $70.

Experimental Psychopharmacology. Andrew J. Greenshaw and Colin T. Dourish, Eds. Humana, Clifton, NJ, 1987. xiv, 494 pp., illus. $59.50. Contemporary Neuroscience.

The Federal Republic of Germany. A Land of Top-Ranking Research. Karl-Heinz Preuss and Rolf H. Simen, Eds. Inter Nationes, Bonn, 1986. 114 pp. Paper. Translated from the German.

Fifty Years of Neutron Diffraction. The Advent of Neutron Scattering. G. E. Bacon, Ed. Hilger, Bristol, U.K., 1987 and International Union of Crystallography (U.S. distributor, Taylor and Francis, Philadelphia). xiv, 280 pp., illus. $66.

Fine Chemicals for the Electronics Industry. P. Bamfield, Ed. Royal Society of Chemistry, London, U.K., 1986. viii, 247 pp., illus. $48. Special Publication no. 60. From a symposium, Bath, U.K., April 1986.

Karst Hydrogeology. Engineering and Environmental Applications. Barry F. Beck and William L. Wilson, Eds. Florida Sinkhole Research Institute and Balkema, Accord, MA, 1987. viii, 467 pp., illus. $55. From a conference, Orlando, FL, Feb. 1987.

Laws and Policies Affecting Adolescent Health. John M. Paxman and Ruth Jane Zuckerman. World Health Organization, Geneva, 1987. x, 300 pp. Paper, $29.40.

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